UNIVERSITY OF GHANA

VOLUME 3

HANDBOOK FOR THE BACHELOR'S DEGREE

COURSE DESCRIPTIONS FOR PROGRAMMES IN THE SCIENCES

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NOTE TO THE UNDERGRADUATE HANDBOOKS

The current edition of the Undergraduate Handbooks of the University of Ghana is published in four volumes as follows:

VOLUME 1: REGULATIONS FOR JUNIOR MEMBERS AND STUDENT FACILITIES

VOLUME 2: COURSE DESCRIPTIONS OF PROGRAMMES IN THE HUMANITIES

VOLUME 3: COURSE DESCRIPTIONS OF PROGRAMMES IN THE SCIENCES

VOLUME 4: COURSE DESCRIPTIONS AND REGULATIONS FOR PROGRAMMES IN THE HEALTH SCIENCES

Undergraduate students should therefore have Volume 1 and either Volume 2, 3 or 4 of the Handbooks, depending on the programme they have been offered.

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UNIVERSITY REQUIRED COURSES

The University has, beginning from the 2010/2011 academic year, introduced a unique general education programme which is intended to provide a rewarding experience for all students who undertake undergraduate studies in the University. The interdisciplinary courses in the programme, which are intended to foster broad student familiarity with key advances in the humanities, science and technology, are the following:

Course Code	**Course Title**	**Target Group**
UGRC 110	Academic Writing I	All students entering the University of Ghana at Level 100
UGRC 120	Numeracy Skills	Students in the Humanities except those offering Economics, Computer Science, Mathematics and Statistics
UGRC 130	Understanding Human Societies	Students in Basic and Applied Sciences
UGRC 140	Science and Technology in our Lives	Students in the Humanities
UGRC 150	Critical Thinking and Practical Reasoning	All First Year Students of the University
UGRC 160	Introduction to Literature	Students in the Humanities offering Economics, Computer Science, Mathematics and Statistics
UGRC 210	Academic Writing II	All students who have completed Academic Writing I at Level 100
UGRC 220	Introduction to African Studies	All students

It is expected that these compulsory courses will, in combination with students' main areas of study, produce students who are equipped to meet the development needs of Ghana and Africa, and equip graduates of the University of Ghana to be confident, rounded scholars, capable of holding their own with graduates from any part of the world.

NOTE: Details of the semesters in which students of various faculties are expected to take University Required Courses may be found in the programme structure for each Department/Faculty.

UGRC 110: Academic Writing I

The main objective of Academic Writing I is to equip students with the language skills that will enable them to read and write effectively. Students will be taken initially through fundamental issues in grammar and composition in order to consolidate their language skills in these areas. Subsequently, reading and writing skills relevant to university work will be introduced. These will include the structure of the essay, unity, completeness and coherence in essay writing; summarizing as a skill basic to exposition, writing from sources, referencing skills and avoiding plagiarism. The course will be taught in small groups and class activities are characterised by group work, oral presentations and extensive practical assignments.

UGRC 120: Numeracy Skills
This course is designed for students to acquire basic numeracy skills needed for solving real life problems. It involves the following: review of basic algebraic skills; rates (fractions, proportions and percentages); approximating numbers (rounding up of numbers and significant numbers); mathematical reasoning, (deductive and inductive reasoning); statements; truth tables; necessary and sufficient conditions; basic set theory; nature and uses of statistics; sources of data; data types and measurement scales; methods of data manipulation (aggregation and interpretation); basic probability with illustrations from various disciplines; establishing relationships between variables, and the use of basic computer packages such as Excel in analyzing data.

UGRC 130: Understanding Human Societies
The course is designed for students pursuing science-related programmes at the undergraduate level. The aim of the course is to introduce students to the broad array of issues that shape human societies. The course is divided into two main parts. Part I seeks to introduce students to the evolution of human societies, the economic basis of human societies, and governance in societies. It covers the first three weeks of lectures and is compulsory for all students. Part II covers 10 weeks, and aims to ground students' understanding of human societies on six selected areas, each constituting a module: the economy and business; culture and development; governance in the information society; human behaviour and the social environment; religion and societies; and language in society. Students are expected to select one out of the six modules provided.

Part I
Course Title: Introduction to Human Societies

Part II
Descriptions of Modules:
The Economy and Business in Ghana
This module is designed to offer students the opportunity of understanding the environment within which business operates in Ghana. The module places emphasis on the extent to which geographical, political, socio-cultural, economic and international forces have shaped the growth and practice of business and management in Ghana over time. It is also designed to help students to understand some macroeconomic issues with particular reference to the Ghanaian economy. More specifically, macroeconomic issues such as inflation, unemployment, poverty, exchange rate and economic growth will be discussed.

Culture and Development
This module introduces students to culture-development linkages. It delineates the basic concepts of culture, resources and development and how these concepts holistically constitute the basis of human society. Approaches to understanding human society, both past and present, form the foundation for understanding cultural formations and the diverse resource usages.

Governance in the Information Society
This exposes students to the concepts of good governance and the information society, and the relationship between information and the key elements of good governance such as the rule of law, transparency and accountability. The module further examines the nature, scope and importance of governance and the relationship between the various institutions of governance in a modern society. The way public services ethics promotes good governance is also explored. Finally, the module takes a look at information literacy and sources of official information.

Human Behaviour and the Social Environment
This module is designed to introduce students to human behaviour and the social environment. There are various dimensions to social issues and it is useful for students to get to know a wide range of these issues that concern them and the people around them. It also adds to their existing stock of knowledge.

Religion and Societies
This module aims at introducing students to the on-going debate on the role of religion in human societies. It focuses on religious perspectives on social issues and discusses the way religion impacts social and political structures such as leadership and the family, as well the environment. Students will in the end appreciate the synergy between science and religion in providing the wellbeing of all creation. Topics to be treated will include origins of religion, science and religion, religion in the modern world, religion and health, religion and the environment, gender, religion and cultural values.

Language in Society
This module is aimed at giving students a basic understanding of what language is and how it works in every human society. The course will help students to appreciate how language is used as a tool for doing things in the world. It shows how the study of language is at the intersection of the humanities and the social and natural sciences and how linguists conduct the business of studying language. Some of the topics to be covered are: the nature and functions of language, the language situation in Ghana, language, power and gender, as well as levels of linguistic analysis.

UGRC 140: Science and Technology in our Lives
This course deals with the application of science to everyday life. The course will, therefore, include material to assist students to appreciate the foundations of scientific thought, the application of science and technology and demands of changing societies for scientific and technological advancement. The course is expected to foster broad familiarity with key advances in science and technology. The course will be delivered through lectures, tutorials, class exercises, homework assignments, and examinations.

Course Structure
The course is divided into two modules. All students are required to take both modules. Module I will give a general overview of the application of science and technology to everyday living, and will last for five weeks (Weeks 1 – 5). In Module II, students will select one out of the six on offer. Module II will last for eight weeks (Weeks 8 – 13). The six areas are: Earth Resources, Geohazards, Chemistry and Life, Food and Nutrition in everyday life, Everyday Physics, and Animals as Friends of Humans.

UGRC 150: Critical Thinking and Practical Reasoning
An essential element in the training of social studies and humanities students is providing a corrective and diagnostic skill set that enables students to discriminate logically between: rhetorical ploys that give *motives* vs. arguments providing *good logical reasons* for believing an assertion. Students need to recognise the contrast between *inductive* and *deductive* reasoning and the different types of support yielded by each, to evaluate the quality of evidence confirming an empirical hypothesis about human conduct, to maintain individual professional and scholarly discretion in the face of peer pressure and mob mentality. Those enrolled in this course will be provided the vocabulary and techniques to employ critical thought and practice within the academic arena and beyond.

UGRC 160: Introduction to Literature

This course will engage students in careful reading and analysis of a challenging selection of literary works from a range of genres including the novel, the short story, poetry and drama. The focus will be on intensive reading and discussion of the literature to inculcate in students the skill of interpretation. Students are expected to be active readers as they analyze and interpret textual detail, establish connections among their observations and draw logical inferences leading toward an interpretive conclusion. They will be introduced to formal features of the selected texts, including plot, character and language, as well as to the links between literature and life, to make them better readers of their world. The course will include a writing component that focuses on expository, analytical and argumentative writing about the literature. In short, students will read, discuss and write about texts while developing skills such as the sophisticated use of literary elements and terminology, close readings of various texts, creating, drafting and editing analytical essays.

At the completion of this course, the students will be able to:

• Make warranted and reasonable assertions about an author's arguments
• Recognize and use literary terms
• Apply literary terminology to fiction, drama, and poetry
• Analyze different genres of literature, particularly short stories, novels, drama and poetry
• Read literary texts closely
• Read, understand and write analytical literary essays
• Recognize and assess the elements of different literary genres

UGRC 210: Academic Writing II

Academic Writing II is a follow-up to Academic Writing I and builds upon the skills acquired in the first year. Students will be required to read and critique a variety of academic essays in their areas of study. Writing activities will derive from these reading tasks and students will be guided to develop their writing through process writing which involves: pre-drafting, drafting, re-writing and revising. In this broad context, students will revise and consolidate their grammar through proof reading and editing activities. The course will also involve training students to write from multiple sources as a preparation for doing research-based writing. Activities will be geared towards getting students to develop the skills of extracting and sorting information from multiple sources and synthesizing them into coherent arguments in an essay. Students will be required to write such a synthesis essay for assessment. Subsequently, students will be introduced to academic presentation skills.

The Language Centre will teach the Academic Writing II course in all the faculties in Level 200, except the following:

- The Faculty of Engineering Science which has opted to offer Technical Report Writing (FAEN 206) in lieu of Academic Writing II.
- The College of Agriculture and Consumer Sciences and some departments in the Faculty of Science which have opted to provide their own courses in the second six weeks of the first semester of Level 200 (Academic Writing II). Faculty-specific lectures in Academic Writing in the second half of the first semester will be run.

UGRC 220: Introduction to African Studies

The African Studies course seeks to provide basic background knowledge of Africa, its histories, people and cultures. After a general introduction to African Studies, General Studies and

Leadership in Africa, students will be required to take one of these five modules: Gender and Culture, Gender and Development, Leadership in Africa, African Art, its Philosophy and Criticism, and Philosophy in African Cultures.
The general introduction takes two weeks and involves four hours of lectures, one hour of tutorial and a practical activity – film show. This module is examinable through the electives.

Description of Modules:
General Introduction to African Studies
This introduction aims to provide basic background knowledge of Africa, its histories, peoples and cultures. It serves as the spring board from which to launch the elective courses on African Studies.

Introduction to Gender
The main objective of the two week introduction is to help students appreciate the gendered nature of African societies, how this impacts development and state as well as state and civil society responses to gender inequalities. The course will cover topics such as why we deal with gender issues in African studies and key gender concepts and make a case for transforming gender relations on the basis of three justifications - citizenship rights and the constitution, development imperatives and the promotion of gender equitable cultures. Week two will focus on state and civil society responses to gender inequalities focusing on legal and cultural reforms, affirmative action, gender and development and civil society activism. The role of individual and group agency and leadership in changing gender relations will be highlighted.

Introduction to Leadership in Africa
Good leaders are expected to solve new problems which arise in their domain and the changing landscape of business. Leadership is a complex process by which the leader influences others to perform and achieve. Leadership attributes – beliefs, values, ethics, character, knowledge and skills – are all traits which can be learned. This course provides the basis for understanding what leadership is and what leaders do to be successful. The course particularly seeks to make students understand traditional and contemporary concepts and practices of leadership in Africa.

Gender and Culture in Africa
This module examines how culture shapes the positions of women and men in African societies and analyses cultures and cultural practices as dynamic, contested and rooted in socio-economic conditions and power relations. Key concepts in gender studies are analysed in relation to debates about accepted notions of culture. Students will be encouraged to reflect on their own experiences of gender and their role in reinforcing and transforming the nature of gender relations in society.

Gender Issues in Africa's Development
This module will introduce students to key concepts and issues in gender and development with specific reference to Africa. It argues that development is not a neutral process, but impacts men and women differently. Key topics will include men and women's access to resources in Africa such as land, labour, credit, time and social capital, production and reproduction. The module will also examine the gendered implications of natural resource management and sustainable development as well as decision making. It will further examine state and civil society responses to gender issues in Africa. The main objective of this foundation course is to sensitize students to gender issues and enable students recognize and understand the relevance of gender as a development issue and how gender inequalities negatively affect development.

Leadership in Africa
This course encompasses leadership styles and models, leadership in management, a history of chieftaincy and traditional leadership in Africa, African leadership and democracy, as well as challenges confronting African traditional leadership.

African Art, its Philosophy and Criticism
This module is designed to introduce students to an understanding of African art and its conceptual framework as evidence of material culture actively involved in the historical process and life of the African. As a cultural practice, it forms the bedrock of African aesthetic expression. The course argues that the environment, availability of materials for producing art, different histories and external influences have affected African art and its development. The course proposes that African art is reflective and representative of African belief, philosophy, values and taste, and that it is used in several social, political and religious functions. As a fairly new field, the course introduces students to the forms of art, historical and theoretical enquiries and approaches to the subject such as art as history, history as an art, aesthetics, style, subject and subject matter interpretations and meanings, visual narratives, gender perceptions, roles and representations, art criticism and contemporary discourses on the practice of art on the continent.

Philosophy in African Cultures
This course aims to introduce students to philosophical thought in African cultures emphasizing its relation and relevance to contemporary African cultures and development. Topics will include African cosmologies, concepts of God, deities, ancestors, African communal and individualist values, the concept of the human being, destiny, evil and ethics/morality, gender and race.

SPORTS FOR ACADEMIC CREDIT PROGRAMME

The University has, beginning from the 2011/2012 academic year, introduced a sports for academic credit programme.

The introduction of the programme is based on the recognition that there is the need to integrate sports into the academic programme of the University, which would enable students earn credits for sports and sport-related courses, which would count towards their total credits earned. The reason for awarding credits for sports participation is to encourage and reward students who spend their time, energy and resources to train and compete for honours to the University and the nation.

Students can be considered for sports credit from their second year based on their previous sports performance in the University. Enrollment is on the basis of application to and recommendation from the Sports Directorate and approved by the appropriate Dean. Sports performers can earn a maximum of three credits per year on the programme, with a maximum of six credits during their course of study in the University.

Courses under the programme will be graded in accordance with the University of Ghana grading system. Practical and theory sections will take 50% each of the final grade.

COURSE OUTLINES
Theory
SPAC 210 BASIC ANATOMY 2 credits
The course introduces students to the study of the human body in stand and in motion.

Course Objectives

- To define the anatomic parts in 3-dimensional space.
- To describe the human body and how it works in motion and in stand.

Course Content

Introduction to the history of Anatomy. General constitution of the human body and its shape. Anatomical positions. Locomotor system. Muscular system. Nervous system. Respiratory system. Digestive system. Reproductive system. Excretory system. Cardiovascular system. Endocrine system. Blood system and immunity. Metabolism.

SPAC 220 SOCIOLOGY OF SPORTS 2 credits

The course analyzes human interaction and studies the application of scientific methods in the observation and analysis of social phenomenon in sports.

Course Objectives

- To provide candidates with opportunities to learn the basic elements of sociology as an analytical behavioral science. It also assists students in developing an awareness of the processes involved in human interaction.
- To define the basic knowledge of sociology and theories of social life.

Course Content

Theories in sociology, Theories about sports and society. Sports and socialization.Current status of sociology of sports. Sports and aggression among spectators. Sports and global political processes.

SPAC 230 SPORTS THEORY 2 credits

This course focuses on the theory behind the practice of sports such as skill analysis and coaching philosophies.

Course Objectives

To familiarize students with the knowledge of the theories in sports coaching, organization and management.

Course Content

Skill analysis and acquisition. Motivation techniques. Teaching progression. Coaching methods. Game Management. Ethical behavior and qualities of professionals in the field of sports.

SPAC 240 SPORTS PHYSIOLOGY 2 credits

This course provides basic principles of physiology of exercise, and the physiological effects on the human organism under different intensities, duration and environment.

Course Objectives

- To acquaint students with the knowledge of how the body systems function in athletes during both wellness and illness/injury. Students will then apply their knowledge in understanding and recognizing injury and illness in athletes in order to assist in the prevention and care of athletic injuries and illnesses.
- To familiarize students with the knowledge of the organ systems and how each functions in the physically active individual.

5. 5.3. Course Content

Introduction to physiology. Organ systems - organs that make up each system, functions of each system. Types of body tissues. Body composition. Effect of exercise on body systems. Common sports injuries pertaining to the body systems. Energy expenditure and fatigue. Measuring energy expenditure. Energy expenditure at rest and during exercise. Fatigue and its causes. Exercise in hot and cold environment: Thermoregulation. Physiological response to exercise in the heat and in the cold. Acclimatization: Prolonged exposure to altitude.

SPAC 250 HISTORY AND PHILOSOPHY OF SPORTS 2 credits

The course covers the history of contemporary sports and physical activity. The subject provides students with reasoning mechanisms, the evolution of sports and the analysis of present realities.

Course Objectives

Students should be able:

- To define the general streams in the history of sports and physical activity, to understand the current realities of sports and its social and cultural dynamics.
- To appreciate the main actors of modern sport and physical activity, in their social and cultural context.
- To evaluate and analyze behaviours, habits and values of sport and physical activity in different social contexts.

Course Content

Genesis of modern sport and physical activity. Medieval and pre-industrial leisure, game and physical activity. The transition to modern game, culture, performance and education. Theoretical models of sport. The German example. The French example. The Swedish example. Organization, dissemination and social discrimination at the turn of the century. Sports and ideology: interpretation. Basic philosophical issues and sports evolution from local, national and international events. History of Sports in Ghana, All African Games, Commonwealth Games and Olympic Games.

SPAC 260 ELEMENTS OF SPORTS FITNESS 2 credits

This course introduces students to the concept of fitness and wellness and how they relate to quality of life.

Course Objectives

To familiarize students with basic knowledge of diet, exercise, stress management, health and other areas
of total wellness and their impact on maintaining healthy lifestyle.

Course Content

The concept of fitness and health. The meaning of physical fitness. Component of physical fitness. The development of the components of physical fitness. Selected lifetime fitness activities. The concept of wellness. The relationship of fitness to wellness. Exercise and fitness. Principles of physical activities. Body systems and physical fitness. Weight management. Fitness assessment and exercise testing for cardio-respiratory fitness, body composition, muscle flexibility. Substance abuse and sexually transmitted diseases and stress management.

SPAC 310 SPORTS INJURIES 2 credits

This course introduces students to the basic injuries associated with the physical activities and the methods to prevent them and manage them if they should occur.

Course Objectives

- This course is intended to provide students with the basic injuries in sports participation; how to assess them, prevent them and manage them.
- To identify the causes of sports injuries and how they can be avoided.
- To define knowledge about the general principles of initial treatment of injuries.

Course Content

Common Fitness/Sports injuries. Prevention of injuries. Treatment and management of injuries. Muscle soreness.

Tendonitis. Lower back pain. Injuries to lower extremities. Heat stress. Exercise in the cold.

SPAC 320 SPORTS PSYCHOLOGY 2 credits

This course leads students to understand how personality, self conceit, self-esteem, self efficacy and other psychological characteristics relate to participation and performance in sport and physical activity. It also helps students analyze and understand motivational bases for sports as well as barriers to participation and special motivational issues in competitive sports.

Course Objectives

- To explore core issues and related intervention strategies in working with athletes and recreational exercisers to enhance performance and participation.
- To define motivational bases for sports as well as barriers to participation and special motivational issues in competitive sports.

Course Content

Motivation in Sports and Exercise. Attention, Concentration and Cognitive styles. Psychological benefits of Sports and Exercise. Group Dynamics and Leadership. Strategies for managing arousal and anxiety in athletic performance.

Principles of goal setting as applied to physical activity participation and performance. Values of imagery training and how it can be applied in sports and exercise.

SPAC 330 ECONOMICS OF SPORTS 2 credits

Investigates what economics has to say about sports as an economic activity: what tools of economic analysis apply to sports. Economics of sports focuses on professional and college sports.

Course Objective

- To give students the theoretical knowledge of the emergence and growth of commercial sports and the general characteristics of commercial sports.

Course Content

Economic motives and the globalization of commercial sports. Media coverage and spectator interest. The use of sports for global expansion. Owners, sponsors and promoters in commercial sports.

SPAC 340 SPORTS: LAW AND PRACTICE 2 credits

This course examines some of the most common legal problems encountered both on and off the playing field. It will concentrate on practical issues and will be presented by legal practitioners, academics and professionals with rich experience in sports management and administration.

Course Objective

This course is intended to familiarize students with the important areas that provide the foundational principles that drive the outcome of most legal disputes arising in the sports industry.

Course Content

The Governance of Sports. Contractual relations in sports. Athlete employment contracts. The role of the agent in professional sports. Legal aspects of sports injuries. Sports marketing, sponsorship and ambush marketing. Appearance contracts. Constitutional and policy issues in sports. The legal regulations of doping. Alternative dispute resolution in sport. The legal regulation of sports Governing Bodies. Antitrust.

SPAC 350 SPORTS NUTRITION 2 credits

An introduction to nutrients and sources, digestive and metabolic processes and the health impact of nutrient deficiencies and excesses.

Course Objectives

- To familiarize students with the fundamentals of sports nutrition as it relates to the physically active. Students will gain an understanding of the importance of sustaining the body with adequate nutrition through food and dietary supplements.
- Students will also discover the sports nutrition products available to fulfill the requirements of the physically active, ranging from the everyday exercise enthusiast to the serious athlete.

Course Content

An Introduction to sports nutrition. Basic nutrition essentials for sportsmen/sportswomen. Preparing the body nutritionally for exercise. Injury and recovery – what happens to the body during exercise and how to feed it for recovery. Strength and Speed - Nutrition for top athletes.

SPAC 360 PRINCIPLES OF SPORTS PERFORMANCE 2 credits

This course is designed to study issues relating to causes of human performance and motor behavior over the lifespan.

Course Objectives

- To familiarize students with the principles underpinning human performances at the same time as improving their own performances in all spheres of life
- To acquaint students with lifestyle management issues and their impact on performance.

Course Contents

Definition of principles. Components of Sports Performance. Internal and External factors of performance. Principles of human performance. Principles of goal setting. Principles of coaching. Test and Measurement of motor abilities. Selection in sports. Strategies and Tactics in sports performance. Psychological and sociological principles in sport performance.

SPAC 370 SPORTS MANAGEMENT 2 credits

This course is designed to provide students with an overview of the basic organizational, and business principles and structure of sport, fitness and leisure industries.

Course Objective

- Students will acquire knowledge necessary to successfully manage any governmental/non-governmental sports institution.

Course Content

The evolution of Sport Management. Scope of Sports Management. Sports Marketing: Strategies and Tactics. Factors involved in Sports Marketing. Sponsorship of sports events. Strategic planning and management in sports. Planning, Funding and Managing sports events. Sports facility management. Leadership in sports organizations.

SPAC 380 SPORTS COMMUNICATION 2 credits

This course introduces students to communication skills necessary for adjustment and success in sports.

The course provides an opportunity for students to learning principles of effective behavior in sports to

reinforce these skills to develop confidence in both spoken and written communications.

Course Objectives

- Define communication and identify the elements of a communication system
- List the various communication media
- Identify barriers to effective communication in sports
- Explain basic technical jargons in sports
- Describe the various communication contexts in sports
- Communicate nonverbally in sports

- Explain the ethics of sports communication.

Course Content

The concept of communication & communication theory. Communication media. Barriers to effective communication in sports. Basic communication skills in sports. (Communication and the Self, Interpersonal communication (two-persons), Group communication (speaking & leading discussions), Fundamentals of public speaking, Intercultural communication). Nonverbal communication in sports. Communications ethic in sports

SPAC 281 - 295 SPORTS SPECIFIC EVENTS/DISCIPLINES (PRACTICALS)

Students will receive instructions in the basic skills, tactics and techniques of the sport.

Course Objectives

Students will acquire skills and knowledge necessary for participation as a competitive, fitness or leisure time activity.

Course Content

History and development of the game. Basic rules and regulations. Basic Skills. Governing bodies at local, regional, national and international levels. Organizing sport events

SPAC 281	Athletics	1 credit
SPAC 282	Badminton	1 credit
SPAC 283	Basketball	1 credit
SPAC 284	Boxing	1 credit
SPAC 285	Cricket	1 credit
SPAC 286	Goalball	1 credit
SPAC 287	Handball	1 credit
SPAC 288	Hockey	1 credit
SPAC 289	Martial Arts	1 credit
SPAC 291	Soccer	1 credit
SPAC 292	Swimming	1 credit
SPAC 293	Table Tennis	1 credit
SPAC 294	Tennis	1 credit
SPAC 295	Volleyball	1 credit

COLLEGE OF AGRICULTURE AND CONSUMER SCIENCES

ADMINISTRATION

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Anna R. Barnes *BSc (Agric) (Ghana) MSc (Cornell)*	-	Associate Professor
Gertrude S. Aboagye *BSc (Agric) (Ghana) MSc (Guelph)*	-	Associate Professor
Kofi Amaning-Kwarteng *BSc. (Agric) MSc (Ghana) PhD (Sydney)*	-	Senior Lecturer
Frederick Y. Obese *BSc. (Agric), MSc (Kumasi), PhD (Melbourne)*	-	Senior Lecturer
Thomas N.N. Nortey *BSc (Agric) (Ksi) MSc (Wageningen), PhD. (saskatchewan)*	-	Lecturer

James E. Futse *BSc (Agric) (Ghana) MSc PhD (Washington State)*	-	Lecturer
Richard Osei-Amponsah *BSc (Agric) MPhil PhD (Ghana),*	-	Lecturer
Raphael A. Ayizanga *BSc (Agric) MPhil (Ghana)*	-	Assistant Lecturer
Emmanuel K. Adu *BSc (Zoology) (UCC), M.Applied Science (New Zealand), PhD (Ghana)*	-	Part-Time

DEPARTMENT OF CROP SCIENCE

Christiana Amoatey *BSc (Agric) MPhil (GH) PhD (Reading)*	-	Senior Lecturer **(Head of Department)**
J. Ofosu-Anim *BSc (Agric) (Ghana) MSc (Kagawa) PhD (Nagoya)*	-	Associate Professor
K. Ofori *BSc (Agric) (Ghana) MSc, PhD (Sask)*	-	Associate Professor
E.Y. Danquah *BSc (Agric) (Gh) MPhil PhD (Camb)*	-	Professor
J.N. Ayertey *BSc (Ed) (UCC) BSc (Ghana) PhD (Lond) DIC*	-	Professor
D. Obeng Ofori *BSc (Agric) (Ghana) MPhil PhD (Camb)*	-	Professor
S.K. Offei *BSc (Agric) (Ghana) MPhil (Lond) PhD (Lond) DIC*	-	Professor
Essie T. Blay *BSc (Agric) (Gh) MSc (Hawaii) PhD (Calif)*	-	Associate Professor
F.K Kumaga *BSc (Agric) (Ghana) PhD (Wales)*	-	Associate Professor
B. A. Boateng *BSc MPhil (Ghana)*	-	Senior Lecturer
E. Cornelius *BSc (Cape Coast) MPhil (Ghana)*	-	Lecturer
N. Amissah *BSc (Agric) (Ksi), MSc, PhD (Cornel)*	-	Lecturer
V.Y. Eziah *BSc, MPhil (Ghana), PhD, Sydney*	-	Lecturer
Gloria Essilfie *BSc, MPhil (Ghana), PhD, (Georgia)*	-	Lecturer
E.P.N. Johnson *BSc MPhil (Ghana) PhD (Cranfield)*	-	Part-Time Lecturer
J.C. Norman *Dip in Agric (Ksi) BSc MSc (Calif) PhD (Bonn)*	-	Part-Time- Professor
K.A. Oduro *BSc (Agric) (KNUSTi) MSc (Plant Path.) (Arizona) PhD (Calif)*	-	Part-Time- Professor

DEPARTMENT OF SOIL SCIENCE

T.A. Adjadeh *BSc Agric (Ghana) MSc PhD (Iwate)*	-	Senior Lecturer **(Head of Department)**
G.N.N. Dowuona *BSc (Agric) (K'si) MSc (Ghana) PhD (Sask)*	-	Assoc. Professor

M.K. Abekoe *BSc (Cape Coast) MPhil (Ghana) PhD (Sask)*	-	Assoc. Professor
S.K.A. Danso *BSc (Agric) (Ghana) MSc PhD (Cornell)*	-	Professor
S.G.K. Adiku *BSc (Agric) (Gh) MSc (Tu-Berlin)PhD (Griff)*	-	Professor
E. Owusu-Bennoah *BSc MSc (Agric) (Ghana) PhD (Reading)*	-	Professor
Stella Asuming-Brempong *BSc (Agric) (Ghana) MSc (Philippines) PhD (Michigan State)*	-	Senior Research Fellow
E.K. Nartey *BSc (Cape Coast) MPhil (Ghana) PhD (Ehime)*	-	Senior Lecturer
I.Y.D. Lawson *BSc (Agric) (Ghana) MSc (Shizuoka), PhD (Gifu)*	-	Senior Lecturer
Dora Neina *BSc (Agric) (Cape Coast), MSc, MSc , Cert (Ghent)*	-	Asst Lecturer
K.B. Laryea *BSc (Ghana) MSc (Sydney) PhD (Guelph)*	-	Part-Time, Professor
J.K. Amatekpor *BA (Ghana) MSc (Gent) PhD (Cornell)*	-	Part-Time, Professor

SOIL AND IRRIGATION RESEARCH CENTRE- KPONG

Dylis S. MacCarthy *BSc. (KNUST), MSc (Germany) PhD. (Bonn)*	-	Research Officer **(Ag. Head of Centre)**
M. Yangyuoru *BSc (Ghana) MSc, PhD (Kyoto)*	-	Associate Professor
F.K. Mawunya *BSc MPhil, PhD (Ghana)*	-	Research Fellow
J. O. Honger *BSc, MPhil (Ghana)*	-	Research Fellow
L. A. Abatania *BSc, MSC (Ghana)*	-	Research Fellow
K. O. Fening BSc, MSC (Ghana, PhD (Kenya))	-	Research Fellow
J. Ofori BSc. (Gh), MPhil (India), PhD (Japan)	-	Research Fellow
B.B. Aligebam BSc., MSc. (Moscow), PhD (Reading)	-	Research fellow

LIVESTOCK AND POULTRY RESEARCH CENTRE- LEGON

A. Naazie *BSc (Agric) (Ghana) MSc (Edin) PhD (Alberta)*	-	Senior Research Fellow **(Head of Centre)**
T. Adogla Bessa *BSc (Ghana) MSc PhD (Reading)*	-	Senior Research Fellow
L.K. Adjorlolo Jnr. *BSc MPhil (Ghana)*	-	Research Fellow
E. Timpong-Jones *BSc (Ghana) MSc (ITC Netherlands)*	-	Research Fellow
E. A. Mahama *MSc (Bulgaria) MPhil (Ghana)*	-	Research Fellow

FOREST AND HORTICULTURAL CROPS RESEARCH CENTRE- KADE

G. Oduro Nkansah *BSc (Agric)(Gh.) MSc (Hort) PhD (Chiba)*	-	Senior Research Fellow **(Head of Centre)**
K. Afreh-Nuamah *BSc MSc (Gh) PhD (Lond) DIC*	-	Professor
K.G. Ofosu Budu *BSc (Agric) (Ghana) MSc PhD (Hiroshima)*	-	Senior Research Fellow
G.K. Hotsonyame *BSc (Agric) MSc (Ghana) PhD (Guelph)*	-	Senior Research Fellow
F.C. Brentu *BSc MPhil (K'si)*	-	Research Fellow
S. Adjei-Nsiah *BSc (K'si) MPhil (Ghana)*	-	Research Fellow
S.K. Torkpo *BSc., MPhil, PhD (Ghana)*	-	Research Fellow
C. Akotsen-Mensah *BSc., MPhil (Ghana), PhD (USA)*	-	Research Fellow
A. Assuming Boakye *BSc., MPhil (Ghana)*	-	Assistant Research Fellow

BIOTECHNOLOGY CENTRE, LEGON

S.K. Offei *BSc (Agric) (Ghana) MPhil (Lond) PhD (Lond) DIC*	-	Professor **(Head of Centre)**

GENERAL INTRODUCTION TO THE 4-YEAR DEGREE PROGRAMME

The School of Agriculture offers a 4-year programme leading to the award of a BSc. Agriculture degree. All courses in the first and second years are core and are designed to provide students with foundations in general Science and Agriculture and further consolidate their understanding of the subject. Students in year three shall take two core courses per semester in the area they wish to specialise and two additional core courses from other department(s) within the School. Students have the option to specialise in any of the following areas: Agricultural Economics; Agribusiness; Animal Science; Aquaculture; Crop Science; Horticulture; Postharvest Technology and Soil Science in the final year of their programme.

For a student to graduate with BSc. Agriculture degree, he/she must have taken a minimum of 142 credits including all University, School and Department required courses, and passed at least 132 credits. The list of courses, their descriptions, codes and credit weighting have been provided below.

PROGRAMME STRUCTURE

A. LEVEL 100 COURSES

All the courses available in Level 100 are compulsory for all students

FIRST SEMESTER

COURSE CODE	COURSE TITLE	CORE/ELECTIVE	CREDITS
AGRC 101	General Chemistry I	C	2
AGEN 101	Agricultural Engineering I	C	2
ANIM 111	Biology of Farm Animals	C	2
CROP 111	Introduction to Agricultural Botany	C	2
SOIL 101	Introduction to Soil and the Environment	C	2
MATH 101	General Mathematics	C	3
UGRC 150	Critical Thinking and Practical Reasoning	C	3
	TOTAL	C	**16**

SECOND SEMESTER

COURSE CODE	COURSE TITLE		CREDITS
AGRC 102	General Chemistry II	C	3
AGEC 102	Introduction to Economics	C	2
AGEX 102	Development Communication and Extension Methods	C	2
AGRC 104	Introduction to Computer Science	C	2
AGRC 108	General Physics	C	3
UGRC 110	Academic Writing I	C	3
UGRC 130	Understanding Human Societies	C	3
	TOTAL	C	**18**

B. LEVEL 200

All the courses available in Level 200 are compulsory for all students

FIRST SEMESTER

COURSE CODE	COURSE TITLE		CREDITS
AGEC 211	Microeconomics: principles and applications to households and firms	C	2
AGEN 201	Agricultural Engineering II	C	3
ANIM 211	Introduction to Monogastric Production	C	2
CROP 221	Introduction to Crop Production	C	2
SOIL 203	Soil Genesis and Characterisation	C	3
BCMB 205	General Biochemistry	C	3
UGRC 210	Academic Writing II	C	3
	TOTAL		**18**

SECOND SEMESTER

COURSE CODE	COURSE TITLE		CREDITS
AGEC 212	Macroeconomics: Principles and Applications to Economy of Ghana	C	3
AGEX 202	Approaches to Extension	C	2
ANIM 212	Elements of Microbiology and Immunology	C	3
CROP 220	Insect Biology and Plant Microbes	C	3
SOIL 204	Chemical and Biochemical Properties of Soil	C	2
AGRC 212	Introductory Statistics	C	3
AGRC 200	Long Vacation Practicals*	C	2
	TOTAL		**18**

**Long vacation practicals are compulsory for ALL Level 200 students and a pre-requisite for progression to Level 300*

C. LEVEL 300

Students shall be required to take all the University and School required courses. Additionally, students shall take TWO courses per semester from the Department of specialisation and TWO courses per semester from other Departments in the School.

1. AGRICULTURAL ECONOMICS AND AGRIBUSINESS SPECIALISATION

FIRST SEMESTER

AGRC 301	Introductory Genetics	C	3
AGEC 311	Farm Management	C	3
AGEC 313	Microeconomic and Macroeconomic Theory	C	3
UGRC 220	Introduction to African Studies	C	3
	Two Electives from other Departments within SOA	E	6
	TOTAL		**18**

SECOND SEMESTER

AGRC 302	Principles of Biotechnology	C	3
AGEX 302	Extension Programme Planning and Evaluation	C	3
AGEC 312	Project Analysis	C	3
AGEC 314	Research Methods, Statistics and Mathematics for Economics and Business	C	3
	Two Electives from other Departments within SOA	E	6
	TOTAL		**18**

2. ANIMAL SCIENCE SPECIALISATION

FIRST SEMESTER

AGRC 301	Introductory Genetics	C	3
ANIM 311	Principles of Animal Nutrition	C	3
FISH 313	Introduction to Aquaculture	C	3
UGRC 220	Introduction to African Studies	C	3
	Two Electives from other Departments within SOA	E	6
	TOTAL		**18**

SECOND SEMESTER

AGRC 302	Principles of Biotechnology	C	3
AGEX 302	Extension Programme Planning and Evaluation	C	3
ANIM 312	Introduction to Ruminant Production	C	3
ANIM 314	Principles of Animal Breeding	C	3
	Two Electives from other Departments within SOA	E	6
	TOTAL		**18**

3. CROP SCIENCE SPECIALISATION

FIRST SEMESTER

AGRC 311	Introductory Genetics	C	3
CROP 311	Crop Protection	C	3
CROP 315	Principles of Horticulture	C	3
UGRC 220	Introduction to African Studies	C	3
	Two Electives from other Departments within SOA	E	6
	TOTAL		**18**

SECOND SEMESTER

AGRC 302	Principles of Biotechnology	C	3
AGEX 302	Extension Programme Planning and Evaluation	C	3
CROP 322	Crop Physiology	C	3
FAPH 304	Introduction to Postharvest Technology and Crop Losses	C	3
	Two Electives from other Departments within SOA	E	6
	TOTAL		**18**

4. SOIL SCIENCE SPECIALISATION

FIRST SEMESTER

AGRC 301	Introductory Genetics	C	3
SOIL 307	Environmental Soil Physics I	C	3
Soil 309	Soil Research Methodology And Laboratory Analysis	C	3
UGRC 220	Introduction to African Studies	C	3
	Two Electives from other Departments within SOA	E	6
	TOTAL		**18**

SECOND SEMESTER

AGRC 302	Principles of Biotechnology	C	3
AGEX 302	Extension Programme Planning and Evaluation	C	3
SOIL 306	Management of Soil Environment	C	3
SOIL 308	Soil degradation and Rehabilitation	C	3
	Two Electives from other Departments within SOA	E	6
	TOTAL		**18**

D. LEVEL 400 COURSES

Students shall be required to take all School required courses. Additionally, students shall select one of the EIGHT subject areas listed under Specialisations and take all the CORE courses listed and some other electives. Level 400 students are expected to report to the School 4 weeks before the commencement of the first semester to begin their research project.

1. AGRICULTURAL ECONOMICS SPECIALISATION

FIRST SEMESTER

AGRC 401	Entrepreneurial Skills	C	3
AGEC 400	Research Project	C	3
ECON 301	Microeconomic Theory I	C	3
ECON 303	Macroeconomics Theory I	C	3
ECON 403	Econometrics I	C	3
AGEC 409	Agricultural Marketing and Price Analysis	E	3
	TOTAL		**18**

SECOND SEMESTER

AGRC 422	Introductory Agroforestry	C	3
AGEC 400	Research Project	C	3
AGEX 402	Management of Development Organisations	C	3
ECON 302	Microeconomic Theory II	C	3
ECON 304	Macroeconomic Theory II	C	3
ECON 404	Econometrics II	E	3
	TOTAL		**18**

2. AGRIBUSINESS SPECIALISATION

FIRST SEMESTER

AGRC 401	Entrepreneurial Skills	C	3
AGEC 400	Research Project	C	3
AGEC 401	Agricultural Marketing and Research	C	3
AGEC 403	Agribusiness Management	C	3
AGEC 405	Quantitative Methods and Operations Research	C	3
AGEC 407	Management Accounting	E	3
	TOTAL		**18**

SECOND SEMESTER

AGRC 422	Introductory Agroforestry	C	3
AGEC 400	Research Project	C	3
AGEX 402	Management of Development Organisations	C	3
AGEC 404	Fundamentals of Business Planning and Policy	C	3
AGEC 402	Agrifood Businesses and Agro Processing	E	3
AGEC 406	Managerial and Business Economics	E	3
	TOTAL		**18**

3. ANIMAL SCIENCE SPECIALISATION

FIRST SEMESTER

AGRC 401	Entrepreneurial Skills	C	3
ANIM 410	Research Project	C	3
ANIM 413	Biometry	C	3
ANIM 415	Applied Animal Nutrition	C	3
ANIM 417	Monogastric Animal Production	C	3
	*Select One Elective from ANIM 419, ANIM 421, ANIM 423	E	3
	TOTAL		**18**

* ANIM 419=Meat Science & Technology (3 credits), ANIM 421=Principles of Range and Forage Science (3 credits), ANIM 423=Micro-Livestock Production (3 credits)

SECOND SEMESTER

AGRC 422	Introductory Agroforestry	C	3
ANIM 410	Research Project	C	3
AGEX 402	Management of Development Organisations	C	3
ANIM 414	Applied Animal Breeding	C	3
ANIM 416	Ruminant Animal Production	C	3
	*Select one Elective from ANIM 418, ANIM 422	E	3
	TOTAL		**18**

*ANIM 418= Animal Health and Physiology (3 credits), ANIM 422= Anatomy of Digestive Physiology (3 credits)

4. AQUACULTURE SPECIALISATION

FIRST SEMESTER

AGRC 401	Entrepreneurial Skills	C	3
ANIM 410	Research Project	C	3
ANIM 413	Biometry	C	3
FISH 411	Introductory Fisheries Taxonomy	C	2
FISH 415	Fisheries and Aquaculture Wildlife management	C	3
	*Select Two Electives from FISH 315, FISH 323, OCNO 329	E	4
	TOTAL		**18**

* FISH 315=Fish Microbiology(2 credits), FISH 323=Fish Diseases and Pathology (2 credits), OCNO 329=Behaviour of Aquatic Animal (2 credits)

SECOND SEMESTER

AGRC 422	Introductory Agroforestry	C	3
ANIM 410	Research Project	C	3
AGEX 402	Management of Development Organisations	C	3
FISH 412	Aquaculture Engineering and Practice	C	3
FISH 414	Fish Processing and utilization	C	3
	*Select One from FISH 422 or OCNO 324	E	2 or 3
	TOTAL		**17 or 18**

*FISH 422=Fish Chemistry and Toxicology (2 credits), OCNO 324 = Aquatic Biodiversity and Conservation (3 credits)

5. CROP SCIENCE SPECIALISATION

FIRST SEMESTER

AGRC 401	Entrepreneurial Skills	C	3
CROP 440	Research Project	C	3
CROP 411	Field Crops	C	3
CROP 423	Plant Pathology	C	3
CROP 425	Statistics for Agriculturist	C	3
	*Select One Elective from CROP 427and CROP 433	E	3
	TOTAL		**18**

* CROP 427=Seed Science and Technology (3 credits) and CROP 433= Molecular Biology (3 credits)

SECOND SEMESTER

AGRC 422	Introductory Agroforestry	C	3
AGEX 402	Management of Development Organisations	C	3
CROP 440	Research Project	C	3
CROP 422	Crop Entomology	C	3
CROP 426	Genetics and Plant Bleeding	C	3
	*Select One Elective from CROP 434, CROP 418 and CROP 424	E	3
	TOTAL		**18**

*CROP 434= Fruit and Vegetable Crops (3credits), CROP 418= Plantation and Industrial Crops (3credits), CROP 424= Plant Virology (3credits)

6. HORTICULTURE SPECIALISATION

FIRST SEMESTER

AGRC 401	Entrepreneurial Skills	C	3
CROP 440	Research Project	C	3
CROP 425	Statistics for Agriculturist	C	3
CROP 435	Environmental Horticulture	C	3
CROP 437	Pest and Diseases of Horticultural Crops	C	3
	*Select One Elective from CROP 411 and FAPH 421	E	3
	TOTAL		**18**

*CROP 411 = Field Crop (3 credits), FAPH 421 = Postharvest Physiology (3 credits)

SECOND SEMESTER

AGRC 422	Introductory Agroforestry	C	3
AGEX 402	Management of Development Organisations	C	3
CROP 440	Research Project	C	3
CROP 434	Fruit and Vegetable Crops	C	3
CROP 426	Genetics and Plant Bleeding	C	3
CROP 418	Plantation and Industrial Crops	E	3
	TOTAL		**18**

7. POST HARVEST TECHNOLOGY SPECIALISATION

FIRST SEMESTER

AGRC 401	Entrepreneurial Skills	C	3
CROP 440	Research Project	C	3
CROP 425	Statistics for Agriculturist	C	3
FAPH 421	Postharvest Physiology	C	3
FAPH 413	Storage, Pest and Diseases: their prevention and control	C	3
	*Select One Elective from FAPH 415 and FAPH 417	E	3
	TOTAL		**18**

*FAPH 415 = Packaging and Environmental Issues in Postharvest (3 credits), FAPH 417 = Quality Assurance in Postharvest Technology (3 credits)

SECOND SEMESTER

AGRC 422	Introductory Agroforestry	C	3
AGEX 402	Management of Development Organisations	C	3
CROP 440	Research Project	C	3
CROP 434	Fruit and Vegetable Crops	C	3
FAPH 424	Processing and Preservation of Agricultural Produce	C	3
	*Select One Elective from FAPH 422, FAPH 426, and FAPH 418	E	3
	TOTAL		**18**

*FAPH 422 = Farm Structures and Environmental Control (3 credits), FAPH 426 = Marketing of Agric. Produce, Food Laws and Legislation (3 credits), FAPH 418 = Micro Enterprise Development and Management 3 credits

8. SOIL SCIENCE SPECIALISATION

FIRST SEMESTER

AGRC 401	Entrepreneurial Skills	C	3
SOIL 400	Research Project and Seminar	C	3
SOIL 411	Soil Genesis, Quality and Land-use Planning	C	3
SOIL 413	Environmental Soil Physics II	C	3
SOIL 415	Clay and Soil Material Science	C	3
	*Select One Elective from SOIL 417 and SOIL 419	E	3
	TOTAL		**18**

*SOIL 417 = Environmental Soil Chemistry (3 credits) and SOIL 419 = Introduction to Paleopedology (3 credits)

SECOND SEMESTER

AGRC 422	Introductory Agroforestry	C	3
AGEX 402	Management of Development Organisations	C	3
SOIL 400	Research Project and Seminar	C	3
SOIL 412	Soil Biochemistry and Microbiology	C	3
SOIL 414	Soil Chemistry and Fertility	C	3
	Select One Elective from SOIL 416 and SOIL 418*	E	3
	TOTAL		**18**

*SOIL 416 = Petroleum Microbiology and Bio-remediation of Contaminated Soil (3 credits) and SOIL 418 = Introduction to Agric. Systems Analysis and Simulation (3 credits)

COURSE DESCRIPTIONS

LEVEL 100 COURSES

AGRC 101: General Chemistry I

Atomic Structure: Rutherford Model, Bohr's model, Quantum chemistry, isotopes; Bonding and Intermolecular Forces: Ionic and covalent bonding, van der Waals forces, hydrogen bonding. Equilibrium in aqueous solutions: Arrhenius, Bronsted and Lewis concepts. Acid Strengths and ion pairs, simple pH calculations for solutions of acids and bases. Principle of pH determination, cation/anion hydrolysis. Chemical equilibrium, solubility and solubility products (K_{sp}). Electrochemical series. Redox systems: Oxidation numbers; Balancing of Redox reactions. Colligative properties, Raoult's Law. Rates of reactions.

Practicals: Quantitative analysis. Routine laboratory procedures; Significant figures; Accuracy and precision; Weighing; Calibration of volumetric glassware; Solution preparation; Standardization of solutions; Acid base titration; Determination of pH of solutions and suspensions; Redox titration.

AGEN 101: Agriculture Engineering I

Importance and strategies of post harvest crop handling in agriculture. Postharvest physiology of farm produce; influence of production practices and technology-Harvest, handling and processing of agricultural produce traditional and modern technologies). Cleaning and sorting equipment. Different types of conveyors, transportation, size-reduction mills. Milling of grains. Influence of crop variable, mill design, separation and cleaning of grain, grain properties aerodynamic drag, friction resilience. Drying equipment principles and practice: Driers, solar driers. Storage methods and structures. Pest management, for storage; food processing and preservation of major types of food products. Hydrologic cycle; role of water in crop growth, concepts of soil water availability; irrigation water requirement, scheduling, water deficits and crop yields; Irrigation and Drainage - Sources of irrigation water, conveyance of irrigation water, methods of irrigation, calculating water requirement, comparison of irrigation systems for various drainage systems, crop water requirement, evapotranspiration and crop coefficient curve. Drainage problems, surface and sub-surface methods of drainage.

ANIM 111: Biology of Farm Animals

Blood and circulation: - composition of blood, functions of blood, heart and blood vessels; the respiratory system: - structure of the respiratory system of mammalian and avian species, gaseous exchange in the lungs and tissues, transport of oxygen and carbon dioxide; the excretory system: - structure of the kidneys, the functional unit of the kidneys and formation of urine; the reproductive system: - reproductive organs of livestock and avian species, spermatogenesis and cogenesis, endocrine functions of the testes and ovaries; skeletal system of livestock and avian species; the digestive system: - structure and functions of the different sections of the digestive systems of livestock and avian species.

CROP 101: Introduction to Agricultural Botany

Hierarchical organization of plant life, from single cells to flowering plants: algae, fungi, bryophytes, pteridophytes, gymnosperms, angiosperms; structure of plant cells, tissues, organs. Fine cell structures and their functions. Mitosis, meiosis, molecular basis of inheritance, protein synthesis. Root modification of roots, arrangement of tissues in monocotyledonous (monocot) and dicotyledonous (dicot) roots. Stem: modification of stems, arrangement of tissues in monocot and dicot stems. Leaf: simple, compound, venation, shapes, arrangement and modification of leaves; arrangement of tissues in monocot and dicot leaves. Reproduction in plants. Flower: parts, types, floral arrangements (inflorescence), and floral diagrams. Fruit and seed: structure, types germination and dormancy. Principles of classification including concepts of species, genus, family, order, division and kingdom, binomial system of nomenclature.

SOIL 101: Introduction to Soil and the Environment

Theory*: Pedology (7 weeks):* Concepts of soil; composition of the earth-crust and its environment, pedogenic factors and their interactions, major components of soils; introduction to inorganic components of soils (origin and nature of rocks); classification systems; ***Soil Physics (6 weeks)*** Soil as a 3-phase dispersed system. The solid phase: bulk density, particle density, specific surface area, soil texture and classification systems, Stoke's law and particle size analysis. The liquid phase: soil water content and methods of determination including gravimetric, neutron scattering, time domain reflectometry; concept of equivalent depth, soil water storage, total soil water potential (matric, pressure, gravitational, and osmotic or solute potentials) and potential diagrams, soil moisture characteristic and its uses.

Practicals: (6 weeks)

Determination of (a) soil water content on (i) mass basis and (ii) volume basis, (b) bulk density, (c) particle density, (d) particle size analysis (e) soil moisture characteristic using the filter paper

method.

MATH 101: General Mathematics

Indices and logarithm. Functions and their graphs, polynomial functions, circular functions, equations and inequalities in one variable. Arrangement and selections. Binomials expansion. Limits of functions, the derivatives of functions and its applications. Integration as the inverse of differentiation. Integral of simple functions. The definite integral as an area. Applications to kinematics. Elementary numerical methods, the Newton-Raphson method.

AGRC 102: General Chemistry II

Systematic Inorganic Chemistry. Periodic classification of elements, Periodic Table (groups and periods), Atomic properties and periodic table, chemistry of alkali and alkali earth metals, halogens and transition elements. Introduction to organic chemistry: Structure of organic molecules, alkanes and cycloalkanes, alkanes as hydrocarbons, sp^3 functional groups. Sources of alkanes, nomenclature and physical properties, isomerism in alkanes; Substitution reactions, halogenation, free radical, effects of halogenation on the ozone layer. Alkenes: sp^2 hybridization, double bond formation, geometry of C=C bond, nomenclature, isomerism: cis and trans configuration, E and Z configuration. Aromatic functional groups: Brief introduction to aromaticity, physical and chemical properties with benzene as typical example, some structures. Structures and namings: nitrobenzene, toluene; chloro, bromobenezenes; aniline, naphthalene; phenanthrene. Some reactions: Friedel-Craft alkylation, acylation, halogenation, oxidation of toluene, benzene with halogens (ring splitting).

Practicals: Qualitative Analysis: Test for cations (NH_4^+, Mg^{2+} , Al^{3+}, Pb^{2+}, Zn^{2+}, Mn^{2+}, Ca^{2+}, Ba^{2+}, Ag^+, Cu^{2+}, Fe^{2+}, Fe^{3+}, Cr^{3+}) and anions (SO_4^{2-}, S^{2-}, CO_3^{2-}, Cl^-, I^-, NO_3^-, NO^{2-}); Selective precipitation of cations and anions; Identification of salts and functional groups. Lucas test for primary, secondary and tertiary alcohols.

AGEC 102: Introduction to Economics

The objective of the course is to provide beginning students with the basic economic tools that will enable them appreciate the economic systems of the world and how an economy works.

Microeconomics

What is Economics? Scarcity and Choice, Economic Systems of the World, Micro and Macro Economics, Positive and Normative economics, Economics and Agricultural Economics, Techniques of Economics Analysis: Inductive and deductive reasoning, Scientific method of enquiry, theory and hypothesis, use of graphs, Analysis of consumer behavior: Consumer choice, concept of utility, indifference curves, budget lines, consumer equilibrium, Demand Analysis: Demand Schedule, Demand curve, Demand function, change in quantity demanded versus change in demand, Factors affecting the demand of a commodity, Supply Analysis: Supply Schedule, Supply curve, Supply function, change in quantity supplied versus change in supply, Factors affecting the supply of a commodity, Elasticity of Demand and Supply: Concept of elasticity, price elasticity of demand and supply, income elasticity, cross price elasticity, Markets: types of markets, characteristics of markets, equilibrium of competitive markets, Theory of the firm (production economics): concept of short-run and long-run, fixed and variable inputs. Concept of cost, fixed and variable costs.

Macroeconomics

Nominal and real values in economics: Consumer Price Index (CPI), GDP deflator, purchasing power, National Income Determination: Gross Domestic Product (GDP), Gross National Product (GNP), consumption function, savings function, the multiplier measurement problems, Inflation: Level of Inflation, rate of inflation, effects of inflation, Unemployment: rate of unemployment, labour force.

AGEX 102: Development Communication and Extension Methods
Definitions and key concepts in Communication; Approaches and models of communication; Models of Development; The concept of Extension Methods. Types of Extension Methods; Use of different Extension Methods; Role of Communication in community development; Communication channels and forms; Indigenous Communication; Information Organisation; Distortion and loss; Non-verbal Communication; Communication strategies and skills; Public relations. Visual Aids; Classification of Visual Aids; Importance of Visual Aids; Development and use of Visual Aids; Selection of Visual Aids for specific learning situations; The use of field Demonstrations.

AGRC 104: Introduction to Computer Science
Types of Computers and their Historical developments. Data representation and manipulation: binary (signed, unsigned, and floating), octal, hexadecimal, ASCII, addition and subtraction, conversion between decimal and other systems, Logic gates: design of simple circuits for data manipulation, Machine organization: ALU, registers, main memory, fetch/decode/execute cycle, Types of software and its applications. Computer Ethics and the Internet. **Laboratory Sessions: Hands on practice on Microsoft word, excel and PowerPoint.**

AGRC 108: General Physics
Viscocity, surface tension, buoyancy, fluid pressure, Newton's law, force, momentum types of forces, work power, energy, conservation of mass, momentum of energy, Heat: temperature, heat, work, gas law, specific heat capacities, heat transfer, melting point, relative humidity, Waves: wave phenomenon types of waves, electromagnetic waves. Magnetics: magnetic field, magnetic effect of current, force on current-carrying conductors, and electromagnetic induction, heat effect of magenetism. Electricity: electric field. The coulomb's law, dialectirc, time domain reflectrometry, conductors and insulators, electric current, electromotive force, Ohm's law, power, electric motors and transformers, electric circuits. Nuclear Physics: radioactivity, fusion, fission, application of nuclear physics.

LEVEL 200 COURSES

AGRC 200: Long Vacation Practicals
Students shall undertake practical training during the long vacation at the three research centres (ARCs) of the College, namely, Forest and Horticultural Crops Research Centre- Kade, Soil and Irrigation Research Centre- Kpong, Livestock and Poultry Research Centre- Legon. Students will be exposed to the following:

- At Kade – forest agriculture, husbandry of crops and agroforestry
- At Kpong – soil classification, soil water relationship and rice cultivation
- At Legon –livestock and poultry, animal nutrition, health and traction.

AGEC 211: Microeconomics (Principles and Applications to Households and Firms)
Overview of Economics. The Economic Problem. Branches of Economics. Overview of Microeconomics: Nature, Use and Limitations. Concept of a Final Good. Concept of an Intermediate Good. Concept of a Market. The Market Mechanism. Shortage and Surplus in a Market. Effects of Demand and Supply Shift Factors on Equilibrium Quantity and Equilibrium Price. Final Goods Markets. Intermediate Goods Markets. Concept of Elasticity. Supply and Demand Elasticities for Final Goods Markets and Intermediate Goods Markets. Consumer Choice: Utility Curve, Utility Surface, Indifference Curve and Indifference Surface. Rate of Commodity Substitution. Budget Line. Consumer Equilibrium and Derivation of Consumer Demand Curve for Final Goods. Income and Substitution Effects. Producer Choice: Concept of a Production

Function. Well-behaved Production Curves and Surfaces. Isoquant Curves and Surfaces. Marginal Rate of Technical Substitution. Production Elasticities. Isocost Curves and Surfaces. Objectives of Producers: Output Maximisation, Cost Minimisation, Profit Maximisation. Equilibrium of the Producer and Factor Demand Curves. Product Supply Curves and Surfaces. The Structure of Markets: Competition, Monopoly, Oligopoly and Monopsony. Agricultural Economics as an Applied Discipline. The Structure of Agriculture in Ghana. Government Policy and Agriculture in Ghana.

CROP 221: Introduction to Crop Production

The physical environment and crop production. Adapting crops and management practices to the environment. Soil and water conservation. Farming, cropping and agro-forestry systems. Plant propagation, crop establishment and management. Weed control strategies. Pest and disease control. Integrated crop nutrient management.

AGEN 201: Agriculture Engineering II

Stages of agricultural mechanization development; Aims and objectives of agricultural mechanization. Sources of farm power- Human, animal and mechanical power sources; types of tractors, features and specifications, comparison of various tractor types; Engines - Internal combustion engines, functions of various parts of the engine; Mechanical Power transmission: Principal reasons for the application of drives, different types of couplings and their applications, chain drives, belt and pulley drives, gear drives, Tractor Power Transmission System. Tillage: Objectives of tillage, primary and secondary tillage equipment (plows, harrows, etc). Planters and seed drills; methods of seed establishment, functions of a seeder, seed metering devices. Fertilizer distribution/broadcasters, Husbandry equipment: Field sprayers/dusters: Types of sprayers (hydro-pneumatic, mist blower etc). Factors affecting sprayer performance. Harvesting equipment: Harvesting methods, combine harvesters (basic operations, working principles, combine losses). Selection and maintenance of farm machinery. Farm machinery costing and records.

ANIM 211: Introduction to Monogastric Production

Origin, distribution and characteristics of breeds of poultry in Ghana and Africa; definitions of terms used in poultry production; systems of poultry production; adaptation of poultry to the tropics; the poultry industry in Ghana – opportunities and challenges. Origin and classification of swine. Distribution of Pigs. Anatomical characteristics. Definition of technical terms and terminology. Importance of swine to man. Swine behaviour. Breeds and their physical characteristics. Adaptive physiology/mechanism of adaptation. Growth and development in pigs. Stress syndrome in pigs. Nutrient requirements in swine life cycle.

SOIL 203: Soil Genesis and Characterisation

Theory: Inorganic components of soils: rocks and minerals, primary minerals, secondary minerals, clay minerals (1:1 and 2:1); weathering of rocks and minerals: types of weathering, types of parent materials; soil formation and profile development: processes and factors of profile development; nomenclature and identification of soil horizons: master and sub-horizons and layers, transitional and combination horizons, suffix symbols, soil catena concept. Soil properties used in soil characterization; surface and subsurface diagnostic horizons and other diagnostic properties; soil classification: basic principles and purposes of soil classification, soil as a population, pedon and polypedon concepts, categories and classes, single and multiple category systems, technical and natural (taxonomic) classification systems. Essence of soil classification, types of soil classification (natural and technical), basic characteristics of the USDA soil orders and their FAO (WRB) equivalents; profile characteristics of major soil orders in Ghana.

Practicals: (13 weeks): Identification of minerals and rocks; Soil profile description: soil depth, boundary between horizons, texture by feel, soil colour, consistence, structure.

BCMB 205 General Biochemistry

Cell Structure and Function and Methods and Techniques of studying the Cell: General features of prokaryotes & eukaryotes; compartmentalization of cellular processes; Source tissue/cells selection; cell disruption and fractionation. Structure, Function and Metabolism of Carbohydrates: - mono-, di-, oligo- and polysaccharides; functions of carbohydrates; stereoisomerism; Glycolysis, substrate level phosphorylation, hexose monophosphate shunt, gluconeogenesis, synthesis of other carbohydrates from monomers, fate of pyruvate in different organisms; the electron transport chain in mitochondria and ATP synthesis. Structure, Function and Metabolism of Lipids: Different types and functions of lipids (fatty acids, triacylglycerols, phospholipids, etc); beta oxidation of fatty acids; fate of acetyl CoA units (TCA cycle, ketone bodies, cholesterol); synthesis of fatty acids. Structure, Function and Metabolism of Proteins: Amino acids: buffer solutions & buffer capacity; the Henderson-Hasselbach equation in the preparation of buffers in biological assays and systems. pKa and pI. Oxidative deamination; decarboxylation; transamination ; urea cycle; NH_3 assimilation; fate of carbon skeleton (glucogenic and ketogenic amino acids); metabolism of some individual amino acids. Integration of metabolism. Protein structure, classification and functions. Enzymes: Properties & classification; factors affecting activity (co-factors & co-enzymes, pH, temp., [S], [E]); control of activity; kinetics; Michaelis-Menten equation. Nucleic acids and Protein Biosynthesis: Nitrogenous bases, nucleosides, nucleotides and nucleic acids. General overview of DNA replication, transcription and translation; Molecular basis of mutations.

AGEC 212: Macroeconomics (Principles and Applications to Economy of Ghana)

Concept of an Economy, Definition of Macroeconomic Theory. National Income Accounting. Aggregate Output Function. Aggregate Labor Demand and Supply Functions. Consumption, Savings and Investment Functions. Money Demand and Supply Functions. Fundamentals of National Income Determination. Aggregate Demand and Supply Curves. Business Cycles. Fundamentals of Exchange Rate Determination. Fundamentals of the Causes of Inflation. Applications to the Economy of Ghana.

AGEX 202: Approaches to Extension

Concepts and relationships between extension, technological and institutional innovation; objectives and importance of extension services. History of development of extension worldwide. Contribution of extension to agricultural and rural development / potential of agricultural extension in developing countries; Major problems and constraints to extension's effectiveness and challenges in agricultural extension and agricultural development. Approaches to agricultural extension delivery - the general agricultural extension approach, Training and Visit approach, farming systems research approach. Cost sharing / cost recovery approach, Commodity Specific approach, Farmer Field Schools, Convergence of Sciences and Innovation Systems approaches; Evolution of extension approaches in Ghana (including the current state and future of extension services in Ghana).

ANIM 212: Elements of Microbiology and Immunology

Distinguishing characteristics of microbes – bacteria fungi, viruses, viroids, protozoa and prions. Morphology, growth and nutrition of common microbes: Microbial culture. Virus replication, infection of cells and disease induction. Classification of microbes and infectious agents. Control of growth of microorganisms. Nature of microbial-host association. Germ Theory of Disease. Fundamentals of Immunology: Innate immunity, Antigen and Antigen and Antibody; Immunity;

principles of vaccination and immunoprophylaxis. Hypersensitivity. Food Microbiology: Food spoilage and preservation; microbiology of fermented foods; Microorganisms as source of food.

CROP 220: Insect biology and Plant Microbes

Insects as arthropods and their inter-relationship with other members of the phylum Arthropoda. Characteristics of insects, features of insects that have enhanced their success. Importance of insects to agriculture. Morphology of insects; Anatomy and physiology of organ systems. Locomotion in insects, and some aspects of insect behaviour. Entomological techniques. Classification of insects, with emphasis on the recognition of representation of all the insect orders. History of Microbiology: role of discovery and spontaneous generation of microbes and germ theory of diseases. Characteristics of plant microbes (fungi, bacteria, viruses, viroids, mollicutes, nematodes, algae and protozoa): morphology, structure and function, growth, reproduction, dispersal and classification of the microbes. Importance of plant microbes in agriculture: including soil fertility involving rhizobia, mycorrhiza and algae.

SOIL 204: Chemical and Biochemical Properties of Soils

Theory: **Chemical Properties (6 weeks):** Soil colloids and ion exchange phenomenon; adsorbed cations- basic and acidic cations, cation exchange capacity (CEC); effective cation exchange capacity (ECEC) of soils; cation exchange and availability of nutrients; anion exchange (AEC). Buffering of soils, buffer capacity of soils. Soil reaction. **Biochemical/ Microbiological Properties (7 weeks):** The soil as a habitat for organisms. The study of some microorganisms in soil (i.e. bacteria, fungi and actinomycetes and composition of their cell walls). Factors influencing microbial growth, microbial nutrition i.e. autotrophy and heterotrophy. Introduction to microbial genetics (study of DNA structure and replication, transformation, transduction, conjugation and transposon). Methods of studying the soil microbial population. Inter-relationships between soil organisms i.e. symbiosis, protocooperation, commensalism, ammensalism, predation, parasitism and competition. Carbohydrates, organic nitrogen and organic acids in soil, soil enzymes. Organic matter composition and functions in soil.

Practicals: (13 weeks): Soil pH, soil organic carbon/organic matter, total soil nitrogen, total soil phosphorus, available soil phosphorus, cation exchange capacity, exchangeable bases. Safety instructions in the laboratory, aseptic transfer techniques, growth requirements of microorganisms (ascertaining the effect of different growth conditions such as temperature, pH, salt and sugar concentrations on different organisms). Inducing bacterial mutations, Gram staining procedure for typing microbes, plate method for estimating microbial numbers, streaking to obtain pure isolates, microbial determination by the static incubation method.

AGRC 212: Introductory Statistics

Descriptive Statistics: Graphical Forms and Charts; Measures of Central Tendency; Summary Statistics; Measures of Dispersion. **Probability and Sampling Distributions**: Normal Distribution; Student's t-distribution; F-distribution; x^2-distribution.

Sampling: Simple Random Sampling; Stratified Sampling; Cluster Sampling; Independent Samples and paired observations. **Estimation and Hypothesis Testing:** Bias, Precision, Accuracy; Type I and Type II Errors; One Sample Hypothesis; Two-Sample Hypothesis.

Chi-Square Analysis and Contingency Tables Correlation Analysis: Types of Correlation, *Rank, Product Moment (standard Correlation) Dichotomous Nominal, Point Biserial, Intra-class, etc*. Test for significance of Correlation; Comparisons of Correlations. **Simple Linear Regression:** Assumptions and Pitfalls; Least Squares Estimation of parameters; Test of Significance/ Comparing Linear Regression models **Introduction to Analysis of Variance:** The Simple One-Factor Model; Two-Factor Models/Interactions of Factors in Analysis of Variance.

AGRC 311: Introductory Genetics

The general approach to biology: genetics and the questions of biology, the molecular basis of genetic information, the program of genetic investigation, methodologies used in genetics, model organisms, genes, the environment and the organism; Transmission genetics: single gene inheritance, independent assortment of genes, mapping eukaryotic chromosomes, gene interaction; From DNA to Phenotype: DNA: Structure and replication, RNA: Transcription and processing; Proteins and their synthesis, Regulation of Gene Expression, Genomes and Genomics; Mutation, Variation and Evolution: The Dynamic Genome, Mutation, Repair and Recombination, Large scale chromosomal changes, Basic concepts in population, quantitative and evolutionary genetics; Gene isolation and manipulation.

AGRC 302: Principles of Biotechnology

An introduction to biotechnology and career opportunities in biotechnology. Basic biological properties: Cells, Information and information transfer, Extra-Chromosomal DNA. Introductory genetic engineering. Cell and Tissue Culture and Cell fusion: plant and animal cell and tissue culture, production of hybrid cells by membrane fusion. Application of biotechnology: The genetic engineering of microorganisms, Transgenic plants – products available and products in the pipeline, development and use of transgenic plants; Production of Transgenic animals and their uses; Improvement of animal health and production; management of soil microorganisms for agriculture – production of inoculants and other biofertilizers. Issues in biotechnology-Ethical issues, Priority setting, Social issues, Financing issues.

AGEX 302: Extension Programme Planning and Evaluation

Functions of Programmes in Extension work; Concept of Extension Programmes; Importance of an extension programme; Stages of an Extension Programme; Measures for enhancing effectiveness of Extension Programmes; Extension Programme Cycle; Concept of Planning; Planning Levels; Approaches to Planning; Activities involved in planning Extension Programmes; Professional abilities needed in Planning; Implementation of extension programme; Responsibilities of Extension Managers and Agents during Implementation; Events that may disrupt implementation of Extension Programmes; Monitoring of Extension Programmes; Evaluating Extension Programes during Implementation; Post-implementation stage of Extension Programmes; Terminal Evaluation.

ANIM 311: Principles of Animal Nutrition

The study of the processes that deal with feed consumption and assimilation to promote maintenance and production; Classification and functions of nutrients; Feed classification and quality evaluation; Interrelationships between nutrition and animal health.

ANIM 312: Introduction to Ruminant Production

Definitions, points of the animal and strategic importance of ruminants to human needs. Origin and distribution of sheep, goats and cattle in Africa. Systematic classification and feeding behaviour of small ruminants and cattle. Characteristics of specialized beef breeds of cattle. Ghanaian cattle breed and characteristics. Factors affecting small ruminant and beef production and constraints to enhanced productivity. Increasing the efficiency of ruminant production-issues to consider. Selection of site, housing and environmental control. Selection and care of foundation, breeding and replacement stock and herd. Systems of husbandry practices in feeding, breeding, record keeping and marketing.

ANIM 314: Principles of Animal Breeding

Genes and gene action; The nature and control of gene function; Phenotypic expression of genes; Types and consequences of mutations and chromosome aberrations; Detrimental and lethal genes in farm animals; The concept of gene frequencies; Economic traits of farm animals; Components of phenotypic variance; Heritability and repeatability; Inbreeding and relationships; Introduction to the principles of selection – theory and practice.

AGEC 301: Farm Management

The Field of Management, Factors Affecting Managerial Effectiveness, Basic Management Concepts, Farm Management Information, Preparation of Financial Accounts, Analysis of Financial Accounts, Management Accounts, Farm Budgets, Control, Risk and Uncertainty.

AGEC 312: Project Analysis

The Project Concept, The Project Cycle, Aspects of Project Preparation and Analysis, Identification of Project Costs and Benefits, Measures of Project Worth, Steps in Agricultural Project Preparation, Guidelines for Project Report Writing, Mutually Exclusive Projects, and Presentation of Group Reports.

AGEC 313: Microeconomic and Macroeconomic Theory

This course builds on courses AGEC 201 and AGEC 202. It presents the theoretical underpinings of both macroeconomic and microeconomic phenomena. At the end of the course, candidates should be able to understand and explain economic phenomena using geometry, calculus and difference equations. Candidates are also required to apply the theories learnt to the economy of Ghana.

I. ***Introduction*:** Overview of the Nature of Scientific Theory. The Scientific Method of Enquiry. Methodology of Economics. Nature and Purpose of Economic Theory. Concept of an Economy. Definition of Macroeconomic Theory. Definition of Microeconomic Theory. Concept of a Market.

II . ***Microeconomic theory*:** Theory of Production. Theory of Cost. Theory of Factor Demand. Theory of Product Supply. Theory of Consumer Demand. Consumer Surplus. Producer Surplus. Economic Welfare.

III. ***Macroeconomic theory*:** The Classical Theory of Employment and Aggregate Output. The Classical Theory of Inflation. The Complete Classical System. The Keynesian Theory of Employment and Aggregate Output. IS/LM Framework. Monetary and Fiscal Policy. The Keynesian Theory of Inflation. The Inflation-Unemployment Relationship. Structuralist Theory of Inflation. The Complete Keynesian System. The New Classical Macroeconomics: Rational Expectations Theory. Theory of Business Cycles.

AGEC 314: Research Methods, Statistics & Mathematics for Economists & Business

The scientific method of Enquiry in Business & Economics research; Basic and Applied Research; the Scientific Research Process; from proposal writing to dissemination of results; Data/Information Gathering; Methods of Data Collection; Sampling Techniques; Organizing Data for Analysis: Coding, Cleaning, Summary Statistics; Farming Systems Research; Economic Analysis of Agronomic Data. Nature of Statistics, Uses of Statistics in Economic and Business Research Models; Concept of a Random Variable; Probability Distribution Functions; Measures of Central Tendency; Measures of Dispersion; Moments of a Distribution: 3rd and 4th Moments (Skewness & Kurtosis); Concept of a model/Use of Economic models; Classical normal regression assumptions and estimation procedures of the Ordinary Least squares; Desirable Properties of estimators & Hypothesis Testing. Role of Mathematics in Economic and Business Research; Variables and Parameters, Domain of Variable; Concept of a Function: Explicit and

Implicit Functions, Inverse Functions; Functional Forms: Linear, Quadratic, Cubic, Polynomial, Logarithmic, Exponential, Inverse, Semi-Logarithmic, Double Logarithmic (Log-Log) Functions; Equations: Solution of Linear, Quadratic and Cubic Equations; Matrix Algebra; Differential Calculus; Optimization Problems: Unconstrained and Constrained Optimization Problems; Integral Calculus

CROP 311: Crop Protection

Concept of pests. Classification of pests. Economic importance of pests. Effects of pest presence. Methods of pest control. Merits and demerits of different methods, with emphasis on pesticides. Current trends in pest control. Meaning, scope and history of plant pathology; concept of diseases in plants; Importance, classification, causes, symptoms and general control of plant diseases.

CROP 315: Principles of Horticulture

An introduction to plant propagation techniques, career opportunities in ornamental horticulture, as well as a look at the ornamental crop industry in Ghana. Methods of propagation, environmental factors affecting production and control of flowering will be treated. Production systems for flower, foliage and turf crops, particularly floral designs, nursery management, house plant care, specialized crop production, postharvest handling and marketing will also be discussed.

CROP 322: Crop Physiology

Major physiological processes in plants including seed germination, plant-water relations, mineral nutrition, photosynthesis, biological nitrogen fixation and respiration. Introductory environmental physiology including photoperiodism, vernalization and temperature stress as well as air, soil and water pollution stresses on plants. Plant growth substances and growth regulation. Crop growth analysis, especially, leaf area index, leaf area duration, crop growth rate and net assimilation rate.

FAPH 304: Introduction to Postharvest Technology and Crop Losses

Meaning, brief history and importance of postharvest technology in Ghana and in the world, Population growth, global food situation and postharvest technology issues, Gender issues in postharvest technology, Types of stored food produce; perishable and durable products, National food security, assessment of regional variations and food balance sheet, Role of postharvest technology in the economic development of Ghana, Methods for increasing food supply e.g. increasing land under cultivation improving productivity, reducing losses etc, Components of the system (e.g. harvesting, Agriculture produce (from, varieties/breeds), Environmental factors (e.g. tropical region, temperature, relative humidity, moisture, gases, light), Pests and diseases, Storage structures, Processing and preservation conveying/transportation, Packaging; Post-harvest losses (definition, origin, nature and extent of losses); agents of losses; biological., microbiological chemical, physical, technical, genetic; detection and assessment of losses (importance of loss assessment, detection of external and hidden infestation, description of various detection methods, inspection procedures and frequency for bagged and bulk durable produce, description of loss assessment methods, simple and complex methods, their merits and demerits, description of equipment used to determine losses, sampling techniques used in loss assessment, demonstration of sampling techniques.

SOIL 307: Environmental Soil Physics I

Theory: Movement of water in soil: saturated water flow in soil, Darcy's law, water infiltration (horizontal and vertical), profile moisture distribution after infiltration, Empirical infiltration equations, Green and Ampt approach; Soil structure: aggregate stability, factors affecting soil structure; Tillage: "clean" and conservation tillage practices, residue management; Physics of rainfall: amount, intensity, kinetic energy, momentum; Surface runoff and water erosion: laminar

and turbulent flow, particle transport by running water, sheet, rill and gully erosion, erosivity of rainfall, erodibility of soil. The Universal Soil Loss Equation (USLE); control of soil erosion: agronomic and engineering methods.

Practicals: Field infiltration determination using the double ring infiltrometer, determination of aggregate stability, estimation of rain drop diameter and kinetic energy of rain, estimation of rainfall intensity from rainfall charts and calculation of kinetic energy using an empirical equation; estimation of soil erodibility using soil particle size distribution; estimation of rainfall erosivity index.

SOIL 306: Management of Soil Environment

Theory: ***Soil Chemistry (7 weeks)***: Nutrient elements: forms and their availability in soils, functions in plants, deficiency symptoms. Types of fertilizers, manufacture of nitrogen, phosphorus and potash fertilizers; fertilizers and calculations involving rates of application. Fertilizer usage: fertilizer and economic development, cost/benefit of fertilizer use, effect of fertilizer use on the soil environment. Fertilizer application methods: broadcast and band application, side-dressing, top dressing, foliar application; liming and liming materials. Nutrient uptake processes, mass flow, diffusion and contact exchange. ***Biochemistry/ Microbiology (6 weeks)***: Crop residue and organic matter decomposition and management (cellulose, hemicellulose, lignin, C/N ratio) microbiology and biochemistry of composting, green manuring, nitrogen, phosphorus and sulphur cycles, microbial respiration and its importance to ecosystem processes (glycolysis, Krebb cycle, respiratory chain, oxidative phosphorylation, proteins in soil).

Practicals: (13 Weeks): Soil fertility assessment, pot experiments with N,P,K, and analysis of plant tissue, micro-nutrient analysis, free iron determinations, pH changes due to nitrogen fertilizers (demonstration in solution culture) heavy metals, soil salinity assessment: electrical conductivity, determination of inorganic carbon, soil carbonate content. Microbial decomposition of organic materials in soils (effect of temperature, C:N ratio, moisture, soil texture, etc.).

SOIL 309: Soil Research Methodology and Laboratory Analyses

Experimental design; Hypothesis formulation; Site selection and sampling techniques; site characterization. Principles of soil, water, air and plant analyses. Instrumentation and methods of analyses – physical, chemical, microbiological and mineralogical. Analytical procedures of stable and radiogenic isotopes. Interpretation of analytical data.

SOIL 308: Soil Degradation and Rehabilitation

Potential problems and management of major soil orders of Ghana. Soil quality and land degradation, basic concepts, resilience and rehabilitation; Soil physical degradation: extent in Ghana and their causes, e.g. deforestation, erosion, mining, water-logging, etc.; Soil chemical degradation: extent in Ghana, depletion of soil nutrients and organic matter, sorption of non-ionic organic contaminant by soil, causes of chemical degradation e.g. leaching, salinity, sodicity, ameliorative measures; Chemical techniques; Soil biological degradation: extent in Ghana and causes, loss of beneficial micro-organisms, preponderance of harmful micro-organisms; soil macro-organisms: earthworms, termites; Soil restoration and reclamation practices.

AGRC 401: Entrepreneurial Skills

Definition of micro enterprise, Classification of micro enterprise. Importance and role of micro enterprise in the socio-economic development of a country. Entrepreneurship and rural livelihoods. Entrepreneurial Characteristics of successful Entrepreneurs. Entrepreneurship development process; opportunity recognition, information search, resource mobilisation, choice of enterprise size/location, launching of enterprises. Principles of innovation. Business Plan Development and

implementation. Product selection and development. Enterprise development opportunities in Ghana; development of micro enterprises in storage/warehousing, transportation, value-added processing, packaging and labelling, sales and distribution, advertising, financing, manufacturing of tools and equipment, processing services, etc; industrial profiles of major agricultural commodities.
Business defined; forms of business - proprietorship, partnership, co-operative societies, companies (Corporations); basic management principles: communication/public speaking; time management; Wining and maintaining customers; source of business finance; financial management tools.

AGRC422: Introductory Agro-forestry
Concept of Agro-forestry: Definitions, Classification, Advantages and Disadvantages, Sustainability of Agro-forestry. Agro-forestry in crop production; Livestock Agro-forestry systems; Agro-forestry for soil fertility management; Economics of Agro-forestry.

AGEX 402: Management of Development Organisations
The concepts of management and dimensions of management jobs. Understanding of organizational structure. Management roles, leadership theories and management in extension organizations. Motivation and delegation in management. Human resource development in extension organizations. Sources of power and the application of power in organizations. The concepts of education and training. Principles of adult learning. Formal, informal, and non-formal agricultural training and education in Ghana. Types of Training and Education in Extension organizations.

AGEC 400: Research Project
Students are expected to choose a subject of scientific inquiry and follow all relevant protocols to investigate the problem. Guided by a lecturer supervisor, they will produce a report, which will be assessed on the basis of its scientific rigour, depth of analysis and flow of thought among other things. The course is run in both first and second semester.
ECON 301: Microeconomic Theory I (See Economics Department)
ECON 303: Macroeconomic Theory I (See Economics Department)
ECON 302: Microeconomic Theory II (See Economics Department)
ECON 304: Macroeconomic Theory II) (See Economics Department)
ECON 403: Econometrics I (See Economics Department)
ECON 404: Econometrics II (See Economics Department)
AGEC 401: Agricultural Marketing & Research
Overview (Definitions, importance of marketing and trade, the role of marketing in Ghana's poverty reduction strategy); business, marketing and trade; problems in agricultural marketing and trade, the concept of market, market structure and trade (the static theory of perfect competition, the static theory of monopoly, the trade theory); marketing research (purpose, uses, procedure and applications in key agribusinesses in Ghana.); Group behaviour and pricing (Non-collusive oligopoly models, collusive oligopoly concepts); non-price competition (theory of product differentiation, useful tools of product differentiation, improving production quality and efficiency); Critical issues in international trade (the foreign exchange market, tariffs, balance of payments, economic integration); Welfare issues in agricultural marketing (social choice mechanisms, market failure and government intervention, pricing public goods and bads; the Ghana National Trade Policy and institutions).

AGEC 402: Agrifood Business and Agroprocessing
Introduction: the agricultural modernisation goal and agro industrial development. The current situation of agro industry in Ghana. A Systems Approach to Agro industrial Analysis: production

chain linkages, macro-micro policy linkages, institutional linkages, international linkages. Alternative analytical methodologies: Porter's value chain approach. Options in Agri food Business Organisation: basic concepts in organisational development, integration, differentiation, the co-operative system, outgrower schemes. Principles of Agro processing: the basic component activities of agro processing (Procurement, processing and marketing). The governance structure: Food safety and environment issues, laws and institutions in Ghana. Case Studies:- The management marketing and financing strategies in the: Egg Production Business, Chicken meat processing business, Palm Oil Processing business, Fruit Processing business, Grain processing business.

AGEC 403: Agribusiness Management

Overview of Managerial and Business Economics; Micro-economic Concepts and their Application to Business; Business Behaviour in Different Market Structures; Production and Costs; The Firm and Its Environment; Demand Estimation: Regression Analysis; Decision Making Under Uncertainty; Product Pricing; Types of agribusiness ownership, such as Sole Ownership, Partnership, Corporate Structure, etc. Managing the agricultural business, including strategic management, comparative advantage and competitive advantage, value-chain analysis. Business analysis and control – financial Statements, profit and loss statement, financial ratio analysis, and performance and activity analysis. Managerial Economics and Public Policy – how and why market regulation. Globalization – of markets and production; drivers of globalization. Economics of Human Resource Management. Case Studies.

AGEC 404: Fundamentals of Business Planning & Policy

The nature and Importance of Business Policy and Planning; Policy and levels of planning (global, national, community and firm). The business Planning Process: Feasibility study, the route to market entry; and the business plan. Strategic planning: Choosing the strategy, implementing the strategy, evaluating the strategy. Annual plans; action plans (the logical framework). Contingency planning; Information systems for planning; Policy implementation.

AGEC 405: Quantitative Methods & Operations Research

Introduction, Probability and Decision Making, Index Numbers, Time Series Analysis, Correlation and Regression Analysis, Forecasting, Network Analysis and Scheduling, Inventory Control, Simulation Analysis, Waiting Lines Analysis (Queuing Theory), Linear Programming- Simplex Method and Advanced Methods, Transportation and Assignment Problem.

AGEC 406: Managerial and Business Economics

The purpose of the course is to introduce students to the economic environment in which businesses operate, and provide an understanding of how economic principles are applied in management and business. Course content: The scope and nature of managerial and business Economics; Internal organization of firms; The firm and its Environment; Alternative Business objectives; Markets and industries; Demand estimation and forecasting; Production and costs; Linear Programming and production Structures; Pricing practices; Decision making under uncertainty; Capital budgeting; The economics of Human Resource Management; Business information; Forms of business organization; The role of government in the market economy.

AGEC 407: Management Accounting

Overview of Management Accounting, Basic Cost Classifications and Concepts, Materials Control, Ledger Accounting, Marginal and Absorption Costing, Product Costing Systems, Cost-Volume-Profit (CVP) Analysis, Budgetary Control, Standard Costing, Performance Measurement.

AGEC 409: Agricultural Price Analysis &Marketing
The role of prices; demand analysis (theory), focusing on review of consumer behavior, utility maximization, elasticity, substitution & income effects of price changes, Engel curves. Demand analysis (empirical consideration), demand for a typical farm product, formulating demand equations, demand for agricultural inputs. Supply analysis, supply relation in agriculture, estimating supply functions (direct & indirect approaches). Estimation problems, model specification, using cross-section and time-series data, interpreting estimated parameters, statistical tests, and forecasts. Introduction to Futures market. General overview of Agricultural pricing policies in Ghana.

Overview; business, marketing and trade; problems in agricultural marketing and trade, the concept of market, market structure and trade; Group behaviour and pricing (Non-collusive oligopoly models, collusive oligopoly concepts); non-price competition; Critical issues in international trade (the foreign exchange market, tariffs, balance of payments, economic integration)

ANIM 410: Research Project
A Student in the final year must choose a specific animal health and production-related topic and under the guidance of a lecturer investigation to produce a dissertation. As a two-semester course, students are expected to spend some time to read and understand the wider context of their area of inquiry. The final report so produced must be submitted to the Department through their supervisors.

ANIM 413: Biometry
Statistical inference; one-way and two-way analysis of variance; experimental design: single factor, factorial experiments. Qualitative and quantitative factors. Fixed, random and mixed models. Nested and nested-factorial experiments. Experimental design – Two or more factors. Split-plot Design; confounding systems. Course will be aided by use of statistical software.

ANIM 414: Applied Animal Breeding
Principles of selection; genetic effect of selection; selection for different kinds of gene action. Basis for selection. Methods of selection, Response to selection and factors affecting it. Systems of mating; Systems of breeding and selection for the genetic improvement of various species of livestock. Special problems of implementing genetic improvement of livestock programmes in the tropics (with particular reference to Ghana); Open nucleus breeding schemes.

ANIM 415: Applied Animal Nutrition
The digestion of starch and protein in the pig and cattle – glands, organs, digestive juices, enzymes and end products. Bioenergetics and partition of energy within the animal. Evaluation of feeds; in vivo, in vitro and in Sacco. Use of metabolizable Energy concept in Animal Feeding. Proteins in feeds – measures of protein quality for monogastrics and Ruminants. Ration formulation and Nutrient Requirements for body functions.

ANIM 416: Ruminant Animal Production
Small Ruminant Production
The millennium development Goals and the Livestock revolution – the role of the Animal Scientist. The bane of the small ruminant production on the coastal savanna of Ghana; sustainable dry season feeding strategies; Improving the reproductive efficiency of breeding ewes and rams. Other management practices – Flushing, creep feeding, weaning and calendar of activities on a small ruminant farm.

Dairy Cattle Production

Importance of milk and dairy products. Breeds of dairy cattle – characteristics and production. Status of the dairy industry in Ghana. Constraints to milk production in Ghana. Essentials of a profitable dairy operation. Milk yield and composition and factors affecting them. Management and milking of the dairy herd. Managing dairy cattle for high fertility.

Forage Production, Management and Conservation

Types of pastures; natural, cultivated. Management and improvement practices of grasslands; reseeding, fertilization, water supply, weed control, burning, supplementary feeding. Concepts of grazing; stocking rate, carrying capacity, grazing capacity, overgrazing. Grazing management systems; continuous, rotational, zero, deferred. Forage conservation; aims, techniques, socio-economic and technical considerations, haymaking, silage making.

ANIM 417: Monogastric Animal Production

Avian biology and its importance in management. Hatchery set up and management. Rearing of broiler breeder. Management of various species of poultry. Processing and marketing of poultry. The importance of swine farming. Housing and equipment. Breeding. Puberty in pigs. Pregnancy and farrowing management. Requirements and management of suckling pigs. Feeding strategies. Feed/diet formulation for sows and growing/finishing pigs. Health, marketing and record keeping.

ANIM 418: Animal Health and Physiology

Physiology (7 weeks) Comparative anatomy of the reproductive organs of the different livestock species. Oestrous cycles and synchronization of estrus. Fertilization and maintenance of pregnancy; structure of the mammary glands, initiation and maintenance of lactation. Reproductive organs of the hen and egg laying. Artificial insemination. Response of farm animals to high and low ambient temperatures. effects of high ambient temperatures on the productivity of farm animals. Alleviation of heat stress through management practices. **Health (6 weeks):** intensive production and reproductive problems in farm animals. Common general pathologic and inflammatory conditions affecting the male and female genitalia of food animals. Classical health problems associated with pregnancy, gestation and the puerperal period in livestock. Abortions and other post-parturient conditions in farm animals. Intensive production and management health problems in poultry. Reproductive failure in farm animals - sterility, infertility and their management and control signs, diagnosis and production significance of pregnancy in food animals. Problems of parturition- dystocia, retained placenta, management of uterine prolapses, ruptures and abnormal presentations in farm animals.

ANIM 419: Meat Science and Technology

Definitions; Anatomy of Livestock/Poultry; Conversion of muscle to meat; Carcass/meat grading and evaluation; By-products of Meat Industry; Storage and Preservation of meat; Microbial flora of meat and meat products; Factors influencing quality of Cured meats; Marketing of meat and meat products.

ANIM 422: Anatomy of Digestive Physiology

Signs and factors affecting health in farm animals. Deficiency diseases of farm animals (mineral and vitamin deficiencies in cattle, sheep, goats and poultry) selected major diseases of farm animals in Ghana. Incidence, aetiology, transmission, epizootioloy, pathogenesis, clinical symptoms, pathology, diagnosis, treatment and control of bacterial viral protozoan and parasitic diseases of ruminants, pigs and poultry. Notifiable and zoonotic diseases, responsibilities of stockowners and in relation to requirements of the Veterinary Services Department of Ghana.

ANIM 421: Principles of Range And Forage Science

Definition of ecological terms. Ecosystem concept and function. Types of biological relationships. Succession and range condition. Ecology and range management. Economic importance and types of grasslands. Factors affecting development of grasslands. Aims and techniques of forage conservation. Criteria for choice of species for forage production. Pasture establishment process and methods. Factors influencing pasture establishment. Factors limiting forage production to Ghana.

ANIM 423: Micro-Livestock Production

The concept of microlivestock production. Bio-geographical and ecological factors in the use of microlivestock. The concept and consequences of domestication. Transportation and housing of new domesticates. Rabbit production. Grasscutter production. Apiculture. Snail production.

FISH 411: Introductory Fisheries Taxonomy

Principles and scope of fisheries taxonomy. The binomial system of naming species, fish origins and diversity in shapes and feeding. Trophic categories in fishes; scope of classification, method of classification; Classification of major groups of fishes; Primitive bony fishes (Coelacanth, *Latimeria chalumnae*, the three living lung fishes, *Protopterus*, *Lepidosiren*, and *Neoceratodus*). Introduction to the use of FAO Fish Species Identification keys with particular reference to species of major importance to fisheries – Elasmobranchs (Sharks and rays), Mollusca (squids, octopus, oysters and clams; Crustacea (crabs, lobsters, shrimps); aquatic plants (e.g. *Laminaria* as source of food and additive); high seas fisheries resources – baleen whales and cetaceans (toothed whales and dolphins); Tuna stocks in principal world fish markets: albacore (*Thunnus alalunga*), big eye (*Thunnus obesus*), yellowfish (*Thunnus albacares*), skipjack (*Katsuwonnus pelamis*), bluefin (*Thunnus thynnus*); Bill fishes in principal world fish markets (Atlantic bluefin marlin, Atlantic whitefish marlin, black marlin, striped marlin, indo-pacific marlin, and the sword fish), Classification of top species produced in world aquaculture. The role of genetics or genetically modified organisms in fisheries. Taxonomy. Identification of unusual fish species and their adaptations e.g. deep sea fishes.

FISH 412: Aquaculture Engineering and Practice

Global status and importance of aquaculture. Design and construction of aquaculture facilities e.g. ponds, cages. Fish feeds formulation, preparation, storage and feeding. Design, construction and operation of fish hatchery. Tilapia and African catfish culture Constraints to production and their mitigation. Fish health management. Environmental impacts of aquaculture developments. Basic genetic principles (molecular genetics and cytogenesis. Tools for genetic engineering (triploidy, gynogenesis, androgenesis, monosex populations, inbreeding, etc.). tools for breeding: hereditabiligy and monosex selection. Aquaculture as a business. Genetically modified organisms.

FISH 414: Fish Processing and Utilization

Principles of fish processing and preservation. Methods of fish processing and preservation by artisanal and industrial fisheries in the tropics. Types of fish products – chilled fish, dried fish, salted fish, smoked fish, fish oil, fish meal, fermented products. Fish handling and storage. Effects of bumper harvest. Fish spoilage. Fish utilization. Fish by-products. Fish marketing Local and foreign markets for diversified fish products. Quality control and packaging.

FISH 415: Fisheries and Aquatic Wildlife Management

Effects of fisheries on the aquatic ecosystem. Definition and scope of fisheries management. General management objectives guided buy the FAD Code of conduct for responsible fisheries.

Fishery management scopes; single-species management compared with multi-species and multi-gear management; ecosystem management. Traditional management and community-based management. Fisheries management approaches, Management strategies and measures. Fishery regulation and policies. Fisheries law of Ghana. IUCN categories and criteria for threatened animals. Threatened species. Extinction in the aquatic wild. Exclusive Economic Zone (EEZ). Special conservation areas and their roles. Framework survey of fisherfolks and communities. Problems in the management of tropical multispecies stocks. Marine mammals of the world and their protection needs.

FISH 313: Introduction to Aquaculture

Water as environment for aquaculture; characteristics for selection of fish for aquaculture; energy budget of fish of typical fish for aquaculture. Aquaculture systems and techniques. Concepts of integrated aquaculture. Mariculture. Principal food chain in fish ponds. Control of aquatic plants, predators and diseases. Status of aquaculture in West Africa Biotechnology and aquaculture. General economics of aquaculture.

FISH 315: Fish Microbiology

Introduction to general microbiology. Fish micro-organisms & pathogens – types, morphological characteristics, processes, mechanisms, disease and prevention. Microbial causes of fish spoilage-enzymatic breakdown of fish molecules, roles of glycolytic and autolytic enzymes. Food and water-borne diseases, fish infections and intoxication. Microbiological methods for assessment of fish quality . Spoilage of fish and influence of temperature. Food contamination and public health microbiology. Importance of potable water in fish processing. Microbial risk assessment, quality control, and microbiological standards in fish consumption and international trade. Sampling, culture techniques, and analysis. Microbial preservation techniques to preserve fish quality and increase shelf life. Survey of tropical fish processing methods including traditional and industrial. Genetic modification of fish and their importance in aquaculture. Nutrient interactions and fish health. Fish immunology. Introduction to fish endocrinology with particular reference to the pituitary hormones, testicular and ovarian steroids and their importance in fish reproduction.

FISH 323: Fish Diseases and Pathology

Host-pathogen-environment relationship, identification and diagnosis of fish diseases. Causative agents – bacteria, virus, parasites etc. Infections and diseases of fish in Africa – viral disease, bacterial infections, fungal and parasitic infections. Environmental and nutritional diseases. Transboundary fish disease. Fish immunology. Control and management of fish diseases. Public health and fish consumption.

FISH 422: Fish Chemistry and Toxicology

General introduction to aquatic toxicology, fish biochemistry, chemistry and toxicology. Molecular composition of fish – water, carbohydrates, lipids, proteins, nucleic acids. Chemistry of fish nutritional quality. Biochemical mechanisms of adaptations of fish to the marine environment. Special emphasis on the effects of pressure, temperature, salinity, dissolved oxygen and light on the physiology and biochemistry. Current and future impact of various pollutants and toxic substances in fish life, human health and the environment. General types of aquatic toxicants. Biotoxins. Toxic fishes. Impact of pesticide residues and oil spils, offshore mining, shipping, long-lived toxic organic compounds such as PCBs and heavy metals in fisheries; impacts of dumping of chemical slops in the marine environment. Chemistry of fish decay. Techniques for the assessment of toxicity in fish. Fish immunotoxicology, environmental genotoxicology and carcinogenicity tests.

OCNO 324: Aquatic Biodiversity and Conservation
Principles of biodiversity and conservation, measurement and analysis of biodiversity; Patterns of species diversity. Indicators of Biodiversity. Conservation of aquatic resources – Protected areas, Heritage sites, Ramsar sites, etc. Convention on Biological Diversity. Resource valuation. National case studies of institutional and legislative framework for biodiversity conservation. Biodiversity and climate change; climate change impacts on aquatic biodiversity. Key biodiversity areas (KBAs) in Ghana and key stone species.

OCNO 329: Behaviour of Aquatic Animals
Concepts of animal behaviour. Behavioural ecology (learning, stimuli, feeding, communication, courtship and mating, migration, protection, territoriality, social organization, orientation, rhythms, hormones and pheromones). Case studies on behaviour of named aquatic organisms.

CROP 440: Research Project
In the final year, a B.Sc. student in Crop Science must choose a topic for a research investigation directed at solving a specific plant science-related problem in consultation with a lecturer who becomes the student's supervisor. A bound dissertation describing this investigation must be presented to the Department before the final examinations begin. Although the research project is basically for training students in scientific research, it must be done conscientiously and the dissertation must contain all the elements of a publishable scientific paper. The course is spread over the first and second semesters.

CROP 411: Field Crops
Origin, botany, distribution, adaptation, propagation, cultural practices, harvesting, utilization and post-harvest handling of tropical food crops including cereals, legumes, root and tuber crops and plantain. Other crops include beverages, oil, spice and fibre crops. Constraints to production and research needs.

CROP 422: Crop Entomology
A detailed study of the biology, economic importance and control of major and minor insect pests of Field, Plantain and Horticultural crops including vegetables: Emphasis would be placed on pests of the above crops both in the field and in storage.

CROP 423: Plant Pathology
Review of the major characteristics of the major pathogen groups; Introductory plant pathology, Development of disease in individual plants and plant population, plant disease triangle, disease cycle and relationship between disease cycle and epidermics in plants; pathogenic attack of plants-role of enzymes, toxins, growth regulators etc. in plant disease; effect of disease on plant metabolism; defence of plants against pathogens – the concept and basis of resistance; genetics of plant diseases, Diagnosis and assessment of plant disease. Some selected plant diseases and their control in Ghana – importance, symptomalogy, aetiology and control

CROP 425: Statistics for Agriculturists
Introduction to planning and execution of agricultural experiments. Principles of scientific experimentation. Statistical methods commonly used in agricultural research and experimental biology. Descriptive statistics. Normal 'T' and 'F' distributions and their uses. Experimental designs, analysis of variance, chi-square tests, simple correlation and regression. Factorial experiments. Introduction to multiple regression and non-parametric statistics. Emphasis will be on applications of these methods rather than on mathematical derivations.

CROP 426: Genetics and Plant Breeding
Introduction to evolutionary, population and quantitative genetics. Plant genetic resources. Reproductive systems in crop plants. The genetics basis and methods for breeding self-and cross-pollinated crops. Mutation breeding. Polyploidy. Inter-and intra-specific hybridization. Introduction to techniques of biotechnology utilized or with potential to be utilized in crop improvement.

CROP 434: Fruit and Vegetable Crops
The fruit industry. Classification of fruit crops. Factors affecting fruit production. Establishment of an orchard: propagation and nursery practices and fruit crop management; fruit quality and marketing. Detailed knowledge of the botany. Physiology and production practices for citrus, banana, mango, avocado pear, cashew and pineapple. Minor fruit crops of Ghana. Importance of vegetables enterprises. Classification of vegetables. Factors affecting vegetables production in Ghana. The vegetable production process: site selection and soil preparation; fertilizers and plant nutrition; water sources; propagation practices; weed, pest and disease control. Vegetable cropping systems. General principles of harvesting, postharvest handling, marketing and storage of vegetables. Cultural practices involved in the production of major vegetable crops in Ghana. Research needs.

CROP 427: Seed Science and Technology
Biology of seeds – ontogeny, structure, storage, germination and storage behaviour. Principles and practices involved in the production, harvesting, processing, conditioning, storage, testing, quality management and use of agricultural seeds. Seed improvement, national seed laws, international seed institutions and regulations, seed industry policy and germplasm policy for Ghana. Developments in the international seed arena including patenting. Establishment and management of seed production as a business**.**

CROP 418: Plantation and Industrial Crops
Ecology, agronomy, physiology, production systems and research needs of major plantation crops in Ghana. Emphasis will be on cocoa, coffee, rubber, shea, sugarcane, oil palm, coconut, tobacco, cotton and citronella. Processing utilization and marketing potential. Prospects and problems of production.

CROP 433: Molecular Biology
The nature of DNA nucleic acids. Replication of double stranded DNA. The Genetic code, Gene and Gene expression. Production of Recombinant DNA. The Polymerase Reaction. Cloning of prokaryotic and eukaryotic genomes. Genome libraries. Analysis of recombinants. Construction of transgenic plants, Application of DNA technology in agriculture.

CROP 424: Plant Virology
History, classification and terminologies in virology. Virus structure, components of viruses. Isolation and characterization of viruses. Transmission of viruses. Life cycle of virus- synthesis and Genome replication of viruses. Virus entry, movement and assemble. Plant virus pathogenesis, cell damage and Host contribution to pathogenesis. Virus evolution, origin and divergence. Prevention and control of viral disease including plant defense agents. **Practical sessions should include:** Detection and assaying of plant viruses using host plants, serology and nucleic acid based techniques. Transmission of virus to test plants, symptomatology and Electron microscopy.

CROP 435: Environmental Horticulture

Landscape Design: History of garden and landscape design. Contemporary trends, types and elements of the landscapes. Objectives of landscaping. Conduction of a landscape survey and analysis of landscape survey data. Materials of design. Principles of design and Principles of landscape design. The functions and design of beds and borders, home gardens, open space, public parks and public gardens. Road, street and industrial landscaping. Landscape graphic techniques. Preparation of plans. The sequence of operation for Landscape, projects. Preparation of costs and estimates. Landscape Horticulture: Importance of landscape plants in the environment. Selection of plants for landscaping. Establishment and maintenance of landscape trees, shrubs, climbing plants, hedges and shelter belts, bedding plants, lawns in garden and parks, and aquatic plants in water garden. Problems of landscape horticulture in Ghana. Establishment of landscape maintenance program.

CROP 437: Pests and Diseases of Horticultural Crops

Overview of the concept of pests and diseases and development of pest and disease in plants. Disease diagnosis, assessment and general control of plant diseases. Study of the identification, damage, economic importance, symptoms and management of major insect pests and diseases of the following crops: (a) Vegetables: Tomato, Cabbage, Garden egg, Baby aubergines, Okra, Pepper, Onion, Water melon, Cucumber etc. (b) Fruit crops e.g. pineapple, mango, citrus, pawpaw, cashew. (c) Ornamental plants.

FAPH 421: Postharvest Physiology

Definitions; developmental cycle of plants structure and composition of produce; physiology and biochemistry of produce toxicants; environmental factors affecting fruit quality. Postharvest treatment of commodities, fruit ripening, storage methods, Harvest indices, Fruit ripening-Ethylene and fruit ripening (temperature, moisture, relative humidity, light, insulation, irradiation); Physiological disorders, low temperature and mineral deficiency disorders; Commodity treatment (e.g. Controlled ripening and de-greening, sprout inhibitors, growth regulators –synthesis, measurement, mode of action, effects and sources, irradiation, ventilation, waxing, cooling, fungicide application, et); Quality assessment.

FAPH 422: Farm Structures and Environmental Control

Materials for building construction: wood, concrete, steel, aluminum, insulation, roofing, finishing materials. Structural design: systems, requirements, analysis. Functional planning: functional planning for storage structure, materials handling centres, machinery and shop buildings. Electrical, mechanical and utilities: electrical systems, heating and cooling, ventilation systems, water supply. Crop storage environment: thermal factors in crop storage, moisture in storage, gases in storage environment, radiation. Traditional structures-their advantages and disadvantages (durability, ventilation, insect infestation, RH, Temp etc.).

FAPH 413: Storage Pests and Diseases, Their Prevention and Control

Identification of infestation and infection; Sources and causes of infestation and infection; Ecology of stored product insects, Life cycle of storage pests (arthropods, vertebrates and microorganisms); Monitoring techniques; Post-harvest diseases (nature, symptoms, causal agents, management); Factors influencing growth and development of storage pests and disease organisms; Isolation and preservation of storage pests and disease organisms; Mycotoxins (nature, causes, effects, prevention and control); food poisoning, food borne infections and toxicants; Prevention and control measures (physical, chemical, biological, attractants and repellents and other novel methods e.g. Integrated Animal and Crop Pest; Management - IACPM); Prevention of re-

infestation and re-infection; Environmental hazards e.g. misapplication, misuse, disposal of agrochemicals

FAPH 424: Processing and Preservation of Agricultural Produce

Principles, concepts, definitions and importance; Types of processing plants (primary, secondary, tertiary); Processing methods (e.g. drying, dehydration, blanching, canning, freezing etc); Processing equipment; Preservation methods (e.g. pickling, salting, fermentation, smoking, pasteurization, asepsis, irradiation); Processing of selected produce (small-scale, medium-scale, industrial-scale); Cereals and legumes (e.g. drying, milling); Roots and tubers (e.g. chipping, grating, drying, starch extraction, "garification"); Fruits (e.g. juice extraction) and vegetables (e.g. chopping, drying, pickling); Oil crops (e.g. oil extraction); Beverage crops (e.g. fermentation, drying etc); Fibre crops (e.g. retting); Medicinal and aromatic plants; Spices e.g. drying, milling etc); Herbs (e.g. drying, milling etc); Meat, dairy, poultry and fish; By-product utilization and management; Post-mortem changes in meat/poultry and fish; Food safety and hygiene; Plant hygiene and safety; Adulteration.

FAPH 415: Packaging and Environmental Issues in Post-harvest

Packaging (definition; effects of packaging on product quality, Principles and functions packaging; Containment (e.g. individual packing, jumble packing, pattern packs, cell packs); Protection against shock, vibration, static compression, external agents (e.g. insects); Apportionment/Convenience and Labeling; Communication; Packaging materials Cushioning materials and their properties; Packaging stations, equipment and machinery; safety and accident prevention; Pack houses; Public health and packaging Advertising and labelling; Environmental Issues; Environmental impact assessment; Waste disposal and management techniques: Incineration, Composting of waste agricultural products, Landfills (land reclamation), Biogas generation from waste products, Recycling of waste products, Pollution and remediation technologies, Agrochemicals; Consumer protection (e.g. production of goods, use of goods, second hand goods, sale of goods-guarantees, damages, trade description); Additives and contaminants;

FAPH 426: Marketing of Agricultural Produce, Food Laws and Legislation

Introduction: Concepts and importance; Marketing evolution; Marketing systems; Market analysis; Theories of supply, demand and equilibrium pricing; Competition; Seasonal variation in supply; Marketing organizations and functions; Government policy; Product quality grading; Labelling, pricing and sales; Domestic and international markets; Marketing channels and international trade; GLOBAL GAP regulations; Introduction: Co-operative marketing strategies; Determination of import and export parity prices; Market efficiency; Legal aspects of marketing; Distribution and salesmanship: Food Standards, Laws and Legislation (definitions); Food standards, laws and legislation of local and international agencies e.g. GSB, WTO, SIAGLOBAL; Outreach programmes e.g. need for outreach programmes, use of appropriate extension tools to reach target groups (farmers, traders, processors, transporters, consumers, etc.).

FAPH 417: Quality Assurance in Postharvest Technology

Scope of Quality Assurance; Good processing/manufacturing practice; Fish and fish products; Dairy products; Poultry products; Other meat products; Assessment methods: HACCP (hazard analysis, critical control point determination, critical limit determination, development of monitoring procedures, development of corrective action plan, development of record keeping procedures, verification procedures); ISO-9000 (standards for processing equipment, overview training, audit readiness, training for auditing, quality manual, sample procedures, Total Quality Management (TQM); Constraints to Quality Assurance in Ghana (lack of appropriate quality

standards, ignorance of quality standards, poverty, commodity supply or availability, technical barriers (equipment and personnel), insufficient knowledge of market promotions, lack of consumer protection. Food laws and regulations (food legislation)
Note: The concept of all quality issues should be related to specific agricultural commodities and products in an interdisciplinary approach. Reduction of cross contamination at the processing and consumer levels. Good agricultural and management practices at the primary level.

FAPH 418: Micro Enterprise Development
Definition of micro enterprise, Classification of micro enterprise. Importance and role of micro enterprise to the socio-economic development of the country. Entrepreneurial theories, concepts, nature and need. Characteristics of successful Entrepreneur (attitudes, skills, and competencies). Entrepreneurship development process; opportunity recognition, information search, resource mobilization, choice of enterprise size/location, launching the enterprise. Business Plan Development and implementation; components/elements of a business plan. Product development. Financial analysis (analysis of cash flow). Enterprise development opportunities in the Post-harvest chain; development of micro enterprises in storage/warehousing, transportation, value-added processing, packaging and labelling, sales and distribution, advertising, financing, manufacturing of tools and equipment for post-harvest services, processing services, etc; industrial profiles of major agricultural commodities (e.g. cassava, plantain, maize, coconut, yam, oil palm,).

SOIL 400: Research Project and Seminar
A project to be carried out by the student under the supervision of senior member(s) of the Department. The student will be required to investigate in some depth a selected problem in soil science, environmental science or agronomy and present seminars and a dissertation in partial fulfillment of the requirements of the B.Sc. Agriculture degree.

SOIL 411: Soil Genesis, Quality and Land-Use Planning
Biogeochemical processes in soil formation: weathering and end-products of inorganic and organic fractions. Eluviation and illuviation of bases, silica, aluminum, iron, clay and organic matter; Development of pans, nodules and concretions; Progressive soil development; Soil orders and the genesis of their diagnostic horizons. Soil survey: scales and kinds of soil survey, soil mapping units, soil survey operations. Environmental regulations of lands; Assessment of soil productivity rating / judgement; soil quality evaluation. Understanding what we see in terms of soil genesis: concept of benchmark soils, defining soil series - the hypothetical model. Soil survey reports: land evaluation, soil care, land-use planning, introduction to GIS (Geographic Information Systems). Use of soil classification in soil management and extrapolation of agronomic research results.

SOIL 412: Soil Biochemistry and Microbiology
Decomposition of organic residues in soils. Transformations of sulphur, iron, manganese in soils, decomposition of pesticide. Biological nitrogen fixation: symbiosis (including grain legumes, trees, Azolla, pasture/forage) and non symbiotic; Biochemistry of nitrogen fixation (symbiotic and non symbiotic), methods of measuring biological nitrogen fixation (BNF), inoculation, mycorrhiza, methods of studying microbial ecology-antibiotic resistance and select-able markers, serology, gene typing and other methods of molecular biology; Biochemistry of nitrification, denitrification and nitrate reduction; Biochemical transformation of phosphorus, sulphur, hydrocarbons and pesticides. Legume bacteriology. Biochemical processes in the rhizosphere.

SOIL 413: Environmental Soil Physics II

Water content and water potential relationship: revision of water content and soil water potential, the water balance of root zone, field capacity, wilting point and plant available water, soil water characteristic, movement of water through two or three soil layers/horizons, steady and non-steady state flow, continuity equation, Darcy-Richards equation, transport of solutes or pollutants in soil, heat movement, Fourier equation; Climatic factors affecting plant growth: saturated vapour pressure, humidity, radiation energy balance, models of water and heat transport in soil.

SOIL 414: Soil Chemistry and Fertility

Solid phase: Origin and distribution of charge on soil colloid surface, point of zero charge, electrical characteristics of soil/water interface, double layer theory; mechanism of cation and anion fixation in soils. Sulphur, aluminium, pyrite in the formation of soil acidity. Liquid phase: composition, concentration, activities and activity coefficients, Debye-Huckle theory; Chemical factors affecting plant growth: growth expressions, Mitscherlich's law of diminishing returns, Liebig's law of the minimum. Methods of evaluating soil fertility; principles of soil fertility management – fertilizer application, liming, lime requirement of soils, reactions of lime in soils. Management of acidic, saline and sodic soils. Soil and plant factors affecting N availability to plants, behavior of P fertilizers and their availability in soils.

SOIL 415: Clay and Soil Material Science

Review of crystal chemistry and mineral structures: types and properties of bonding; Structural classification of soil minerals; Minerals in soil environments, origin and chemical composition; Clay minerals: low activity and high activity clays, genesis and properties; Mineral separation and identification: fractionation and analytical methods; Applications of clay and soil minerals: functional properties, uses in industry, agriculture and environmental management.

SOIL 416: Petroleum Microbiology and Bioremediation of Contaminated Soils

Components of petroleum (mixture of aliphatic, alicyclic and aromatic hydrocarbons); Microbial metabolism (aerobic alkane metabolism, aerobic PAH metabolism, anaerobic hydrocarbon metabolism); behavioral and physiological responses of microbes to hydrocarbon, microbial community dynamics; microbial treatment of petroleum waste (treatment of contaminated soils and sludges, factors affecting bioremediation, passive bioremediation process, land farming on oily waste, bio-reactor based process, biofiltration of volatile organic compounds, removal of hydrogen sulphides and sulphates, chemical methods of bioremediation of oily wastes). Microbial processes for recovery and upgrading petroleum (microbial enhanced oil recovery, microbial de-emulsification, microbial desulfurization, microbial denitrogenation, enzymatic upgradation of petroleum fractions and pure hydrocarbon); bacterial biosensors. Microbial and chemical techniques to reclaim contaminated soils. Effect of chemicals and pollutants on microbial population, basic principles governing bio-degradation, bio-transformation reactions.

SOIL 417: Environmental Soil Chemistry

Overview of soil environments; Physico-chemical reactions in relation to agriculture, forestry and ecosystem health. Solution chemistry of nutrients and pollutants: hydrolysis and, polymerization, dissolution-precipitation, complexation, ion-pair formation; Surface chemistry of nutrients and pollutants: cation, anion, molecular adsorption. Chemistry of N, P, K and micro-elements and heavy metals in soils. Applications of dating of materials in plant nutrition and metabolism. Origin and reactions of minerals in soils and sediments, hydrological cycle, mineral exploration and human health. Recycling of waste materials.

SOIL 418: Introduction to Agricultural Systems Analysis and Simulation
Systems dynamics: definition, types of systems, causal and flow diagrams. Behaviour of systems, homeostasis, heterostasis, chaos; Simulation of biological systems. Models: types of agricultural models, methods of modeling, validating models, sensitivity analysis, construction of simple models (using DYNAMO) for population growth, predator-prey systems, nitrogen cycle, pesticide transport and nutrient leaching. Demonstration of some soil/crop models e.g. QUEFTS and NuMAS, etc.

SOIL 419: Introduction to Paleopedology
Conceptual Background; Geological history of the Earth: geological time-scale; geological formations of Ghana. Relative and absolute dating. phytolith analysis: History of Phytolith research, production, deposition and dissolution of phytolith, phytolith morphology, field techniques and research design, interpretation of phytolith assemblages, the role of phytoliths in paleo-environmental reconstruction; Economic importance of phytoliths.

DEPARTMENT OF FAMILY AND CONSUMER SCIENCES

Christina A. Nti *BSc (Ghana) MPhil (Oslo) PhD (Ghana)*	-	Associate Professor (**Head of Department**)
Angelina O. Danquah *BSc (KNUST) MSc (Acadia) PhD (McGill)*	-	Senior Lecturer
Docea A.G. Fianu *BSc (Ghana) MSc (Guelph)*	-	Associate Professor
Clara Opare-Obisaw *BSc (Ghana) MSc (Guelph) PhD (Ghana)*	-	Associate Professor
Laetitia A.P. Hevi-Yiboe *BSc (Ghana) MSc (Guelph) PhD (Iowa State)*	-	Associate Professor
Cynthia Gadegbeku *B.Ed. (UCC) MPhil (Ghana) PhD (Reading)*	-	Lecturer
Elizabeth M. Ba-Ama *BSc, MPhil (Ghana)*	-	Lecturer
Vivian Tackie-Ofosu *BSc, MPhil (Ghana), MPA(Iowa)*	-	Lecturer
Efua T. Vandyck *BSc, MPhil (Ghana)*	-	Lecturer
Joris G. Niilante Amissah *BSc (KNUST) MSc, PhD (Cornell)*	-	Lecturer
Sheriffa Mahama *BA , MPhil (Ghana)*	-	Assistant Lecturer
Nana Yaa Asantewaa Nyarko *BA, MPhil (Ghana)*	-	Assistant Lecturer
Alice Koryo-Dabrah *BSc, MPhil (Ghana)*	-	Assistant Lecturer
William K. Senayah *B.Ed. (UCC), MPhil (Ghana)*	-	Assistant Lecturer
Margaret A. Essamuah *BSc Grad Dip (KNUST), MPhil (Ghana)*	-	Part-Time Lecturer
Vivian Biney-Aidoo *B.Ed. (UCC), MPhil (Ghana)*	-	Part-Time Lecturer

FOODS & CLOTHING OPTION
LEVEL 100 COURSES
The Courses available in Level 100 are compulsory for all Foods & Clothing Option Students

FIRST SEMESTER

FOODS & CLOTHING OPTION			
COURSE CODE	**COURSE TITLE**	**CORE/ELECTIVE**	**CREDITS**
FCOS 101	Introduction to Foods & Nutrition	C	2
FCOS 103	Introduction to Textile Fibres & Fabrics	C	3
MATH 101	General Mathematics	C	3
AGRC 101	General Chemistry I	C	2
CROP 101	Introduction to Agricultural Botany	C	2
UGRC 150	Critical Thinking and Practical Reasoning	C	3
	TOTAL		**15**

SECOND SEMESTER			
FOOD AND CLOTHING OPTION			
COURSE CODE	**COURSE TITLE**	**CORE/ELECTIVE**	**CREDITS**
FCOS 102	Scope & Philosophy of Family & Consumer Sciences	C	2
FCOS 104	Introduction to Family Resource Management	C	2
AGRC 102	General Chemistry II	C	3
AGRC 104	Introduction to Computer Science	C	2
AGRC 108	General Physics	C	3
UGRC 110	Academic Writing I	C	3
UGRC 130	Understanding Human Societies	C	3
	TOTAL		**18**

LEVEL 200 COURSES

The Courses in Level 200 are compulsory for all Foods & Clothing Option Students

FIRST SEMESTER

FOODS AND CLOTHING OPTION			
COURSE CODE	**COURSE TITLE**	**CORE/ELECTIVE**	**CREDITS**
FCOS 201	Child & Adolescent Development	C	2
AGEC 201	Microeconomics	C	2
PSYC 201	Introduction to General Psychology	C	3
SOCI 201	Basic Concepts in Sociology	C	3
BCMB 205	General Biochemistry	C	3
UGRC 210	Academic Writing II	C	3
	TOTAL		**16**

SECOND SEMESTER

FOODS AND CLOTHING OPTION			
COURSE CODE	**COURSE TITLE**	**CORE/ELECTIVE**	**CREDITS**
FCOS 202	Introduction to Fashion Design	C	2
FCOS 204	Adult Development	C	2
FCOS 206	Principles of Foods	C	3
FCOS 208	Human Physiology	C	3
FCOS 212	Concepts of Family Resource Management	C	2
AGRC 202	Introductory Statistics	C	3
	TOTAL		**15**

LEVEL 300 COURSES

The students shall be required to take all the University and Department's required courses. Additionally, the student shall take at least TWO electives per semester.

FIRST SEMESTER

FOODS AND CLOTHING OPTION			
COURSE CODE	**COURSE TITLE**	**CORE/ELECTIVE**	**CREDITS**
FCOS 300	Family & Consumer Sciences Internship	C	2
FCOS 301	Consumer Behaviour & Education	C	2
FCOS 303	Principles of Housing	C	2
FCOS 305	Textile Design	C	3
FCOS 307	Basic Nutrition	C	3
UGRC 220	African Studies	C	3
	Select ANY one elective	E	3
	TOTAL		**18**

*******FCOS 309 =Dynamics of Family (2 credits), FCOS 311 =Parenting (2credits), FCOS 315 = Textiles and Apparel Product (2 credits), FCOS 317 =Evolution of Fashion (2 credits)*

SECOND SEMESTER

FOODS & CLOTHING OPTION			
COURSE CODE	**COURSE TITLE**	**CORE/ELECTIVE**	**CREDITS**
FCOS 302	Food Hygiene and Safety	C	3
FCOS 304	Family Resource Management	C	2
FCOS 306	Research Methods	C	3
FCOS 308	Housing the Family	C	2
FCOS 312	Nutritional Assessment Methods	C	2
FCOS 318	Sensory Evaluation of Foods	C	2
	Select ANY one elective	E	3
	TOTAL		**17**

LEVEL 400 COURSES

The student shall be required to take all the Departmental required courses. Students may also take some elective courses. Level 400 students are expected to report to the School 4 weeks before the commencement of the first semester to begin their research project.

FIRST SEMESTER

FOODS & CLOTHING OPTION			
COURSE CODE	**COURSE TITLE**	**CORE/ELECTIVE**	**CREDITS**
FCOS 400	Research Project	C	3
FCOS 401	Life Cycle Nutrition & Meal Management	C	3
FCOS 403	Apparel Design and Production	C	3
FCOS 405	Extension Theory	C	2
AGRC 401	Entrepreneurial Skills	C	3
	Select 2 electives from FCOS 407,FCOS 411 & FCOS 415*	E	4 or 5
	TOTAL		**18 or 19**

**FCOS 407 =Management of Household Tools & Appliances(3 credits),FCOS 411= Garment and Accessories Technology(2 credits, FCOS 415 =Management of Food Service Systems(2 credits)*

SECOND SEMESTER

FOODS & CLOTHING OPTION			
COURSE CODE	**COURSE TITLE**	**CORE/ELECTIVE**	**CREDITS**
FCOS 400	Research Project	C	3
FCOS 402	Textiles & Apparel Policies	C	2
FCOS 404	Current Issues in Foods and Nutrition	C	2
FCOS 406	Extension Practical	C	1
FCOS 408	Family Resource Management Practicum	C	3
FCOS 414	Textiles & Clothing Maintenance	C	3
	Select 2 electives from FCOS 412,FCOS 416,FCOS 418,FCOS 422 & FCOS 424*	E	4
	TOTAL		**18**

**FCOS 412=Policy perspectives in Child Studies(2 credits), FCOS 416=Special Topics in Family Resource Management(2 credits) FCOS 418=Marriage, Family & Intimate Relationships(2 credits), FCOS 422=Food Product Development(2 credits, FCOS 424=Fashion Production Internship(2 credits)*

2. FAMILY AND CHILD STUDIES

LEVEL 100 COURSES

The Courses available in Level 100 are compulsory for all Family and Child Studies Option Students

FIRST SEMESTER

FAMILY AND CHILD STUDIES OPTION			
COURSE CODE	**COURSE TITLE**	**CORE/ELECTIVE**	**CREDITS**
FCOS 101	Introduction to Foods and Nutrition	C	2
FCOS 103	Introduction to Textile Fibres & Fabrics	C	3
MATH 101	General Mathematics	C	3
SOCI 101	Introduction to Sociology	C	2
PSYC 113	Psychology for Everyday Living I	C	3
UGRC 150	Critical Thinking and Practical Reasoning	C	3
	TOTAL		**16**

SECOND SEMESTER

FAMILY AND CHILD STUDIES OPTION			
COURSE CODE	**COURSE TITLE**	**CORE/ELECTIVE**	**CREDITS**
FCOS102	Scope & Philosophy of Family & Consumer Sciences	C	2
FCOS 104	Introduction to Family Resource Management	C	2
SOCI 102	Diversity of Peoples and Cultures	C	3
PSYC 114	Psychology for Everyday Living II	C	3
AGRC 104	Introduction to Computer Science	C	2
UGRC 110	Academic Writing I	C	3
UGRC 130	Understanding Human Societies	C	3
	TOTAL	-	**18**

LEVEL 200 COURSES

The Courses in Level 200 are compulsory for all Family and Child Studies Option Students

FIRST SEMESTER

FAMILY AND CHILD STUDIES OPTION			
COURSE CODE	**COURSE TITLE**	**CORE/ELECTIVE**	**CREDITS**
FCOS 201	Child & Adolescent Development	C	2
FCOS 203	Task Performance Management	C	3
PSYC 201	Introduction to General Psychology	C	3
SOCI 201	Basic Concepts in Sociology	C	3
AGEC 201	Microeconomics	C	2
UGRC 210	Academic Writing II	C	3
	TOTAL		**16**

SECOND SEMESTER

FAMILY AND CHILD STUDIES OPTION			
COURSE	**COURSE TITLE**	**CORE/ELECTIVE**	**CREDITS**
FCOS 202	Introduction to Fashion Design	C	2
FCOS 204	Adult Development	C	2
FCOS 214	Foundations of Early Childhood Education	C	3
SOCI 202	Comparatives Social Institutions	C	3
FCOS 212	Concepts of Family Resource Management	C	2
AGRC 202	Introductory Statistics	C	3
	TOTAL		**15**

LEVEL 300 COURSES

The students shall be required to take all the University and Department's required courses. Additionally, the student shall take at least TWO electives per semester.

FIRST SEMESTER

FAMILY AND CHILD STUDIES OPTION			
COURSE CODE	**COURSE TITLE**	**CORE/ELECTIVE**	**CREDITS**
FCOS 300	Family & Consumer Sciences Internship	C	2
FCOS 301	Consumer Behaviour & Education	C	2
FCOS 303	Principles of Housing	C	2
FCOS 309	Dynamics of Family Relations	C	2
FCOS 311	Parenting	C	2
FCOS 313	Home Furnishings	C	2
UGRC 220	Introduction to African Studies	C	3
	Select ANY one elective	E	3
	TOTAL		**18**

SECOND SEMESTER

FAMILY & CHILD STUDIES OPTION			
COURSE CODE	**COURSE TITLE**	**CORE/ELECTIVE**	**CREDITS**
FCOS 304	Family Resource Management	C	2
FCOS 306	Research Methods	C	3
FCOS 308	Housing the Family	C	2
FCOS 314	Personal and Family Finance	C	2
FCOS 316	Curriculum Planning for the Young Child	C	3
FCOS 326	Child Studies Laboratory Experience	C	2
	Select ANY 2 or 3 other electives	E	6
	TOTAL		**20**

LEVEL 400 COURSES

The student shall be required to take all the Departmental required courses. Students may also take some elective courses. Level 400 students are expected to report to the School 4 weeks before the commencement of the first semester to begin their research project.

FIRST SEMESTER

FAMILY AND CHILD STUDIES OPTION			
COURSE CODE	**COURSE TITLE**	**CORE/ELECTIVE**	**CREDITS**
FCOS 400	Research Project	C	3
FCOS 401	Life Cycle Nutrition & Meal Management	C	3
FCOS 405	Extension Theory	C	2
FCOS 407	Management of Household Tools & Appliances	C	3
AGRC 401	Entrepreneurial Skills	C	3
	Select 2 electives FCOS 411 & FCOS 415*	E	4
	TOTAL		**18**

**FCOS 411= Garment and Accessories Technology(2 credits, FCOS 415 =Management of Food Service Systems(2 credits)*

SECOND SEMESTER

FAMILY & CHILD STUDIES OPTION			
COURSE CODE	**COURSE TITLE**	**CORE/ELECTIVE**	**CREDITS**
FCOS 400	Research Project	C	3
FCOS 406	Extension Practical	C	1
FCOS 408	Family Resource Management Practicum	C	3
FCOS 412	Policy perspectives in Child Studies	C	2
FCOS 416	Special Topics in Family Resource Management	C	2
FCOS 418	Marriage, Family and Intimate Relationships	C	3
	Select 2 electives from FCOS 402,FCOS 404,FCOS 414,FCOS 422 & FCOS 424*	E	4
	TOTAL	-	**18**

**FCOS 402 =Textiles & Apparel Policies(2 credits), FCOS 404 =Current Issues in Foods and Nutrition(2 credits)*
FCOS 414= Textiles & Clothing Maintenance(2 credits), FCOS 422=Food Product Development(2 credits)

FCOS 424=Fashion Production Internship (2 credits)

COURSE DESCRIPTIONS

FCOS 101 Introduction to Foods and Nutrition

Fundamental knowledge of food preparation methods, cookery terms and basic measuring techniques; Introduction to kitchen and laboratory appliances and their uses. Safety measures in the laboratory and kitchen; basic cooking methods, modes of heat transfer, the food groups and their functions in the body: Recommended dietary allowance and planning daily meals.

FCOS 102 Scope & Philosophy of Family & Consumer Sciences

Philosophy, scope and historical developments of Home Science (Now Family and Consumer Sciences); examination of basic human needs; the impact of local and global issues on the needs; overview of programme approaches in Family and Consumer Sciences which help to meet the needs for good quality of life for the family - the focus of the Family and Consumer Sciences programme; objectives for the establishment of Family and Consumer Sciences programmes and Associations/ Organisations; historical development of names of the discipline and core subjects; the need for the Social and Natural Sciences, Humanities and Fine Arts Subjects; socio- economic and cultural issues on family food security; clothing, housing, education, health needs and maintenance culture; career opportunities.

FCOS 103 Introduction to Textile Fibres & Fabrics

Production, classification, physical and chemical properties of fibres; subjective and objective methods of fibre identification; fibre morphology and its effect on fibre properties; yarn type and structure; methods of fabric construction; fabric type/names, fabric finishes; the effect of fibre properties, yarn and fabric structure and fabric finishes on performance; the selection, use and maintenance of fabrics based on specific end uses; the impact of textile production, use and disposal on the environment. At the end of the course each student will produce a scrap book of different fabrics.

FCOS 104 Introduction to Family Resource Management

Fundamental knowledge in Family Resource Management and overview of the family, its types, stages of the family life cycle and managerial functions of families; Meaning, scope and significance of management and its application in the home; Analogies between management in the home and management in other establishments; Introduction to basic concepts such as values, goals, standards, needs and wants; Identification of family resources, classification, characteristics and the role resources play in management.

FCOS 201 Child & Adolescent Development

Physical, intellectual and socio-emotional development of children; progression of pregnancy and prenatal development, birth and the newborn, types of growth and development, stages of growth and development, needs of children and adolescents, factors influencing the behavior of children, health and safety of children, the effects of technology on child development, and careers related to the area of child development.

FCOS 202 Introduction to Fashion Design

Concepts and practices for garment production, Selection, use, care and storage of tools and equipment used in apparel production; Body measurements/ reference points with their names and symbols; Figure types; Basic stitches, methods of obtaining patterns, pattern markings, processes in garment construction - seams, edge finishes, pockets, collars, sleeves and closures. At the end of the course students will produce a clothing item.

FCOS 203 Task Performance Management

The purpose of simplifying home related-work. Application of principles of body mechanics relating to the work place, work methods, time and motion. Disabilities and home-related work life; Housing and Maslow's notion of human needs.

FCOS 204 Adult Development

Fundamental concepts and empirical research on the development and changes in perception, cognition, emotion, and social functioning over the adult lifespan; Analysis of change from early adulthood through death in the areas of social, cognitive, and physical development; examination of theories, concepts, and research in the area of lifespan development; study of the problems of aging, plasticity of functioning, and ingredients of successful aging.

FCOS 206 Principles of Foods

Basic composition of foods, their physical and chemical properties and their relationship to food preparation; Fruits and Vegetables, Carbohydrate structural constituents, Pigments, Flavours, Changes during cookery; Milk and Milk Products, Components, Processing, Cookery; Fats and Oils, Glycerol and Fatty acids, Structures of fats in foods, Functional roles of fat, Food applications; Eggs, Formation and Structure, Composition, Quality and Safety, Functional properties; Meat, Fish and Poultry, Classification, Structure, Pigments, Factors affecting quality, Identification of Meat Cuts, Meat cookery techniques; Structure and Functional properties of starch, Food applications; Flour and Flour products, Types; Roles of Ingredients, Baking Applications.

FCOS 208 Human Physiology

Composition of blood: Anaemia; blood groups; homeostasis and blood coagulation; conditions that cause excessive bleeding; functions of blood; structure of the heart. Cardiac cycle; Circulatory systems; factors that affects heart rate. Structural organization of the respiratory system; mechanisms of inspiration and expiration; Types of breathings; pulmonary volumes and capacities; transport of oxygen and carbon dioxide; factors that affect respiratory rate; regulation of respiration. Hypoxia and respiratory disorders. Structural organization of the urinary system; the nephron; formation of urine filtration, reabsorption and secretion; Regulation acids-base balance; Effect of kidney malfunction on the body. Basic structure of the digestive system; secretions, functions and regulation of saliva, gastric juice, pancreatic juice, intestinal juice and bile; movements of the small and large intestine; Digestion and absorption of carbohydrates, fats and proteins; Peptic ulcer. Physiologic anatomy of the male reproductive organs; Ogenesis; endocrine functions of the ovaries; the female sexual cycle. Pituitary gland and its hormones; the thyroid gland and its hormones; Hypothyroidism and Hyperthyroidism; Regulation of blood calcium level; Hormones of the adrenal glands; Hyperadrenalism and Hypoadrenalism; Pancreatic hormones; regulations of blood glucose level.

FCOS 212 Concepts of Family Resource Management

Family Resource Management unlocks the complexity of family decision making; the concepts and the underlying explanations of family behaviors: Understanding of the major management principles and frameworks with emphasis on the managerial processes: decision making; goal setting; maintaining standards and developing values as the cornerstone of a healthy family and society; importance of home management; the management process; motivating factors in management.

FCOS 214 Foundations of Early Childhood Education
Historical and philosophical foundations of Early Childhood Education; Major contributions of renowned theorists and theories to the development of early childhood education; Relevance of early education to the growth of the individual; History of early childhood education in Ghana, the current status, the early childhood care and development policy and the functions of the various stakeholders in the implementation of the policy; Different types and methods of early childhood care in Ghana; Future trends in these fields; Practical exposure of students to early childhood care and education in the child development center.

FCOS 300 Family & Consumer Sciences Internship
A six to eight week intensive practical training in a related field of Family & Consumer Sciences: This takes place at the end of the second semester of level 200.

FCOS 301 Consumer Behaviour & Education
Examination of the market place arrangements, Consumer choices; Consumer protection and action groups; problems of consumer products and services in Ghana; levels of consumer behaviour, understanding the consumer, consumer rights and responsibilities, Role of advertisements.

FCOS 302 Food Hygiene and Safety
Introduction of food hygiene, food spoilage and problems of food poisoning; and the basic principles of food preservation; Physical and chemical processes that control changes in foods during ageing, the role of microorganisms in food spoilage and the consequences on eating unwholesome food; Application of both traditional and modern methods of food storage and preservation; Factors affecting the quality and wholesomeness of food, Principles of food hygiene practices; Sanitary measures in handling and storing food at home and in the market; Chemical Spoilage as a results of enzyme activities, Microbial Spoilage due to molds, yeast and bacteria; Bacterial Food Poisoning and/or infection e.g botulism, salmonellosis, staphylococcal infection, etc. and other types of food poisoning.

FCOS 303 Principles of Housing
The right to housing for all; Concepts of the family and housing, the household and human need in relation to shelter; Issues related to housing, socio-cultural and environmental; The housing quality, needs and provision; the provision of utilities and infrastructure; the housing conditions in Ghana today, housing designs, settlements, neighborhood and the community, components of sound buildings, modern housing in Ghana, acquiring a house and landscaping.

FCOS 304 Family Resource Management
Overview of Family Resource Management, Components; the family system; the family in Ghana; the family as an ecosystem; purpose of Family Resource Management; Acquisition of managerial skills; The management of some specific resources such as time, energy, stress and money (as a material resource) and contribution to satisfactory family living. Communication as a significant family resource; Barriers in communication; The family as an ecosystem.

FCOS 305 Textile Design
Dyes and pigments, with emphasis on vat and direct dyes; application of the elements and principles of design to textile design; basic principles of dyeing and printing techniques; factors affecting the application of dyes and pigments to fabrics; fabric problems related to colour, the maintenance of dyed and printed textile fabrics; the production of dyed fabrics - batik, tie & dye

and also printed fabrics using block and silk screen printing, the effect of dyeing and printing on the environment.

FCOS 306 Research Methods

Basic principles of research in studying the family; the home environment, and the utilization of resources; Problem identification, data gathering techniques including the use of questionnaire, interviews, and observation; Statistical analysis and presentation of results and report writing. Students are required to carry out their own investigation on a special problem in any of the fields of Family and Consumer Sciences during the long vacation and present a written and oral report during the final year.

FCOS 307 Basic Nutrition

Nutrients, their food sources, digestion, absorption, utilization, storage and functions in the body; Nutritional deficiency disorders; Classification and chemical composition of carbohydrates, Digestion, absorption, utilization and storage, Functions in the body and in the diet and Food sources; Classification and chemical composition of lipids, Digestion, Absorption, Utilization and Storage, Functions in the body and in the diet and Food sources; Chemical composition, Digestion, absorption, utilization and storage of proteins, Functions in the body, Protein quality determination and Food Sources; Protein-Energy Malnutrition; Energy value of Foods, the body's need for energy, Factors affecting energy needs, Mechanisms for controlling energy balance, Obesity and Under Weight; Classification, Functions, deficiency signs and symptoms, and Food sources of Mineral Elements; Classification of vitamins, Functions, deficiency signs and Food sources; Water - Distribution in the body, the body's source and requirements, Functions in the body, maintenance of body fluid.

FCOS 308 Housing the Family

Housing in relation to settlements and the housing units as a basis to understanding the settlement; Technical skills in assessing architectural drawings; design considerations for the climatic zones of Ghana; Essential parts of a building; human issues and housing, residential and community life, assessing housing quality and needs, traditional housing and the two basic housing typologies in contemporary Ghana - the compound and self-contained houses. Principles of kitchen design and interior design in relation the importance of the outdoor space and landscaping.

FCOS 309 Dynamics of Family Relations

Introduction to the Family as a social institution. The relationship between family members, outsiders and the community will be emphasized. Diversity of Family Relations and how these affect the individual. Understanding what the family is, its impact, relevance and contributions to individual's personality development.

FCOS 311 Parenting

Exploring the concepts of parenting and the skills needed for effective parental role; essential policy and professional issues in culturally divergent family settings; parenting children with special needs in areas of physical, mental, social and educational functioning, utilization of community and technological advances for the provision of parental support.

FCOS 312 Nutritional Assessment Methods

Nutritional assessment systems; anthropometric assessment such as measurement of body size, growth indices, body mass in children, adolescents and adults, measurement of body composition, interpretation and evaluation of anthropometric data, measurement errors; dietary assessment methods including quantitative and qualitative methods, measurement errors and evaluation of

nutrient intake data; biochemical assessments including both functional tests and static tests; and clinical assessment methods including physical examination and its limitations, classification and interpretation of physical signs, functional assessment.

FCOS 314 Personal and Family Finance
Understanding the strategic role of money in the daily financial decisions of individuals and families. Relationship of: Attitudes about money to economic success; economic conditions to income and its use; life stage to earning potential; plan of action formulation for family financial management.

FCOS 315 Textiles and Apparel Product Development
Study of knitting machines, looms and their accessories for textiles and apparel production: emphasis will be on locally produced looms; history of the production of strip - woven textiles in West Africa with special reference to those locally produced; The production of fabrics, garments and household articles on the broad loom and knitting machine; braiding, crocheting and knotting.

FCOS 316 Curriculum Planning for the Young Child
In-depth knowledge of Early Childhood Education Curriculum; Factors that contribute to effective learning with reference to young children; Organization of curriculum including but not limited to units on science, mathematics, art literature and all the necessary inputs in an Early Childhood Curriculum. Students demonstrate their knowledge through inquiry, critical analysis, and synthesis of the subject. At the end of the course, they should be able to effectively plan school-based instruction, activities or curriculum for roles as early childhood educators. Students' knowledge, skills, and dispositions are applied effectively in practice activities in the Child Study Center. Students should also be able to work with children, families, and communities in ways that reflect the dispositions expected of professional childhood educators.

FCOS 317 Evolution of Fashion
Historical developments of costume and accessories of past periods; historical dress forms of the Egyptians, Greeks and Romans; evolution of various garment forms from the fifteenth to the 21st century. The course will also draw parallels and diverse details between the past and present fashions and develop ideas and designs for today's fashion.

FCOS 318 Sensory Evaluation of Food Products
Physiological bases of sensory evaluation - olfactory receptors, taste receptors, visual, etc; Sensory characteristics of food - appearance, aroma, flavour, texture, etc; Sensory Panels, Recruitment, Orientation, Screening, Training, Monitoring, Motivation; Environment for Sensory Evaluation; Sample Preparation and Presentation; Types of Tests, Preference and Acceptability; Errors in Sensory Testing; Designing Scorecards; Planning a sensory experiment.

FCOS 319 Meal Service and Table Etiquette
Knowledge and practice of meal service at both family and institutional level; Formal and informal meal service, table setting and table arrangement, the proper use of cutlery and glassware; and waiting on table; Table etiquette or rules of table courtesy.

FCOS 322 Family Food Security
Overview of the world and national food situations; Various definitions of food security; The components of food security at national and household levels; Institutional, economic, social, infrastructural and environmental constraints to achieving family or household food security; The contributions of food security to health of individuals.

FCOS 324 Food Habits
Foundations of human food habits or dietary pattern; the influences of the various factors on food choices and eating patterns; and reasons underlying food likes and dislikes; Cross cultural meal patterns and the influence of food habits on nutritional wellbeing of people; The changing trends in food habits in contemporary society (Ghana in particular), their influences on individuals and family health, impact on national economy; Relevance of food habit knowledge in planning successful nutrition intervention programmes.

FCOS 326 Home Furnishings
The evolution of the furniture industry, from its conception to the present; selection, use and maintenance of materials for furniture, floor, ceiling, window, table and bed coverings; floral arrangement; functions of items used for home furnishings; application of the elements and principles of design to practical furnishing techniques and the manufacture of items used for home furnishing.

FCOS 400 Research Project
Creative review of literature and investigation on a special problem in any of the field of Consumer Sciences, condition of oral examination on the problem studied during scheduled seminar periods and the submission of a typed written report a week before the second semester examinations begin.

FCOS 401 Life Cycle Nutrition and Meal Management
Nutritional requirements and food needs of individuals at varying physiological stages in the life cycle (infancy throughout the ageing years); Meal management goals and techniques of planning balanced diets to meet the food and nutritional needs of different individuals are taught. The student has opportunity to put theory into practice in the diet laboratory by applying meal management principles to plan and serve appetizing, sufficient and affordable meals for all family members using local food items. The use of underutilized nutrient-dense local foods is emphasized. The student is taught how to analyze nutritional compositions of meals and how to evaluate the nutritional adequacy of diets and organoleptic qualities of meals.

FCOS 402 Textiles & Apparel Policies
The course will cover policies related the production, local and international fibre, fabric and apparel standards, exports and import of textiles fibres, fabrics, garment and related articles. The topics will include policies on ethics of labor and production, African Growth and Opportunity Act (AGOA), global sourcing, environmental laws and regulations; competitive advantage of nations and social responsibilities expected of textiles and apparel firms.

FCOS 403 Apparel Design and Production
The course focuses on concepts and practices for the production of clothing items; design analysis, dart manipulation and adaptation, development of basic blocks, flat pattern making, sizing and grading of patterns, application of garment construction process to produce a garment for personal or family use. An intensive study of principles and processes of flat pattern making and free-hand cutting. Development of basic blocks, pattern alterations, design analysis, dart manipulations, adaptation, grading and sizing to make patterns for Children, Teenage, Women, Men and Physically-challenged clothing.

FCOS 404 Current Issues in Foods and Nutrition
Food and nutritional problems in Ghana; nutrition education as a major solution to nutritional problems (emphasis on principles of nutrition education); government and non-governmental

programmes aimed at solving food and nutritional problems in Ghana. The student is given the opportunity to select one or two organizations and study in detail with regards to aims, specific objectives and target groups, programme activities, expected outcome, and future plans. Food legislation and Consumer protection in Ghana are also covered.

FCOS 405 Extension Theory

Principles of learning and teaching, setting objectives and working with adults. Programme planning and development based on identified needs at home or family level. Communication techniques, motivation and use of demonstrations, group dynamics, mass-media and simple audio-visual. Selection and use of local leaders and use of methods of programme evaluation.

FCOS 406 Extension Practical

A practical course which involves a field trip. Students apply the principles and techniques studied in FCOS 405. Members in the selected communities are introduced to Child Nutrition Education, Family Planning, Parenting Education, Sex Education and Teenage Pregnancy, Sanitation Improvement, Money Management, Pastry Making, Tie/Dye/ Batik Making, Clothing Care and Maintenance and Consumer Education.

FCOS 407 Management of Household Tools & Appliances.

Principles and factors that influence the selection of equipment and tools for the home and dynamisms of technology in the home. Practical exposure to different types of equipment, tools and appliances used in the home emphasizing those likely to be found in urban and rural Ghanaian homes; consumer concerns relating to household equipment; classification of household equipment; Selection, use and care of equipment in the Home relating to source of energy available.

FCOS 408 Family Resource Management Practicum

A residential course during the final year when students move from their usual residences on or off campus to live in groups at the Family Resource Management Center "FIDUA" at the University of Ghana, Legon for a specific period to stimulate living. Students put into practice all theories learnt in previous courses in Family and Consumer Science. The course works towards skills development and enhancement. This practicum is also to prepare students for the roles, responsibilities and relationships essential to functional families and to understand the nature, function and significance of human relationships within the individual/family units.

FCOS 411 Garments and Accessories Technology

The course will examine the development of patterns for men and women's bespoke tailored suits; construction techniques including lining, interfacing, padding, bound pockets and button holes, welt pockets and pressing; different materials and fabrics used for fashion accessories. The design, production and care of accessories with emphasis on millinery, belts, bags, shoes and neck wear will also be handled.

FCOS 412 Policy Perspectives in Child Studies

Analysis of issues, contexts and variables related to children- how these factors impact on families and childcare professionals; examination and discussion of children's rights, global and national perspectives of these issues and barriers to the realization of these ideals. Advocacy issues and how they relate to public policy decision making of children and their families.

FCOS 413 Child Study Laboratory Experience
Laboratory experience at the Child Study Center which includes observing and recording the growth and behaviour of toddlers and preschool children and working in the classroom with children; understanding principles and techniques for assessing, planning and working with young children through direct experience.

FCOS 414 Textiles and Clothing Maintenance.
Historical development of soaps and detergents (surfactants); structure, properties, categories and functions of surfactants, dry cleaning agents, builders, stain/spot removers; types of dirt/soil, detergency, effect of water hardness, temperature, pH and agitation on detergency and soil removal; types of washing machines, rules governing the care of clothing; commercial and home laundering procedures, laundry mishaps; care labeling and labeling symbols; ironing/pressing equipments; storage and repair of clothing; preparation of soap.

FCOS 415 Management of Food Service Systems
The course aims at enabling the student to have a comprehensive appraisal of all elements involved in good management of food service systems. Areas to be covered will include food service systems and their development; food service organization and management - This will include discussions on Theories of organization; Types of organizations; Functions of management, Tools of management, Scheduling of employees, and Work improvement; Personnel Management - The employment process involving recruitment and Selection; the worker on the job with emphasis on orientation, training, work standard and productivity, performance, promotion and transfer, routine supervision and decision- making; Cost Control - Factors affecting cost control such as Food costs, Labour costs, Operating and other expenses, Records for control including Procurement and receiving records, Storage and storeroom, control, Production and services, Dining room records, Cash transaction, Operating and maintenance, and Personnel cost control records; Reports as a Management Tool including Budget planning, Financial reports, and Annual reports.

FCOS 416 Special Topics In Family Resource Management
The course will examine how gender studies and social class shape the experience of family life in contemporary African Countries. This multi-disciplinary course introduces a broad range of concepts and issues related to contemporary women, men, young people, reproductive health and rights and health communication in African Families. The course incorporates foci on reproductive health (including Adolescents Reproductive Health and rights), Gender Based Violence (with attention to historical responses and prevention efforts, and HIV/AIDS (including global inequities in risk, incidence and treatment).

FCOS 418 Marriage, Family and Intimate Relationships
Topics include romantic love, meaning of marriage, qualities of a successful marriage, sexual patterns, courting and dating, love and mate selection, intimate relationships, happiness and tension and conflict in relationships, separations, divorces, widowhood, remarriages, family systems in other cultures, family system in Ghana, minority family patterns, current changes, and prospects for the future. Presents sociological descriptions and explanations of these topics and also guides students into ways of coping better in their own relationships

FCOS 422 Food Product Development
Designing new products from a market perspective; Driving forces in the market place; Consumer Research; Methods of Idea development and management, Product development sequence; Engineering role in a typical food process; Food packaging industry, Safety and Regulatory

Aspects; Agencies responsible for food safety, HACCP system, Nutrition promotion; Standardizing recipes.

FCOS 424 Fashion Production Internship
A semester of intensive practical training in fashion design or accessories under the tutelage of an experienced fashion designer; acquisition of hands on skills in a commercial environment to be able to link classroom experiences to commercial production of apparel design and accessories. Students will choose commercial Production units where a) the designer uses paper pattern/ freehand-cutting method for garment production or b) specializes in the making of accessories, for their internship. At the end of the programme, students will present either i) three (3) different tailored garments or ii) three (3) accessories (two hats and a neck-tie) for grading. In addition, each student will hand in a detailed report on activities covered. There will be occasional supervision by lecturer in charge of the course.

SCHOOL OF VETERINARY MEDICINE

DOCTOR OF VETERINARY MEDICINE (DVM) PROGRAMME

INTRODUCTION
The goal of the School of Veterinary Medicine is to train and equip veterinary professionals to manage, control and prevent diseases of food and companion animals, wildlife and fish and to prevent and control diseases which are transmissible from animals to humans.

A wide range of courses in Basic Sciences, Animal Science, Biomedical and Clinical Sciences are included in the curriculum to ensure a good knowledge base and skills required for a graduating veterinarian.

A student shall be required to pass all subjects. A student who fails to obtain a pass mark (50%) in any subject shall be eligible for a Re-sit Examination. A student who fails the re-sit shall be requested to repeat the year and the course. A student can proceed to the next stage of the programme only if he/she has passed all the courses of the preceding year. To satisfy requirements for graduation a student must have accumulated a total of 263 credits.

COURSE STRUCTURE
The 6-year Doctor of Veterinary Medicine (DVM) programme consists of three phases:

The Pre-professional phase (Level 100) which shall be used to upgrade the level of science of WASSCE candidates.

Each Semester (1 & 2) shall consist of 16 weeks as follows:

13 weeks of Teaching
1 week of Revision
2 weeks of Examinations

The professional phase of the curriculum (Level 200 – 600, or DVM I – DVM V) shall consist of :

i. Basic Veterinary Sciences (Semesters 3&4)

ii. Para-Clinical Veterinary Sciences (Semesters 5,6, 7 &8)
iii. Clinical Veterinary Medical Sciences (Semesters 9, 10, 11 & 12)

Each Semester of the professional phase shall consist of 18 weeks as follows :

15 weeks of Teaching
2 weeks of Revision
1 week of Examinations

SCHOOL OF VETERINARY MEDICINE
DOCTOR OF VETERINARY MEDICINE (DVM) PROGRAMME

FACULTY

George K. Aning *DVM (Ibadan) Ph.D (Liverpool)*	-	Associate Professor (Acting Dean)
Bawa Awumbila *MVSc (Ukraine) Dr. Vet. Med (Giessen)*	-	Associate Professor
William B. Bosu *DVM, MSc (Guelph), Ph.D (Uppsala)*	-	Professor
Paul G. Mbuthia *BVM, MSc, Ph.D (Nairobi), FRCVS (Uppsala)*	-	Senior Lecturer
Hope R. Otsyina *DVM (ABU), M.Phil (KNUST)*	-	Lecturer
Ann N. Etsey *BSc, M.Phil (Ghana)*	-	Assistant Lecturer
Eistine Boateng *BSc, M.Phil (Ghana)*	-	Assistant Lecturer
Shelly A. M. Johnson *DVM (Havana), M.Phil (Ghana)*	-	Assistant Lecturer
Kofi Afakye *DVM (Ukraine), M.Phil (Ghana)*	-	Assistant Lecturer
Kwasi A.Bugyei *DVM (Ljubljana), Ph.D (Guelph)*	-	Part-Time Lecturer
Phyllis Addo *MVSc (Ukraine), Ph.D (Ghana)*	-	Part-Time Lecturer
Kwasi K. Addo *DVM, Ph.D (Kosice, Slovakia)*	-	Part-Time Lecturer
Augustine Ocloo *BSc (Ghana), Ph.D (Cambridge)*	-	Part-Time Lecturer
Gordon A. Awandare *BSc, M.Phil (Ghana), Ph.D (Pittsburg)*	-	Part-Time Lecturer
Patrick Arthur *BSc (Ghana), MSc, Ph.D (Gottingen)*	-	Part-Time Lecturer
Enoch B.M. Koney *BSc (Ghana), DVM (Saskatoon), Ph.D (Edinburgh)*	-	Part-Time Lecturer
Delphina A. Adabie-Gomez *BSc (KNUST), MSc, Ph.D (Ghana)*	-	Part-Time Lecturer
Charles K. Desbordes *BSc (Guelph), DVM (ABU), MSc (Ibadan)*	-	Part-Time Lecturer
Joseph A. Awuni *MVSc (Ukraine), MSc (Edinburgh)*	-	Part-Time Lecturer
K. M. Bosompem *BSc, Ph.D (Ghana)*	-	Part-Time Lecturer

Level 100 (Courses taken in the Faculty of Science and School of Agriculture)

Semester 1

Course code	Course Title	Core / Elective	Credits
UGRC 150	Critical Thinking and Practical Reasoning	C	3
VBAS 101	Introduction to Veterinary Medicine	C	1
ABCS 101	Introductory Animal Biology	C	3
CHEM 110	General Chemistry I	C	3
PHYS 101	Practical Physics	C	1
PHYS 143	Mechanics and Thermal Physics	C	3
MATHS 101	General Mathematics	C	3
	Total		17

Semester 2

Course code	Course Title	Core / Elective	Credits
UGRC 110	Academic Writing I	C	3
UGRC 130	Understanding Human Societies	C	3
BOTN 104	Growth of Flowering Plants	C	3
CHEM 112	General Chemistry II	C	3
CHEM 110	Practical Chemistry	C	1
PHYS 102	Practical Physics II	C	1
PHYS 144	Electricity and Magnetism	C	3
AGEC 102	Introduction to Economics	C	2
AGEX 102	Development Communication and Extension Methods	C	2
			21

PRE-CLINICAL YEAR (DVM 1) LEVEL 200

SEMESTER 1

COURSE CODE	COURSE TITLE	CORE/ELECTIVE	CREDITS
VBAS 201	Veterinary Gross Anatomy I	C	4
VBAS 203	Histology	C	4
VBAS 205	Veterinary Physiology I	C	3
BCMB 207	Veterinary Biochemistry I	C	2
ANIM 201	Introduction to Monogastric production	C	2
UGRC 210	Academic Writing II	C	3
	TOTAL		**18**

SEMESTER 2

COURSE CODE	COURSE TITLE	CORE/ELECTIVE	CREDITS
VBAS 202	Veterinary Gross Anatomy II	C	4
VBAS 204	Embryology	C	2
VBAS 206	Veterinary Physiology II	C	4
BCMB 208	Veterinary Biochemistry II	C	3
BCMB 212	Veterinary Biochemistry III	C	3
VBAS 208	Animal Management I	C	2
*VBAS 210	Field Practice I (Long Vacation)	C	6
	TOTAL		**24**

**Long Vacation Field Work (6weeks) in Animal Husbandry*

PARA-CLINICALYEAR (DVM II) LEVEL 300

SEMESTER 1

COURSE CODE	COURSE TITLE	CORE/ELECTIVE	CREDITS
VPCS 301	Veterinary Microbiology I(Bacteriology and Mycology)	C	3
VPCS 303	Veterinary Parasitology I(Helminthology and Acarology)	C	3
VPCS 305	General Pathology	C	3
VPCS 307	General and Autonomic Pharmacology	C	3
ANIM 301	Principles of Nutrition	C	3
VBAS 301	Animal Management II	C	3
UGRC 220	Introduction to African Studies	C	3
	TOTAL		**21**

SEMESTER 2

COURSE CODE	COURSE TITLE	CORE/ELECTIVE	CREDITS
VPCS 302	Veterinary Microbiology II (Virology and Immunology)	C	4
VPCS 304	Veterinary Parasitology II(Entomology and Protozoology)	C	4
VPCS 306	Systemic Pharmacology	C	4
ANIM 304	Introduction to Animal Breeding	C	3
*VPCS 308	Field Practice II (Long Vacation)	C	6
	TOTAL		**21**

*Long vacation field work in Diagnostic/Research Laboratories

CLINICAL PROGRAMME FOURTH YEAR (DVM III)

LEVEL 400

SEMESTER 1

COURSE CODE	COURSE TITLE	CORE/ELECTIVE	CREDITS
VCLS 401	General Medicine	C	3
VPCS 401	Systemic Pathology I	C	3
VPCS 403	Clinical Pathology	C	3
VBAS 401	Clinical Anatomy	C	3
VCLS 403	Anaesthesia and Intensive Care	C	2
VPCS 407	Computer Application in Vet. Practice	C	2
ANIM 405	Monogastric Animal Production	C	3
	TOTAL		**19**

SEMESTER 2

COURSE CODE	COURSE TITLE	CORE/ELECTIVE	CREDITS
VCLS 402	General Surgery	C	3
VPCS 402	Systemic Pathology I	C	3
VPCS 404	Vet Toxicology	C	1
VBAS 402	Biostatistics	C	3
ANIM 404	Ruminant Production	C	3
*VCLS 404	Field Practice III (Long Vacation)	C	6
	TOTAL		**19**

**Long vacation field work (6 weeks) in clinics*

CLINICAL PROGRAMME FIFTH YEAR (DVM IV)

LEVEL 500 SEMESTER 1

COURSE CODE	COURSE TITLE	CORE/ELECTIVE	CREDITS
VCLS 501	Avian Medicine and Pathology	C	4
VCLS 503	Porcine Medicine	C	2
VCLS 505	Small Animal Surgery	C	2
VCLS 507	Epizootiology and Disease Prevention	C	2
VCLS 509	Food (meat and milk) Hygiene and Inspection	C	2
VCLS 511	Medicine Clinics I	C	6
VCLS 513	Surgery Clinics I	C	3
VCLS 515	Wildlife and Aquatic Animal Medicine	C	3
	TOTAL		**24**

SEMESTER 2

COURSE CODE	COURSE TITLE	CORE/ELECTIVE	CREDITS
VCLS 502	Ruminant Medicine	C	3
VCLS 504	Small and Lab Animal Medicine	C	3
VCLS 506	Orthopaedic Surgery	C	2
VCLS 508	Surgical diseases	C	2
VCLS 510	Theriogenology	C	3
VCLS 512	Zoonosis and Environmental health	C	2
VCLS 514	Public Health Clinics I	C	3
VCLS 516	Theriogenology Clinics I	C	3
*VCLS 518	Field Practice IV (Long Vacation)	C	6
	TOTAL		**27**

**Long vacation field work (6 weeks) in Abattoirs and Livestock movement control posts*

CLINICAL PROGRAMME SIXTH YEAR (DVM V)

LEVEL 600 SEMESTER 1

COURSE CODE	COURSE TITLE	CORE/ELECTIVE	CREDITS
VCLS 601	Equine Medicine	C	2
VCLS 603	Vet Ethics, Jurisprudence of Extension	C	2
VCLS 605	Operative Surgery	C	2
VCLS 607	Obstetrics, Mastitis and Udder Management	C	2
VCLS 609	Medicine Clinics II	C	6
VCLS 611	Surgery Clinics II	C	6
VCLS 613	Theriogenology Clinics II	C	6
VPCS 601	Diagnostics Clinics	C	6
	TOTAL	C	**32**

SEMESTER 2

COURSE CODE	COURSE TITLE	CORE/ELECTIVE	CREDITS
VPCS 602	Veterinary Pharmacy	C	2
VCLS 602	Diagnostic Imaging	C	2
VCLS 604	Surgery Exercises	C	2
VCLS 606	Public Health Clinics	C	6
VBAS 602	Veterinary Economics and Business Management	C	2
#Code 620	Student Project	C	6
	TOTAL		**20**

#Research projects supervised by SVM faculty. Course abbreviation will be that of the Department Supervising the project work

DESCRIPTION OF COURSES

FIRST YEAR (PRELIMINARY YEAR OR LEVEL 100)

Course descriptions are the same as Level 100 of Faculty of Science and College of Agriculture and Consumer Sciences.

VBAS 101 Introductory Veterinary Medicine
Prospects and job opportunities in Vet practice;
Vet clinical practice with particular reference to Small Animal Practice;
Vet. Clinical services and Livestock and Poultry production.
The role and relevance of Vet. Public Health and Preventive Medicine to the practice of Vet. Medicine, The history of vet education – national and global.
Introduction to breeds of food and companion animals.
The role and relevance of the following disciplines in the Vet. Medicine Curriculum:
Vet. Anatomy, Vet. Physiology, Toxicology, Biochemistry, Pathology, Microbiology, Parasitology, Surgery, Reproduction and Medicine.

SECOND YEAR: DVM I (LEVEL 200) – PRE-CLINICAL COURSES

VBAS 201 Veterinary Gross Anatomy I
Introduction to Gross Anatomy. Basic concepts and techniques in gross anatomy. Comparative study of the functional anatomy of Musculo-skeletal, Integumentary, Respiratory, Cardiovascular, and Lymphatic systems of domestic animals (cattle, horse, sheep, goat, donkey, camel, pig, dog and cat) and birds.

VBAS 202 Veterinary Gross Anatomy II
Comparative study of the functional anatomy of the organs of the special senses, Nervous, Endocrine, Digestive, Reproductive, and Urinary systems of domestic animals and birds. Anatomy of fish.

VBAS 203 Histology
Introduction to the history and evolution of histology as an anatomical science; the central role of the microscope and microtome in histology. Structural organization of cells and distinguishing characteristics of the basic tissues: epithelium, connective tissue, muscular tissue and nervous tissue. The organization of tissues into organs and organ systems and their relationship to normal physiological and biochemical functions. Relationship to pathological changes in diseases and trauma of the organ systems. The Practical Histology Classes are aimed to equip students with skills to identify/distinguish microscopic sections of tissues as a prerequisite to examining the basic pathologic abnormalities that affect tissue and organ function.

VBAS 204 Embryology
General Embryology – prezygotic, immediate post – zygotic events; development of foetal membranes and establishment of body form. Systemic embryology – cardiovascular, central nervous, respiratory, digestive, urinary and genito-urinary systems development. Correlation of embryology with gross anatomy and histology.

VBAS 205 Veterinary Physiology I
Introduction to physiology. Cardiovascular physiology. Production, function and degradation of blood cells; body fluids, blood groupings and blood clotting. Heart action, blood pressure and

control of heart rate. Circulation of blood through the heart, lungs, brain, liver and kidney. Peripheral and lymphatic circulation. Iron metabolism. Respiratory physiology, mechanisms of breathing, gaseous diffusion, perfusion ratios. Respiratory stressors. Regulation of respiratory and buffers in blood. Avian Respiration. Neurophysiology; sensory physiology, nerve conduction, sensory organs, The Central Nervous System and Autonomic Nervous System. Pain in animals. Motor cortex, descending fibres. Reflexes.

Practical: Nerve: Basic morphology, excitation and conduction, resting membrane potential, latent period action potential, all–or-none law; strength-duration curve; biphasic action potential, ionic basis of excitation and conduction, compound action potential.

Muscle: Morphology, electrical characteristics, ionic distribution fluxes, neuromuscular transmission, contractile responses, energy sources and metabolism.

VBAS 206 Veterinary Physiology II

Comparative aspects of digestion: prehension and mastication, salivary secretion, deglutition, eructation; Digestion in the simple stomach, gastric secretion; contractile activity of the stomach, emesis. Digestion in the ruminant stomach, function of the epithelium, microbial digestion, volatile fatty acids, nitrogen conservation, Carbohydrate digestion; Absorption across rumen epithelium. Digestion in the small and large intestines.

Endocrinology, Neuro-endocrine control of blood glucose, digestion and defaecation.

Reproductive physiology. Steroid genesis, andrology, fertilization, implantation, ovarian cycles, pregnancy parturition, lactation, manipulation of reproduction. Comparative reproduction of the body. Exchange between intracellular and extracellular fluids. Alternative in fluid balances. Acid-based relationships to body fluids; kidney function. Acid-base regulation; Micturition; Thermoregulation. Tropical temperature adaptation.

BCMB 207 Veterinary Biochemistry I

Cell and Tissue: Their principal chemical constituents and main metabolic activities. The characteristics of, and differences between eukaryotes, prokaryotes and viruses. Compartmentalisation and control of cellular environment. Functional role of the main cellular components; nucleus, ribosomes, Golgi bodies, endoplasmic reticulum, mitochondria and lysosomes. Biochemical technique for investigating cell structure and function. **Chemistry & Function of Biological Compounds: Biomolecule***s:* - monomers; polymers; macromolecules; supramolecules. **Carbohydrates***:* - mono-, di-, oligo- and polysaccharides (structural and storage); stereoisomerism; mutarotation; reactions of carbohydrates. Other derivatives of monosaccharides. Glycol-congugates: carbohydrates, sorting of molecules into-subcellular compartments, diseases of sorting. **Lipids***:* - classification (fatty acids, triacylglycerols, phospholipids, sphingolipids, steroids, cholesterol, eicosanoids); simple lipoproteins; glycolipids (cell-cell recognition, receptors etc). **Proteins***:* - amino acids:- basic structure, classification, acid/base properties, essential & non-essential; peptides; protein structure- primary, secondary, tertiary and quaternary structures, classification and properties. Enzymes as proteins. **Nucleic Acids***:* - nitrogenous bases, nucleosides, nucleotides, cyclic nucleotides and nucleic acids DNA and RNAs (brief review of replication, transcription, and translation). **Other cellular molecules:** Porphyrins, Vitamins and co-enzymes alkaloids & inorganic ions.

BCMB 208 Veterinary Biochemistry II

Carbohydrates Metabolism: Digestion of carbohydrates, glycolysis and fate of pyruvate in different organisms; tricarboxylic acid (TCA) cycle; pentose phosphate pathway and fate of reduced coenzymes; catabolism of monosaccharides other than glucose; gluconeogenesis, Calvin Benson cycle, Cori cycle, glyoxylate cycle; glycogenesis and glycogenolysis; regulation of carbohydrate metabolism; Diseases of carbohydrate metabolism. Aerobic metabolism of pyruvate;

starvation and obesity. The coenzyme role of B vitamins. Changes in nutritional requirement and metabolic rate in injury and disease. **Lipids Metabolism:** Digestion of triacylglycerols; the different lipases (lipoprotein lipase, hormone-sensitive lipase); fate of glycerol; beta-oxidation of fatty acids; fate of products (acetyl and propionyl CoA, ketone bodies, reduced coenzymes); synthesis of fatty acids triacylglycerol, cholesterol; regulation of metabolism. **Protein Metabolism:** Digestion of proteins, transamination, deamination and decarboxylation of amino acids and the fate of ammonia (urea cycle) and carbon skeleton; metabolism of specific amino acids (aromatic and sulphur-containing amino acids); synthesis of amino acids; in-born errors of amino acid metabolism; regulation of metabolism. **Enzymes as biological catalyst:** Enzyme kinetics and concept of rate-determining step. Enzyme specificity and allosteric regulation. Mechanisms of enzyme action and examples. Coenzymes and vitamins. Drugs and their effect on enzymes.

BCMB 212 Veterinary Biochemistry III

Glycosylation of proteins. Fibrous structural proteins. Structure and biosynthesis of collagen and elastin, intra-cellular and extra-cellular medication of proteins after translation. The collagen gene; disturbances in collagen synthesis. Diversity of protein function related to their structure. The relationship between structure and function as exemplified by haemoglobin, myoglobin and collagen. Plasma proteins. Detail of immunoglobin structure. Classes of immnuglobin and their functions. Protein in normal disease situations. Defects in protein structure as basis of disease e. g. sickle cell anaemia. **Lipid and protein components**: Glycoprotein and the cell surface. Erythrocyte membrane as a model system. Blood cells: Haemopoiesis, sites of production, growth inducers, differentiation inducers. Red blood cells (erythrocytes) functions, morphology and membrane function, formation and destruction of haemoglobin. White blood cells (leucocytes) types and morphology, functions, platelet functions. Blood clotting: haemostasis blood coagulation, definitions and components, mechanism of blood coagulation, anti-clotting mechanisms, fibrinolysis and haemostasis. **Energetics:** Chemical energy and concepts of energy transfer within cells; "high energy" compounds as "high energy currency". Principles of energy abstraction. Energy source and utilization. Free energy and biochemical reactions (spontaneity, anabolic and catabolic reactions); metabolic reactions and ATP; energy of hydrolysis of ATP, ADP and phosphorylation products; ATP production (substrate level and oxidative phosphorylation, photophosphorylation, C_3, C_4); coupling reactions; uncoupling agents. Specific enzymes associated with inner and outer mitochondrial membranes, matrix and intermembrane space. Reverse electron transport, the concept of "high energy pool". Michell's chemiosmotic theory. Mitochondrial transport and inhibitors of mitochondrial function. **Interplay of tissues, pathways and hormones in energy metabolism**: Key regulatory enzymes: allosteric control of pyruvate carboxylase, phosphofructokinase, fructose 1,6-phosphate, pyruvate dehydrogenase. Effect of ATP, AMP, NADH, citrate, relevance of energy status to control. "Futile" cycles and function in thermogenesis and control sensitivity. Covalent modification: beta-adrenergic receptor and cascade processes.

ANIM 201 Animal Production

Origin, classification, global distribution. Adaptive physiology/Mechanism of adaptation, stress syndrome in swine. Anatomic and physiological characteristics, importance of swine to man. Breeds, Behaviour: maternal , social, investigatory, territorial, sexual, Anomalous behaviour; Growth and development in pigs. Nutrient requirements in life cycle; definition of technical terms. Origin and domestication of Poultry, Classification and world/global poultry distribution. Anatomy and physiological characteristics and adaptation of poultry to the tropics. Terminology in poultry. Importance of Chicken to Man. Factors affecting Poultry Production. Systems of production. Incubation and Hatchery management. Brooding of chicks. Management and rearing

of broilers and layers; Requirements/Standards for Poultry Feeds. Poultry Behaviour Record keeping.

VBAS 211 Animal Management 1

Introduction to livestock husbandry, species, breeds and distribution. Animal management in vet practices. Animal behaviour and restraint. Practical guide and demonstration on estimation of weight and age. Disbudding, hoof trimming, tagging and branding. Feeds and feeding. Grooming of companion animals.

THIRD YEAR: DVM II (LEVEL 300)

VPCS 301 Veterinary Microbiology I (Bacteriology and Mycology)

History of microbiology, General characteristics of bacteria, fungi, mycoplasma and rickesttsias; classification, structure and functions of cellular components; Pathogenesis of microbial disease. Bacteria of veterinary importance: Staphylococci. Streptococci, Neisseria, Bacillus, Lactobacillus, Corynebacterium, Erysepelotrix, Listeria, Bacillus, Clostridium, Escherichia, Shigella, Salmonella, Arizona, Proteus, Klebsiella, Brucella, Yersinia, Campylobacter, Vibrio, Actinobacillus, Haemophilus, Mycobacterium, Pseudomonas, Dermatophilus, Leptospira, Chlamydia, Mycoplasma, Rickettsia, Ehrlichia. Fungi of Veterinary Importance: Mucoraceae, Ascomycetes, Crytococcaceae, Fungi imperfecti. Mycotoxicosis in farm animals.

VPCS 302 Veterinary Microbiology II (Virology and Immunology)

Morphology and classification of viruses. Reproduction and growth characteristics of viruses. Methods of isolation, identification and purification of viruses. Strain variation and pathogenicity of viruses. Important RNA and DNA Viruses of animals, their pathogenicity and diseases they cause. Prions and Viroids.

Basic immunology – History and definitions, Innate immune systems, determinants: mechanical and physicochemical barriers, phagocytes, Natural Killer cells and soluble factors, complement. Adaptive immune system: fundamental features; Development of the immune system; Development and differences between. T and B lymphocytes; Antibody determination, principles of immunological testing, serological tests. Immunological diseases: Hypersensitivities, Immonodeficiencies, Auto-immune diseases.

VPCS 303 Veterinary Parasitology I (Helminthology and Acarology)

Definitions, classification and taxonomy of helminths and tick parasites of animals, Principles of diagnosis and control of parasitic disease. Nematodes of animals: Ascaris, Toxocara, Trichostrogyles, Strongyles, Spirurids, Filaria. Cestodes (Tapeworms): Taenia Moniezia, Echinococcus, Diphlylidium, Davainea etc. and Trematodes (Flatworms): Fasciola Schistosoma, Dicrocaelium. Their characteristics, life cycles, intermediate hosts, locations in the final hosts, economic importance and control.

Ticks of Veterinary importance; classification and identification; Hard Ticks: Amblyomma, Boophilus, Hyalomma, Ripicecaphalus, Haemophysalis; Soft – ticks: Argas, Ornithodoros, Otobius. Their biology and ecology, life cycles. Three – host, two-host and one-host ticks. Economic importance and control of ticks. Considerations in tick control: cost, availability of acaricides, safety, environmental contamination. Interference of enzootic stability.

VPCS 304 Veterinary Parasitology II (Entomology and Protozoology)

Introduction to the Insect orders: Nematoceran flies:Iceratopogonidae, Simulidae, Culicidae. Cyclorrhaphan flies: Tsetse, Stomoxys, Haematobia, Oestrus, Hypoderma, Gastrophilus and Musca. Their characteristics and identification, biology, ecology and life cycle and economic

importance. Mites of Veterinary importance: Psoroptes, Chorioptes, Otodectes, Sarcoptes, Notoedres. General characteristics, classification and identification, life cycle and economic importance. Lice and Fleas of animals – General features, life cycle and control.
Protozoology: General introduction to, and study of protozoan parasites of domestic animals and wildlife. Features and identification, life cycles, ovations, epidemiology, pathogenicity, clinical signs, diagnosis, treatment and control of protozoan diseases: trypanosomiasis, coccidiosis anaplasmosis, babesiosis, theleriosis, histomoniasis, trichomoniasis, avian malaria, etc.

VPCS 305 General Pathology
This course is concerned with the basic reactions of cells and tissues to injurious agents or stimuli and practical diagnostic procedures in gross and microscopic lesions. The theoretical part should cover a brief introduction to pathology, structural and functional aspects of the normal cell (cell membrane, the cytoplasm with its various inclusions and vesicles). This is followed by: (1) Cell injury and death of cells and tissues, necrosis and infarction, cellular infiltrations and degenerations mineral deposits and pigments (2) Disturbance of growth (3) Disturbance of circulation, (4) Inflammation and body reaction (5) Neoplasia (6) Disorders of the immune system.

VPCS 307 General and Autonomic Pharmacology
General principles: Introduction to pharmacology and its relation to physiology and biochemistry. Basic concepts; dose and drug dosage forms e.g. Injection, mixture, tablets. Routes of administration of drugs, factors guiding the choice of routes. Advantage and disadvantage of various routes. Pharmacokinetics-factors affecting absorption, distribution, biotransformation and excretion of drugs. Enzyme induction and inhibition and implications. General factors affecting drug action. Targets for drug action-concept of receptors and drug receptor theories, enzymes, ion channels, carrier systems, Receptor super families. Agonists, practical agonists and antagonists. Drug antagonism and types-competitive versus non competitive, physiological and chemical. Affinity, efficacy and potency defined. DR relationships (Log DR versus DR curves) and significance of slope and shape of DR curves.
Autonomic pharmacology: Somatic, efferent and ANS. Parasympathetic and sympathetic, Ganglionic transmission, blockers, Transmitter processing at the cholinergic synapse. Sites for drug action. Nomenclature for muscarinc receptors, agonists, antagonistic, effectors.
Adrenergic transmission. Adrenergic receptor classification. Pre-and post-functional sites for drug Uptake Metabolism and inhibitors.

VPCS 306 Systemic Pharmacology
Anti-inflammatory agents and antacids. Histamine: synthesis, storage and release: Types of histaminic receptors and antagonists. Role of histamine in inflammation and anaphylaxis agents classification and actions. Steroids and inflammation.
A study of chemotherapeutic agents including anti-microbial, anti-protozoal, anti-viral, anthelmintics, antiseptics, disinfectants and vitamins: General concepts, classes, modes of action, factors influencing their choice, resistance mechanisms, drug interactions.

Drugs acting on the digestive, renal, cardiovascular, endocrine, respiratory, reproductive and central nervous systems. Hypersensitivity.

ANIM 301 Principles of Animal Nutrition
Animal nutrition and its importance in modern agriculture; introduction to animal nutrition; feed composition and common methods of analysis for nutrients and feedstuffs; the gastrointestinal tract and nutrition; measurements of feed and nutrient utilization and requirements by farm animals.

ANIM 304 Introduction to Animal Breeding
Genes and gene action – nature and control of gene function and the phenotypic expression of genes; definitions, types and consequences of mutations and chromosome observations; detrimental and lethal genes in farm animals; concept of gene frequencies; variations in economic traits of farm animals – genetic, environmental and phenotypic variance, heritability and repeatability; definitions and measurements of inbreeding and relationships; introduction to the principles of selection – theory and practice.

VBAS 301 Animal Management II
A course on animal welfare, applied ethology, nomadism, animal housing and hatchery management, Management of farm wastes, Management of grasscutter and rabbits. Application of restraint techniques in animal handling. Animal judging for quality; care of suckling, food and companion animals. Application of modern techniques in domestic animals management; wildlife routine management and health. Routine farm operations. Adaptation of animals to harsh environments, stress and pain in animals. Animal transportation. Kennel and stable management.

VBAS 302 Field Practice II
A long vacation field practical of six weeks duration on livestock farms, hatcheries and diagnostic laboratories. Inspection visits shall be conducted to such places by lecturers from the Veterinary and Basic Sciences and Paraclinical Sciences Departments.

CLINICAL PROGRAMME

FOURTH YEAR: DVM III (LEVEL 400)

VCLS 401 General Medicine
Introduction to veterinary clinical examination: history taking, influence of environment on diseases, use of common diagnostic instruments; diagnostic methods used for the detection and differentiation of disease according to the systems, principles of treatment and prognosis. General systemic diseases affecting companion and farm animals.

VCLS 402 General Surgery
Concepts in surgery, instrumentation and suturing, theatre techniques; nature of surgical disease; the emergency case; patient assessment, principles of anesthesia, operative techniques; post-operative care; wound healing, complications in surgery; shock, fluid theory; cryo- and electro-surgery.

VPCS 401 Systemic Pathology I
Systemic or special pathology is the application of the basic changes that have been learnt in general pathology to the various body systems or various specific diseases.
The theoretical part of special pathology should cover pathological changes taking place in the various organ systems of the body (circulatory, haemopoietic, respiratory, digestive, reproductive, urinary, musculo-skeletal, and endocrine). The studies here should take note of non-infectious (teratogenic deficiencies, metabolic, traumatic, toxicological) and infectious diseases (bacterial, viral, mycoplasma, fungal and other parasitic diseases).
The practical aspects of special pathology will consist of collection of pathological samples of the systems studied from slaughter houses, examining the samples grossly and diagnosing the causes. Studies will also be taken through histopathology of diseases affecting the various organs systems.

VPCS 402 Systemic Pathology II
A study of the pathology of the nervous, haematopoietic, urinary and genital, system, Post-mortem diagnostic procedures.

VPCS 403 Clinical Pathology
A study on clinical haematology and biochemistry as well as exfoliative cytology. Blood volume and water balance; haemorrhage and blood restoration. Blood cells in diseases; Effects of ionizing radiations on blood. Clinical chemistry: cardiac, liver and kidney function tests. Clinical chemistry of some diseases in domestic animals; diarrhea, colic, diabetes, gastritis, pregnancy, parturition, congestive heart failure, etc.

VBAS 401 Clinical Anatomy
Topographic morphology of domestic animals with special reference to surgical and medical practice. A review of gross anatomy relevant to meat inspection, obstetrics and gynaecological problems in animals.

VCLS 403 Anaesthesia and Intensive Care
Anaesthesia principles and techniques in small and large animals; drugs and apparatus used in anesthetic management; anaesthetic accidents and emergencies, care of the unconscious animal, maintenance of circulation. Pulmonary hepatic and renal homeostasis in animals suffering from trauma and advanced diseases
before, during and after surgery.

VPCS 405 Veterinary Toxicology
General principles of toxicology. Toxicology of heavy metals, poisonous plants, toxins, nitrates, cyanides and environmental poison. Toxicological antidotes and clinical usages.

VPCS 407 Computer Application in Veterinary Practice
History of computers. Hardware components. Operating and application of software. Feature and uses of word processing packages; Introduction to spreadsheets; Introduction to Database. Database Management Systems and designing computer-based. Veterinary disease reporting system. Introduction to word processing. Date transmission. Introduction to basic programming. Input and Output statements. Other uses of computers in veterinary practice.

VBAS 402 Biostatistics
Veterinary recording and data types. Classification and tabulation of data; Descriptive and inferential statistics. Sampling methods; Variations, rates and rational means; median and mode. Normal and other distributions, standard deviations and variance. Chi-square and student T tests. Elements of vital statistics. Uses of statistics in veterinary practice and research work.

ANIM 403 Ruminant Production
Limitations to the small ruminant industry in Ghana and Government interventions to enhance the industry; reproductive wastage and factors that affect reproductive rates in small ruminants – little size, young mortality and lambing/kidding interval; management practices – flushing, mating, creep feeding, meaning, castration, dehorning, spraying and drenching. Year – round programming for a small ruminant enterprise; status of the dairy industry in Ghana; constraints to cattle milk and meat production in West Africa; factors affecting profitability of a dairy enterprise. Variations in normal lactation; factors affecting yield and composition of milk; dairy management; production systems in the tropics – extensive, semi-intensive and intensive.

ANIM 404 Monogastric Production
Avian biology and its important in management; hatchery set-up and management; processing and marketing of poultry; rearing of broiler breeder; management of various species of poultry; Housing and equipment for swine production; breeding and marking of swine; management of silts and sows during pregnancy and farrowing; requirements and management of suckling pigs; Health problems of swine. Record keeping in swine production.

VCLS 404 Field Practice III
A long vacation field practice of six weeks duration in clinics and abattoirs. Inspection visits shall be conducted to such places by the supervising departments.

FIFTH YEAR: DVM IV (LEVEL 500)

VCLS 501 Avian Medicine and Pathology
Systemic and special pathology of the avian species.
Description of the etiology (including predisposing factors), clinical signs, diagnosis and treatment of infectious and non-infections diseases of poultry, emphasizing tropical diseases. External and Internal parasites. Mycotoxicoses, Nutritional deficiencies and Miscellaneous diseases. Management-related disorders and behaviour disorders. Post mortem diagnostic procedures for avian species.

VCLS 503 Porcine Medicine
A course study on infectious, non-infectious, metabolic and nutritional diseases of pigs. Primary emphasis will be placed on the epidemiology, clinical signs, treatment and control of relevant disease of importance in the tropical environment.

VCLS 502 Ruminant Medicine
A course of study on infectious and non-infectious, including metabolic and nutritional diseases of small and large ruminants. Emphasis would be placed on epidemiology, clinical signs, diagnosis, treatment and control of specific diseases of importance in the tropics.

VCLS 504 Small and Laboratory Animal Medicine
Lectures and discussions on infectious, non-infectious metabolic and nutritional disease of cats and dogs, infectious and non-infectious diseases of laboratory animals including rabbits, rats, mice, etc. Emphasis will be placed on the epidemiology, clinical signs, diagnosis and treatment of diseases of importance in the tropics.

VCLS 505 Small Animal Surgery
Cosmetic, palliative, curative and operative procedures on the head, neck, thorax, abdomen and perineum of small animals.

VCLS 507 Epizootiology and Disease Prevention
History, scope and uses in veterinary practice. Descriptive, analytic and experimental phases; medical detection, ecological and mathematical approaches. Occurrence, frequencies and implications. Diseases in populations, Mass action against diseases: Chemoprophylaxis, chemotherapy, sero-prophylaxis, serotherapy. Immunization procedures, etc. Effects of climates on animal population.

VCLS 509 Food (meat and milk) Hygiene and Inspection

Principles of meat hygiene. Biological and chemical bases of meat hygiene, ante-mortem and post-mortem procedures. Description of various categories of slaughter policies. Basic construction and principles of a functional abattoir. Potable water supply; canning, freezing, smoking and other preservation methods. Water, meat and milk-borne diseases. Food microflora and spoilage; food poisoning. Control of vermin. Detection of drug residues in meat. Effluents and their disposal. Milk and milk products; Inspection and laboratory examination for milk quality.

VCLS 515 Wildlife and Aquatic Animals Medicine

Fish anatomy, physiology, microbiology, parasitology, pathology and medicine. Fish ecology and nutrition. Capture, restraint and handling of live-trapped animals. Wildlife pharmacology, Wildlife habitats, types, values and distribution of biotic communities. Care of zoo animals. Methods of sampling of wildlife species. Dynamics and characteristics of wildlife populations, social organization of game species. Diseases of wildlife species – primates, ungulates, hares, rodents, reptiles, birds, carnivores and amphibians. Introductory aquatic ecology, fisheries management and fish cultures, fishing gears and methods. Nutritional deficiencies, neoplastic, environmental parasitic, viral, bacterial diseases of fish. Wildlife surgery and theriogenology, Agriculture.

VCLS 506 Orthopaedic Surgery

Fractures and bone repair, orthopaedic examination of the patient, reduction and fixation of fractures; orthopaedic nursing; diagnosis and treatment of fractures of long bones, pelvis, spine and skull; diagnosis and treatment of lameness in horses, cattle, sheep and pigs; Management of infections, nutritional and neoplastic bones diseases; joint diseases.

VCLS 508 Surgical Diseases

Clinical features, investigative procedures, treatment options and prognosis of common surgical conditions in small and large animals; congenital anomalies, trauma, non-neoplastic lumps, neoplasia, obstructions, displacements, degenerations and fluid leakage.

VCLS 510 Theriogenology

Functions and clinical examination of female reproductive organs of large animals; puberty and sexual reproductive hormones and glands; oestrous cycle processes of copulation, fertilization and gestation; anomalies of foetal development (including genetic and acquired causes) Oogenesis disturbances of ovulation and nidation. Causes of infertility and sterility in female animals. Diseases influencing sexual functions. Udder health. Small Animal reproduction; pseudo pregnancy, different methods of pregnancy detection; contraception.

VCLS 512 Zoonoses and Environmental Health

Concepts, definitions and classifications of zoonoses. Studies on specific bacterial, viral, bedsonia, rickettsial, protozoan and fungal zoonoses with emphasis on prevention, early detection, control and eradication. Ecology, water sources and purification, waste disposal, public health significance of rodents, birds, flies and mosquitoes. Environmental pollution and control. Occupational health.

VCLS 511 Medicine Clinics I

Clinical and practical training of students with emphasis on the handling and examination of animals, including the introduction to patient care and hospital practices including the clinical exposures and management of disease outbreaks.

VCLS 513 Surgery Clinics I
A course covering the first and second semester in which hospital cases are used to instruct the student in diagnosis and management of surgical diseases of small and large animals.

VCLS 514 Public Health and Preventive Medicine Clinics I
Record keeping in veterinary clinics. Hospital practices, ethics and hospital administration. Clinics and practical training of students in handling of vaccines, vaccination techniques in cattle and other ruminants, poultry, dogs and cats. Diseases preventive measures in domestic animal species. Meat inspection practical zoonotic disease detection techniques.

VCLS 516 Theriogeneology Clinics I
Clinical training of students with emphasis on the handling of gaenecological cases, treatment of infertility in animals. Instrumentation, Microscopy, Pregnancy diagnosis.

VCLS 518 Field Practice IV
Field practice of six weeks duration in clinics and abattoir and livestock movement control posts. Inspection visits shall be conducted to such places by lectures and co-ordinators to assess student's participation.

SIXTH YEAR: DVM V (LEVEL 600)

VCLS 601 Equine Medicine
Infectious and non-infectious (including metabolic and nutritional) diseases of equidae with particular reference to horses used for polo and security patrols of mounted troops. Emphasis would be placed on the clinical signs, diagnosis, treatment and control of specific disease of economic importance in the tropics. The course highlights the problem-oriented approach in the management of equine disease and disorders.

VCLS 603 Vet. Ethics, Jurisprudence and Extension
Various legislation regulating veterinary practice, legal and professional responsibilities of veterinary surgeons in the control of animal movements, control of animal diseases, meat inspection, animal husbandry, wildlife and fish handling and management. Organization of Veterinary Services in Ghana. Concepts of veterinary and livestock production extension. Veterinary extension promotion and delivery. Rural sociology and rural health education. Ethics in Animal Experimentation.

VCLS 605 Operative Surgery
Indications; pre-operative care and details of procedures; Post-operative care; possible complications of model operations on small and large animals.

VCLS 607 Obstetrics, Mastitis and Udder Management
Anatomy of the pelvis and pelvic ligaments. Disease and accidents during gestation. Parturition and its disease; types of dystocia, causes and presentation; obstetrical procedures and post-operative complications; care of the newborn. Abnormal conditions of the placenta, uterus and vagina; types of mastitis, clinical signs, diagnosis and treatment. Management of the udder of dairy animals. Dairy farm analysis. Strategies for boosting milk production in the tropics.

VPCS 602 Veterinary Pharmacy
Principles of drug dependency; compounding and prescription. Common drug abbreviations. Apothecary and avoidupois weights, household equivalents of weights and measures. The

therapeutic strategies, choice of drugs, monitoring of therapeutic responses. Organization of pharmacy; inventory in a veterinary hospital. Formulation of veterinary drugs. Medicinal plants of veterinary importance.

VCLS 602 Diagnostic Imaging
Introduction, including history; production of x-rays; Radiation safety; X-ray film exposure and processing; radiographic interpretation; radiation therapy. Principles of ultrasound scanning; application of scanning in veterinary medicine. Echocardiography, Principles of Computed Tomography (CT Scan). The uses of diagnostic imaging techniques in pregnancy diagnosis and in reproductive disorders. Review of Clinical imaging cases.

VCLS 604 Surgical Exercises
Laboratory (practical) sessions on selected procedures designed to enable students develop basic technical skills in anaesthesia, theatre routines and selected soft tissue and orthopaedic procedures.

VCLS 609 Medicine Clinics II
This is a continuation of Medicine Clinics I.

VCLS 611 Surgery Clinics II
This is a continuation of the course Surgical Clinics I (500 Level)

VCLS 613 Theriogenology Clinics II
A course in which hospital cases are used to instruct students on diagnosis and management of obstetrical and gynaecological problems. Examination of the bull, ram, boar, dog, stallion for breeding soundness. Semen collection and processing in various species (including the use of electro-ejaculator and artificial vagina). Using clinical rectal palpation in males and females. Diagnosis of infertility and their causes. Use of Phantoms for treatment of dystocia.
The above syllabus and teaching methods is adequate to meet requirements of a Veterinary Professional (See Appendix I).

VCLS 606 Public Health Clinics II
Clinics and practicals in field epizootiological investigations in farms, ambulatory visits to farms to carry out deworming, vaccinations in all species; disease investigation and control. Disease reporting and surveillance techniques. Veterinary extension techniques. Pilot projects in veterinary extension; Control of zoonoses. Prevention of occupational hazards to veterinarians, butchers and animal product processors. Ambulatory clinical services.

VBAS 602 Vet. Economic/Business Management
Basic micro and macro-economic concepts. Cost of public health schemes. Demand and supply of veterinary services. Economics of livestock production. Economics of operating a Veterinary practice/hospital. Benefit – cost analysis. Business organization, administration and promotion. Veterinary business management. Introduction to Project appraisal and feasibility reports.

VCLS 620 Student Project
Introduction to the principles of research proposal design, research methods and scientific communication (oral presentation and preparation of dissertation). Students will be assigned a simple research topic in any area of research in veterinary science/medicine. Examination shall be by presentation of project report

FACULTY OF ENGINEERING SCIENCES

INTRODUCTION

The Faculty of Engineering Sciences has been running a four-year degree programme since its inception in 2004. The programme was structured to ensure that all students have the basic courses required for graduation in an engineering programme. These included four levels of mathematics each with a credit load of 4, General Physics, General Chemistry, Engineering Drawing, Basic Mechanics, Basic Electronics, Applied Electricity, Fluid Mechanics, Introduction to Information Technology. Departments also had courses required for students to graduate with a BSc degree in Engineering

The Faculty of Engineering Sciences has reviewed its programmes taking into consideration both the quality and conformance to accreditation requirements. There will be a total workload of 144 credits for Engineering programmes at the University of Ghana. This will be an average of 18 credits per semester.

The study programme for the Bachelor of Science in Engineering will comprise:

a. General University requirements
b. Faculty Requirements
c. Core Courses (Departmental requirements)
d. Prescribed Electives (defined by Departments)

General Graduation Requirements

To graduate with a Bachelor of Science Degree in Engineering, a student must satisfy all requirements of the University, the Faculty of Engineering, and the Department.

A. University Requirements

1. Students must take and pass all the following University required courses:

UGRC 110	Academic Writing I
UGRC 150	Critical Thinking and Practical Reasoning
UGRC 130	Understanding Human Societies
UGRC 220	Introduction to African Studies
FAEN 206	Technical Report Writing *(To replace University required course UGRC 210 Academic Writing II)*

B. Faculty Requirements

2. A student shall be deemed to have satisfied the requirements for graduation if he/she passes the following courses:

   FAEN 101 – Algebra
   FAEN 102 – Calculus I
   FAEN 201 – Calculus II
   FAEN 202 – Differential Equations

3. A student must have accumulated 144 credits and passed at least 120 credits.
4. He/she must not have failed more than 24 credits of core and prescribed electives, provided that the failed grades are not lower than "E"

C. Details of the Programme for each department are summarized below.

D. Departmental requirements for each Department follow course descriptions.

ADMINISTRATION

Richard J. Bani *BSc (Kumasi) MSc PhD (Cransfield)*	-	Dean
Joseph K. Osei *BA (Ghana) Post Grad. Dip (GIMPA)*	-	*Faculty Officer*

DEPARTMENT OF AGRICULTURAL ENGINEERING

OVERVIEW

The Agricultural Engineering Department looks at the role of engineering practices directly or indirectly in the production, distribution, and processing of agricultural products. The Department presently provides training, makes many cooperative research and extension services with other colleagues in the industry in areas of professional practice of Agricultural Engineering to meet the challenges of increasing the quantity and quality of food, feed and fibers of the country.

The areas of activities of the Department are grouped under the following headings:

- Power Systems Engineering
- Soil and Water Engineering
- Postharvest Engineering

The Department offers courses at both the undergraduate and graduate levels. The Department also teaches courses in the College of Agriculture and Consumer Sciences and provides other services required.

Academic Staff

Dr. Aliu A. Mahama *MSc. (Eng) PhD (Tech.Sc)(Tashkent)*MGhIE	-	Senior Lecturer (Head of Dept.)
Prof. Edward Baryeh *BSc. (Eng) (KNUST), MSc., PhD (Iowa State)* MGhIE	-	Professor (On contract)
Dr. Richard J. Bani *BSc (KNUST) MSc PhD (Cransfield)*	-	Assoc. Professor
Dr. Malcolm N. Josiah *BSc (Eng) (KNUST), Msc MPhil (Newcastle) PhD (Calif)* MGhIE	-	Senior Lecturer
Dr. S. Abenney-Mickson *BSc (Agric) (Ghana) MSc PhD (Okaygma)*	-	Senior Lecturer
Dr. Eric K. Kra *BSc (Agric) (Ghana) MSc (Brit Col) PhD (Utah State)* MGhIE	-	Senior Lecturer
Dr. Edward B. Sabi *BSc (Eng) (KNUST) MSc PhD (Gifu)* MGhIE	-	Lecturer
Mrs. Peace K. Amoatey *BSc (Eng) (KNUST) MSc (Karlshure)* MGhIE	-	Lecturer
Mr Seidu Mahama *BSc (Civil Eng,) MSc (M.Eng)*	-	Part-Time Lecturer
Mr. E. Kuatsinu *BSc (Eng) (KNUST) MSc(Wageningen)*	-	Part-Time Lecturer
Mr. J. Y. Amoah *BSc (Eng) (Pakistan) MSc., (Wageningen)* MGhIE	-	Part-Time Lecturer

Mr. A. K. Ussher - Part-Time Lecturer
BSc. (Ghana) MSc (Melbourne)
Mrs. J. Aseidu-Dartey - Part-Time Lecturer
BSc (Eng) (KNUST) MSc Geodetic Eng)

SUMMARY OF COURSES

Level 100 courses – Semester 1

Course code	Course Title	Core/ Electives	Total (Credits)
FAEN 101	Algebra	C	4
FAEN 103	Basic Mechanics I	C	3
FAEN 107	General Chemistry	C	3
FAEN 109	General Physics	C	3
AREN 101	Engineering Graphics	C	3
UGRC 110	Academic Writing I	C	3
	Total		**19**

Level 100 courses – Semester 2

Course code	Course Title	Core/ Electives	Total (Credits)
FAEN 102	Calculus I	C	4
FAEN 104	Basic Mechanics II	C	2
FAEN 106	Applied Electricity	C	3
FAEN 108	Basic Electronics	C	3
AREN 102	Engineering Drawing	C	2
AREN 104	Internship (Industrial Practice I)	E	1
UGRC150	Critical Thinking ,and Practical Reasoning	C	3
	Total		**18**

Level 200 courses – Semester 1

Course code	Course title	Core/ Electives	Total (Credits)
FAEN 201	Calculus II	C	4
FAEN 203	Strength of Materials	C	3
FAEN 205	Thermodynamics	C	3
AREN 201	Engineering Surveying	C	3
AREN 203	Introduction to Crop Production	C	3
UGRC130	Understanding Human Societies	C	3
	Total		**16**

Level 200 courses – Semester 2

Course code	Course title	Core/ Electives	Total (Credits)
FAEN 202	Differential Equations	C	4
FAEN 204	Fluid Mechanics	C	3
FAEN 206	Technical Report Writing (Academic Writing II)	C	3
AREN 202	Physical and Engineering Properties of Biological Materials	C	3
AREN 204	Internship (Industrial Practice II)	E	0
UGRC220	Liberal and African Studies	C	3
	Total		**16**

Level 300 courses – Semester 1

Course code	Course Title	Core/ Electives	Total (Credits)
FAEN 301	Numerical Methods	C	3
AREN 301	Soil and Crop Mechanics Application to Mechanization	C	3
AREN303	Animal Production	E	3
AREN 305	Heat Transfer	C	3
AREN 307	Farm Structures & Environ. Engineering	C	3
AREN 309	Soil and Water Engineering	C	3
	Total		18

Level 300 courses – Semester 2

Course code	Course Title	Core/ Electives	Total (Credits)
FAEN 302	Statistics for Engineers	C	3
AREN 302	Agricultural Materials Handling	C	3
AREN 304	Soil Mechanics	C	3
AREN 306	Hydrology and Water Resources Management	C	3
AREN 308	Agricultural Machinery Technology	C	3
AREN 312	Energy and Power Utilization on Farms	C	2
AREN 314	Internship (Industrial Practice III)	C	1
	Total		**18**

Level 400 courses – Semester 1

Course code	Course Title	Core/ Electives	Total (Credits)
AREN 400	Project	C	3
AREN 401	Farm Machine Design	C	3
AREN 403	Rural Engineering	C	3
AREN 405	Maintenance and Management of Agricultural Machinery	C	3
FPEN 409	Engineering and Design of Food Process III (Plant Products)	E	3
FAEN 401	Law for Engineers	C	3
	Total		**18**

Level 400 courses – Semester 2

Course code	Course Title	Core/ Electives	Total (Credits)
AREN 400	Project	C	3
AREN 402	Technology of Tractor and Implement	C	3
AREN 404	Irrigation and Drainage Engineering	C	3
AREN 406	Storage of Agricultural Produce and cold chain mgt	C	3
AREN 408	Agro-Meteorology and Climatology	C	3
FAEN 402	Principles of Management and Entrepreneurship	C	3
	Total		**18**

Course Description

Core (Level 100)

FAEN 101 Algebra (4 credits)
Concept of a function of a single variable, graphs of functions - linear, quadratic and higher degree polynomial functions, rational functions, inequalities in one and two variables, binomial theorem, circular measure, trigonometric functions, exponential and logarithmic functions, hyperbolic functions. Algebra of complex numbers. Vectors and matrices, the solution of linear systems of equations, vector spaces and subspaces, orthogonality, determinants, eigenvalues and eigenvectors, linear transformations.

FAEN 102 Calculus I (4 credits)
Limits and Continuity of a function of a single variable. Differentiation: Rules of differentiation, chain rule and parametric differentiation, differentiation of trigonometric functions and their inverses, exponential and logarithmic functions, higher order derivatives, Leibnitz's rule. Differentiability: Rolle's Theorem, mean-value theorem, approximate methods of solving equations (graphical and Newton-Raphson methods). Integration and its applications: Area under curve, volumes of solids of revolution. Numerical integration: Trapezium and Simpson's rules. Vector function of a single variable: Differentiation and integration of vector functions, kinematics of a single particle in motion. Newton's laws of motion, motion in a straight line and in a plane, projectiles and circular motion, work, energy and power; impulse and momentum, moment of a force, couple, conditions for equilibrium of rigid bodies

FAEN 103 Basic Mechanics I (3 credits)
General principles of mechanics, methods of problem solution, and numerical accuracy. Force vectors and mathematical operations. Static Particles: Coplanar force on a particle, resultant of forces, resolution of forces, conditions for the equilibrium of a particle, Newton's first law, free-body diagram, forces in space. Force System Resultants. Statics of a rigid body and conditions for equilibrium. Centroids and centers of gravity.

FAEN 104 Basic Mechanics II (2 credits)
Branches of dynamics, Rectilinear Motion of Particles: Displacement, velocity, acceleration, uniformly accelerated motion, relative motion, dependent motions, and graphical methods. Curvilinear Motion of Particles: Displacement, velocity, acceleration, rectangular components, tangential and normal components. Kinetics of Particles: Newton's second law of motion, equations of motion. Work, Energy, Power and Efficiency: Work done by a force, springs, kinetic and potential energy, conservation of energy, principle of work and energy, power, efficiency. Impulse and Momentum: Impulse, linear and angular momentum, conservation of momentum, system of particles. Kinematics of Rigid Bodies. Introduction to Vibration: Undamped free vibration, undamped forced vibration, rotational vibration, energy method, damped free vibration, damped force vibration, electric analogue

AREN 101 Engineering Graphics (3 credits)
Introduction to the history of drawing, drawing instruments, scales, lettering and drawing lines. Orthographic Projections: Points, lines and planes. Projections of points, lines and figures on planes. Intersections of lines: Intersections of lines with solids. Intersections of figures with planes. Determination of true lengths of line segments, Angles of inclination of a line to the plane of projections through projections on planes, rotation of rabatment, projections of planes; Interpenetration of figures and solids. Developments: Surfaces, prisms, right pyramids, cylinders, cones. Introduction to Isometric Drawings. Introduction to AutoCAD.

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AREN 102 Engineering Drawing (2 credits) .

Advance Isometric drawing. Graphic presentation of materials' cross-sections: metals, solid materials, non-metallic, wood (along and across grains), glass, liquid and panel. Machine design drawings: Bolts, nuts, screws thread, auger development. Dimensioning and tolerance: Lines and symbols, rules for dimensioning, dimensioning methods, dimensioning standard features, limits and tolerances, fit and allowances, notes and specification, surface texture. Sections and Conventions: Types of sections, section lining, conventional practices, conventional breaks. Working Drawings: Detail drawings, assembly drawings, part lists. Screw Threads and Fasteners: Thread representation, threaded assemblies, fasteners, keys, rivets. Symbols of machine parts in engineering drawing. Schematic diagrammatic drawings (symbols) in engineering applications: Mechanical elements: forms of drives, aggregations. Hydraulic and pneumatic elements: Basic architectural constructional drawing (building plans phases of building, storey building. Profile of building parts). Electrical and electronic elements Applications of AutoCAD in engineering drawings.

FAEN 106 Applied Electricity (3 credits)

Foundations of electricity: voltage, current, resistance, DC and AC, AC waveforms, magnitude and phase, applications of AC and DC systems. Series and Parallel circuits. Transformers: Principle of operations, transformer types, ratings, considerations for transformer selection. AC Circuits: Single and three-phase systems, voltage levels and frequencies used in Ghana, harmonics in power systems. Power Factor and its calculation and correction in power systems, power in resistive and reactive AC circuits, active power, reactive power, and apparent power. Motors and Controls: Principles of operation of motors, control techniques for motors, motor types and applications. Electricity Generation: Generation sources, Power generation process, transmission and distribution in Ghana. Conductors and Insulators: Power transmission and distribution conductors, sizes, choice of conductor sizes, fuses, insulator break-down. Electrical Safety: Importance of electrical safety, shock current, safe practices, common sources of hazards, safe circuit design and safe meter usage.

FAEN 107 General Chemistry (3 credits)

Atomic Structure: The Schrödinger equation, quantum numbers, solution to the Schrödinger equation for one electron atom. Hund's Rule, Pauli's and Aufau principles. Periodic properties of elements: Overview of general features of S-block, P-block and D-block elements. Thermochemistry: Heat and energy, heat of formation, Hess Law, estimation of bond energies. Acids and Bases: pH, strengths of acids and bases, buffers, salts, electrolytic solutions solubility and solubility products concept. Oxidation: Reduction reactions, standard electrode potential, electrochemical cell, concentration dependence of electrode potential, electrochemical series, corrosion, prevention of corrosion, electrolysis, and Faraday's laws

FAEN 108 Basic Electronics (3 credits)

History of electronics from vacuum tubes to large scale integration, classification of electronic signals (digital, analog, role of A/D and D/A converters), electronic components, symbols and identification. Semiconductivity. Diodes and Diode Circuits: diode characteristics, model, and behavior in relation to circuits and analysis. Field-Effect Transistors and Circuits: MOSFET characteristics and model, biasing techniques, circuit symbol, analog MOSFET amplifier. Bipolar Junction Transistors (BJT): Physical structure of the BJT, circuit representation, transistor biasing, and transistor ratings. Fundamentals of Digital Electronics: Ideal logic gates, logic level definition and dynamic response of logic gates, logic gates examples. Signal Amplifiers: Concept of amplification, operational amplifier and its application as a filter, the BJT and MOSFET transistor as amplifiers, small signal behavior of the transistor. Basic Analog and Digital circuit elements, frequency response, signal generator, filters and waveform shaping circuits.

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FAEN 109 General Physics (3 credits)
Vibrations: Simple harmonic motion damped harmonic motion, forced harmonic motion, resonance and applications. Waves: Wave types, wave phenomena – interference and diffraction and applications. Electricity: Coulomb's law, electric field, Gauss's law, electric potential, current electricity – EMF, Kirchhoff's laws, DC circuits. Magnetism: Magnetic field, Bio-Savart's law, Ampere's law. Induction: Faraday and Lenz's law. AC Circuits: Reactance, Impedance, power factor, resonance. Introductory Modern Physics: Bohr's atom, quantum theory of atom, electronic transitions, optical spectrum. Photoelectric effect.

Core (Level 200)
FAEN 201 Calculus II (4 credits)
Vector spaces and Subspaces: Linear independence and dependence of vectors, Basis and dimension, linear transformations and matrices, determinants, application to the solution of systems of linear equations. Eigenvalues and eigenvectors. Sequences and Series: Evaluating limits of sequences, tests of convergence of finite series, power series; radius and interval of convergence, Maclaurin and Taylor series. Improper integrals: Convergence, Gamma and Beta functions, Lagrange polynomials, finite differences, and least square approximation

FAEN 202 Differential Equations (4 credits)
Functions of Several Variables: Limits and continuity, partial differentiation, critical points and their classifications, increments and differentials, implicit differentiation, the chain rule, directional derivatives. Differential operators: The gradient, the divergence and the curl operators, line integrals, multiple integrals, integration of vector functions, Green's theorem, divergence and Stoke's theorem. Differential Equations: First and Second order ordinary differential equations, series solutions, system of ordinary differential equations. Initial-value problems: Laplace transforms, partial differential equations, boundary-value problems, applications to strings and membranes, Fourier series and transforms

FAEN 203 Strength of Materials (3 credits)
Introduction: Basic concepts of material bonding, material structure and material defects. Properties of Materials: Mechanical properties, thermal properties, electronic and ionic conductivity of materials, dielectric and magnetic properties of materials. Simple stress and strain within elastic limit and thermal stress. Tensile bending and shear bending of beams. Torsion of circular shafts. Torsional stress and strain. Strength of solid and hollow shafts. Theories of failure. Compound stress-strain system (Mohr's stress and strain circles). Torsion of circular shafts Torsional stress and strain. Fatigue failure and Struts. Beams of small radius of curvature. Springs (helical, spiral and flat), Strain energy method (Castigliano's theorem). Bending under plastic conditions. Torsion under plastic conditions. Thin walled pressure vessels. Composite shafts

FAEN 204 Fluid Mechanics (3 credits)
Introduction: nature of fluids, analysis of fluid behaviour, viscosity, surface tension and capillary effects. Fluid Statics: hydrostatic forces on submerged plane and curved surfaces; buoyancy and stability; Elementary Fluid Dynamics: static, dynamic and total pressure; energy line and hydraulic grade line. Fluid Kinematics: velocity and acceleration fields; control volume and system representations; Reynolds transport theorem. Control Volume Analysis: continuity equation; linear momentum and moment-of-momentum equations; energy equation; irreversible flow. Differential analysis of fluid flow: fluid element kinematics; conservation of mass; conservation of linear momentum; inviscid flow; plane potential flows. Similitude, dimensional analysis, and modeling: dimensional analysis; Buckingham Pi Theorem; common dimensionless groups; modelling and similitude. Flow in pipes: laminar and turbulent flow; fully developed laminar flow; fully developed turbulent flow; dimensional analysis of pipe flow; pipe networks; flowrate measurement. Flow over immersed bodies: drag and lift; friction and pressure drag; flow over flat plates, across

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cylinders and spheres. Open-channel flow: general characteristics: surface waves; energy considerations; uniform flow; gradually varied flow; rapidly varied flow; flow measurement. Turbo-machines: basic energy and momentum considerations; centrifugal pumps; dimensional parameters and similarity laws; axial-flow and mixed-flow pumps; fans; turbines; compressible flow turbomachines.

FAEN 205 Thermodynamics (3 credits)
Fundamental concepts of thermodynamics. First and second Laws of Thermodynamics and their applications. Properties of Substances: Properties of pure, simple and compressible substances. Introduction to Gas and Vapor Power Cycles.

FAEN 206 Technical Report Writing (3credits)
Course Content:
Audience Analysis, Types of Genres, Preparing an outline. Referencing and Documentation. Illustrations: table and figures, bar charts, graphs, organization charts, flow sheets, drawing and photographs. Research proposal writing, Technical Style: use of abbreviations, Numbering of headings. Design of Questionnaires. Oral Presentations. Case Study

AREN 201 Engineering Surveying (3 credits)
Definitions and types of surveying. Principles, field surveying, leveling instruments, differential and profile leveling, contours, map work, scale, reading and interpreting maps. Theodolite and its applications. Description of the Instrument – the 3 main parts. The usage of the instrument – setting up the instrument, Readings of the vertical and horizontal angles. Applications – traversing and control points establishment.

AREN 202 Physical and Engineering Properties of Biological Materials (3 credits)
Physical characteristics: Shape, size, weight, volume, surface area, density, porosity, color, appearance, drag coefficient, center of gravity. Mechanical properties: Hardness, compressive strength, tensile strength impact resistance, compressibility, shear resistance, sliding coefficient of friction, static coefficient of friction, coefficient of expansion, plasticity, bending strength, aerodynamic properties, hydrodynamic properties. Thermal properties: Specific heat, thermal capacity, thermal conductivity, surface conductance, absorptance, emittance, transmittance. Electrical properties: Conductance, resistance, capacitance, dielectric properties, electromagnetic properties. Optical properties: Light transmittance, light reflectance, light reflectance, light absorptance, color.

Electives (Level 200)
AREN 203 Introduction to Crop Production (3 credits)
Refer to the College of Agriculture and Consumer Sciences Curriculum for course details of CROP 201: Introduction to Crop Production and prerequisites. CROP 201 is taken inplace of AREN 203 for now.

AREN 204 Internship (Industrial practice II) (1 credit) Prerequisite: *Level 200 standing*
Second year attachment with industry.

Core (Level 300)
AREN 301 Soil and Crop Mechanics Application to Mechanization (3 credits)
The application of soil mechanics principles to the design of soil engaging equipment for tillage and earthmoving, methods for predicting performance and results of detailed field and laboratory studies on soil profiles and soil disturbance. Physical properties on tillage, planting, harvesting etc: texture, mass, porosity, compaction etc. Mechanical properties of soil on tillage resistance: density, friction etc. Crop physical properties on planting, harvesting etc: size, weight, volume, surface area, texture, density, moisture, porosity, compaction etc.

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Mechanical properties of crop on planting, harvesting: friction bending strength, aerodynamic properties etc. Environmental influence on mechanization: temperature, humidity, dust and altitude.

FAEN 301 Numerical Methods (3 credits) Prerequisites: *FAEN 101, FAEN 110, FAEN 201*
Matrices and vector operations, linear homogeneous systems, Eigen-vectors and values. Numerical errors, absolute and relative errors, stability and convergence of numerical algorithms. Interpolation Methods: Lagrange polynomials, finite differences, least square approximation. Numerical solutions to Nonlinear Equations: Newton Raphson method, secant, false position, bisection, fixed point algorithm. Numerical Integration: Simpson's rule, trapezoidal rule, Newton-Cotes method. Numerical solutions to Ordinary Differential Equations: Taylor series method, Euler method, Runge-Kutta method. Numerical solutions to Partial Differential Equations: Second order quasi-linear equations, numerical solutions.

FAEN 302 Statistics for Engineers (3 credits) Prerequisites: *FAEN 201, FAEN 202, FAEN 301*
Probability functions axioms and rules, counting techniques, conditional probability, independence and mutually exclusive events. Discrete Random Variable: Expectation and variance, Binomial distribution, Hypergeometric distribution, Poisson distribution, relationship between Poisson and Binomial. Continuous Random Variable: Percentiles and cumulative distribution function, expectation and variance, uniform distribution, normal distribution, exponential distribution and other distributions. Joint Distributions. Covariance and Correlation. Sampling Distributions: Distributions of statistics, central limit theorem, samples from normal distribution (t-distribution, X^2 distribution and F-distributions). Estimation: Common point estimators, interval estimators. Hypothesis Testing. Introduction to Regression Analysis. Engineering applications in quality control, process control, communication systems and speech recognition

AREN 302 Agricultural Materials Handling (3 credits)
Principles, concepts, definitions and importance, classification of agricultural materials (fluids, semi-fluids unitized). Conveying - classification of conveying equipment; methods of conveying; types of conveying equipment; reliability of conveyers; conveyer systems. Selection of conveyers. Design consideration for conveyer performance efficiency

AREN 303 Animal Production (3 credits)
Refer to College of Agriculture and Consumer Sciences Curriculum for course details and prerequisites.

AREN 304 Soil Mechanics (3 credit)
Classification, Definition, Compaction, Effective Stress, Steady State, Flow nets, Anisotropic flow, One-dimensional compression, One-dimensional settlement, One-dimensional consolidation, Numerical solutions, Elasticity of soils, Settlement of foundations, Soil strength, Stress-strain, Earth pressure (Rankine's method), Earth pressure (Coloumb's method).

AREN 305 Heat Transfer (3 credits)
Basic definitions, introduction of the different modes of heat transfer. Conduction of heat transfer; Fourier's law, steady state heat transfer, heat transfer through plane walls, cylinders and spheres. Electrical analogy, heat transfer through materials in series and parallel and in fins. Convection heat transfer: Introduction to dimensional analysis. Forced convection, Reynold's analogy, flow over plates, flow in tubes; natural or free convection. Radiation heat transfer: Black body and grey body concepts, emmissivity, absorbtivity, transmissivity, radiosity, Lambert's law, geometric factor, radiation shields, parallel plates, electrical analogy. Mixed mode heat transfer. Expand surfaces, cooling fins and heat exchangers

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AREN 306 Hydrology and Water Resources Management (3 credits)

Components and processes of natural hydrologic systems, Hydrologic cycle, Precipitation and snow melt. Infiltration. Storm frequency and duration analysis. Hydrograph analysis. Frequency and probability with application to precipitation and floods. Evaporation, transpiration and evapo-transpiration. Ground water resources. Pumping tests and water balance studies. Concepts of Water Resources Management: The Water Resources System, Integrated Water Resources Management, Watershed Management, Wetlands and their Management, Integrated Water Resources Management (IWRM) in Ghana, Human Interferences in the Water Resources System, Wetlands and IWRM. Storm water Run-off Management: Uncontrolled Storm Water Runoff, Prevention measures to Address Storm Water Runoff. Water Demand management: Tools and techniques for demand management. Principles of water conservation, water storage structures. Water harvesting. Embankments and farm ponds. Flood control, open channels and vegetative water ways. Terracing: - functions of terraces, terrace classification, terrace design.

Urban Water Conservation, Concept of Non-Revenue Water, Policy Setting and Advocacy issues, Ghana Water Policy. Tools for Water Resources Systems Analysis

AREN 307 Farm Structures and Environmental engineering (3 credits)

Different types of on-farm structures. Planning of a farm structure: selection and preparation of site, layout and design. Building materials: selection, properties, wood, plywood, earth as a building material. Elements of construction, frames. Structures for poultry, dairy, cattle and pigs.

Heat and moisture production by crops and animals, environmental control, feeding systems and waste management, thermal insulation and moisture barriers, ventilation control and quantification of performance, ventilation rates, energy and mass balance, equipment for environmental control.

AREN 308 Agricultural Machinery Technology (3 credit)

The performance and design characteristics of crop establishment, protection, harvesting and handling equipment, the selection of suitable machinery to meet the performance requirements of various agricultural operations. Tillage: Objectives of tillage, primary and secondary tillage equipment (plows, harrows, etc). Ploughs - Functions of the ploughs, principle of operation of the plough, types of ploughs, setting and adjustments of ploughs, calculating draught requirement for ploughs; Cultivators and Harrows - Types of cultivators, functions of the cultivators principle of operation of cultivators; Ridgers - Types of ridgers, principles of operation of ridgers. Planters and seed drills; methods of seed establishment, functions of a seeder, seed metering devices. Fertilizer distribution/broadcasters, Husbandry equipment: Field sprayers/dusters: Types of sprayers (hydro-pneumatic, mist blower etc). Factors affecting sprayer performance. Harvesting equipment: Harvesting methods, combine harvesters of grains, tubers and fruits (basic operations, working principles, and combine losses).

Equipment for Livestock - Milking systems an mechanisms, principle of operation, Hatchery equipment: setters and hatchers; egg handling - layout of setters, puckers etc.

AREN 309 Soil and Water Engineering (3 credits)

Introductory Concepts: soil water potential concepts; potential distribution of soil water under field conditions; methods of soil water determinations; soil water retention curves; hysteresis. Soil Water Flow: flow of water in model systems - tubes and pipes; darcy's law; transport of soil water under saturated conditions; transport of soil water under unsaturated conditions; determination of hydraulic conductivity. Soil Water Flow Processes in the Field: infiltration; runoff; internal drainage and redistribution; evaporation. Basic concepts of soil erosion; control of soil erosion; Mechanics of wind and water erosion; water and wind erosion control practices; concept of runoff and its estimation

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AREN 312 Energy and Power Utilization on Farms (2 credits)
Principles and stages of agriculture mechanization (reference to Ghana) Mechanized activities in crop production. Power sources on farm: human, animal, wind, water solar energy, bio-energy, Internal combustion engines (I.C.E.): petrol and diesel engines. Components of internal combustion engines, classification of I.C.E Working principles of I.C.E. Two and four stroke engines. Engine Systems: Fuel, cooling, lubrication, ignition and hydraulic system. Mechanical power transmission: Principal reasons for application of drives, classification of drives, belt, gear and chain drives. Tractor power transmission to final drives, hydraulic, traction aids.

AREN 314 Internship (Industrial practice III) (1 credits) Prerequisite: *Level 300 standing*
Third year attachment with industry.

FAEN 302 Statistics for Engineers (3 credits) Prerequisites: *FAEN 201, FAEN 202, FAEN 301*
Probability functions axioms and rules, counting techniques, conditional probability, independence and mutually exclusive events. Discrete Random Variable: Expectation and variance, Binomial distribution, Hypergeometric distribution, Poisson distribution, relationship between Poisson and Binomial. Continuous Random Variable: Percentiles and cumulative distribution function, expectation and variance, uniform distribution, normal distribution, exponential distribution and other distributions. Joint Distributions. Covariance and Correlation. Sampling Distributions: Distributions of statistics, central limit theorem, samples from normal distribution (t-distribution, X^2 distribution and F-distributions). Estimation: Common point estimators, interval estimators. Hypothesis Testing. Introduction to Regression Analysis. Engineering applications in quality control, process control, communication systems and speech recognition

Core (Level 400)
AREN 400 Project (3 credits)
Students work independently on original project under the direction of their approved advisor, make an oral presentation at a seminar, prepare and submit thesis for approval.

AREN 401 Farm Machine Design (3 credits)
Quick reminder of stress and strain analysis and theories of failure. Factor of safety, stress concentration, design of machine elements like shafts and axles, couplings, riveted joints, welded joints, bolted joints. Product specification and selection of standard parts like bearings, gears, keys and springs. Manufacturing processes, role of CAD/CAM.
Study of agricultural machinery with reference to functional and design requirements of various farm machines; cost – benefit analysis, machinery testing methods. Design for manufacture.

AREN 402 Technology of Tractor and Implement (3 credits)
Tractor and implement, construction and operational features transmission systems, implement attachment and control, tractive performance, traction aid, performance and efficiency indices, soil compaction and smear, tractor design and function, tractor hitching system, kinematic and equilibrium analysis of tractor/implement combination draw bar for performance prediction, steer ability.

AREN 403 Rural Engineering (3 credits)
Land and water use planning; planning and design of rural houses, rural roads, village drainage systems, waste disposal and sanitary structures, integrated rural energy planning and development; rural electrification.

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AREN 404 Irrigation and Drainage Engineering (3 credits)
Water for irrigation - surface and ground water quality and water flow rate; types, performance and selection criterion for pumps, irrigation requirements and scheduling, farm irrigation systems design, surface sprinkler, trickle, subsurface and surface drainage design and practices, drainage and environmental conservation.

AREN 405 Maintenance and Management of Agricultural Machinery (3 credits)
Defects of farm machinery (wear and breakages); instruments to measure defects; materials for repairs; diagnostic testing; bench work, blacksmithing and welding; repair and maintenance of farm equipment (tractors, tillage equipment, harvesting equipment, etc; lubrication and preservation of farm machines; field capacity and efficiency, machinery operation costs, machinery selection and replacement

AREN 406 Storage of Agricultural Products and Cold Chain Management (3 credits)
Choice of systems for reception, storage and handling of agricultural produce, types of storage systems: construction details and design of systems, access roads, dust extractors, capacity of equipment, system selection and reliability. Grain storage methods, storage of fresh fruits and vegetables, storage of roots and tubers; Physiological disorders, chemical and integrated pest control methods, legislation on chemical use, quality assurance, bio-deterioration, inspection procedures, loss assessment, pest proofing. Safety in stores. Principles of refrigeration; refrigeration equipment; refrigerated storage construction; air circulation and fruit temperatures; pack house design and management; quality and safety in cold storage; hazard analysis critical control path; packaging and cold storage; cold chain from producer to consumer; safety

AREN 408 Agro-Meteorology and Climatology (3 credit)
Solar radiation, short and long wave radiation, direct and diffuse radiation, Net radiation, measurement and estimation; radiation utilization in photosynthesis; Energy balance/Bowen ratio; Evaporation and evapo-transpiration models; Soil temperatures; Drought; Windbreaks and shelter belts. Introduction to Meteorological Instrumentation and Observation; Weather Analysis/Forecasting; Physical Climatology - Causes of Climatic Phenomena including Heat and Water balance of the Earth's Atmosphere system and application of the Physical Principles involved in Agro-meteorology and Hydrology.

FAEN 401 Law for Engineers (3 credits)
Course discussions cover contracts (formation, performance, breach, and termination), corporations and partnerships, insurance, professional liability, risk management, environmental law, torts, property law, evidence and dispute resolution. The course emphasizes those principles necessary to provide engineers with the ability to recognize issues which are likely to arise in the engineering profession and introduces them to the complexities and vagaries of the legal profession.

FAEN 402 Principles of Management & Entrepreneurship (3 credits)
Introduction: Definition of management. Evolution and Perspectives of Management: classical, human relations and management science. Hierarchy of Management, Managerial roles and Management Styles. Inside and Outside an Organisation: adapting to change and understanding the environment. Management Functions: Planning and Decision Making, Organising, Leading and Communicating.
The Entrepreneurial Process and Types of Businesses. Creating New Products/Services and Business plans. **Evaluation:** Analysis of new ventures, valuation techniques, Intellectual Property Issues. Financing New Ventures. Elements of Marketing Management. Managing Growth and Exit Strategy.

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Electives (Level 400)
FPEN 409 Engineering and Design of Food Process III – Plant Products (3 credits)
(See Department of Food Process Engineering)

Departmental Requirements for B.Sc. Engineering (Agricultural Engineering)

In addition to the University and Faculty requirements to graduate with a B.Sc. Engineering (Agricultural) a student must pass the following courses not lower than "D":

FAEN 203 Strength of Materials
AREN 201 Engineering Surveying
AREN 308 Agricultural Machinery Technology
AREN 309 Soil and Water Engineering
AREN 400 Project
AREN 402 Technology of Tractor and Implement
AREN 404 Irrigation and Drainage Engineering
AREN 406 Storage of Agricultural Produce and Cold Chain Management

Student must have taken at least two out of the three Internship (Industrial practice) programmes and one of which must be AREN 314 Internship III (Level 300).

DEPARTMENT OF BIOMEDICAL ENGINEERING
FACULTY

Elsie A. B. Effah Kaufmann *BSE MSE PhD (Pennsylvania)*	-	Senior Lecturer/ **(Head of Department)**
John K. Kutor *BSc MSc (Cape Coast) PhD (Zhejiang)*	-	Lecturer
Henry Ato Ogoe *BSc (Kumasi) MSc (Åbo Akademi)*	-	Lecturer **(on Leave)**
Peter Agbekoh *BSc (Ghana) MRes (Strathclyde)*	-	Assistant Lecturer
Kwabena Kan-Dapaah *BSc (Kumasi), MSc (Lübeck)*	-	Assistant Lecturer
Balapangu Shankar Srinivasan *BSc MSc (Madras)*	-	Assistant Lecturer
Bernard O. Asimeng *BSc MSc (Kumasi)*	-	Assistant Lecturer
Sophia Tetteh *BSc MSc (Drexel)*	-	Assistant Lecturer
Shiloh D. Osae *BSc. (Ghana) MSc PhD (Okayama Japan)*	-	Part-Time Lecturer
Edward A. Essah *BSc (Kumasi) MSc (Lübeck)*	-	Part-time Lecturer
Daniel G. Achel *BSc MPhil (Ghana)*	-	Part-Time Lecturer
Joseph R. Fianko *BSc Dip Ed (Cape Coast) MPhil PhD (Ghana)*	-	Part-Time Lecturer

PROGRAMME STRUCTURE

Level 100 – Semester 1

Course Code	Course Title	Credits
FAEN 101	Algebra	4
FAEN 103	Basic Mechanics I	3
FAEN 105	Engineering Drawing with CAD	3
FAEN 107	General Chemistry	3
FAEN 109	General Physics	3
UGRC 110	Academic Writing I	3
	Total	**19**

Level 100 – Semester 2

Course Code	Course Title	Credits
FAEN 102	Calculus I	4
FAEN 104	Basic Mechanics II	3
FAEN 106	Applied Electricity	3
FAEN 108	Basic Electronics	3
FAEN 112	C Programming	2
BMEN 102	Internship (Industrial Practice I) OPTIONAL	-
UGRC 150	Critical Thinking and Practical Reasoning	3
	Total	**18**

Level 200 – Semester 1

Course Code	Course Title	Credits
FAEN 201	Calculus II	4
FAEN 203	Strength of Materials	3
FAEN 205	Thermodynamics	3
BMEN 201	General Biology	2
CPEN 203	Digital Circuits	3
UGRC 220	Introduction to African Studies	3
	Total	**18**

Level 200– Semester 2

Course Code	Course Title	Credits
FAEN 202	Differential Equations	4
FAEN 204	Fluid Mechanics	3
FAEN 206	Technical Report Writing	3
BMEN 202	Introduction to Biomedical Engineering	3
BMEN 204	Introduction to the Structure and Properties of Materials	2
BMEN 206	Internship (Industrial Practice II) OPTIONAL	-
UGRC 130	Understanding Human Societies	3
	Total	**18**

Level 300 – Semester 1

Course Code	Course Title	Credits
FAEN 301	Numerical Methods	3
BMEN 301	Human Biology I (Anatomy)	2
BMEN 303	Bioinstrumentation	3
BMEN 305	Biomaterials	3
BMEN 307	Biomechanics	3
BMEN 309	Research Methods	1
CPEN 101	Engineering Computational Tools*	2
	Total	**17**

Level 300 – Semester 2

Course Code	Course Title	Credits
FAEN 302	Statistics for Engineers	3
BMEN 302	Human Biology II (Physiology)	2
BMEN 304	Solution and Colloid Chemistry	3
BMEN 306	Design and Selection of Biomaterials	3
BMEN 308	Design of Mechanical Systems	3
BMEN 312	Medical Imaging	3
BMEN 314	Internship (Industrial Practice III)	1
	Total	**18**

Level 400 Courses – Semester 1

Course Code	Course Title	Credits
FAEN 401	Law for Engineers	3
BMEN 400	Project(Design/ Research)	3
BMEN 401	Engineering Principles of Human Physiology and Anatomy	2
BMEN 403	Cell and Molecular Biology	3
BMEN 405	Cardiovascular Mechanics	2
BMEN 407	Haemodynamics	2
BMEN 409	Local Issues in Biomedical Engineering	3
	Total	**18**

Level 400 Courses – Semester 2

Course Code	Course Title	Credits
FAEN 402	Entrepreneurship	3
BMEN 400	Project (Design/ Research)	3
BMEN 402	Tissue Engineering and Biotechnology	3
BMEN 404	Biomedical Engineering Systems	3
BMEN 406	Transport Processes in Living Systems	2
BMEN 408	Professional Development Seminar	2
BMEN 412	Medical Physics	2
	Total	**18**

COURSE DESCRIPTIONS

Core (Level 100)

FAEN 101: Algebra

Concept of a function of a single variable, graphs of functions - linear, quadratic and higher degree polynomial functions, rational functions, inequalities in one and two variables, binomial theorem, circular measure, trigonometric functions, exponential and logarithmic functions, hyperbolic functions. Algebra of complex numbers. Vectors and matrices, the solution of linear systems of equations, vector spaces and subspaces, orthogonality, determinants, eigenvalues and eigenvectors, linear transformations.

FAEN 102: Calculus I

Limits and Continuity of a function of a single variable. Differentiation: Rules of differentiation, chain rule and parametric differentiation, differentiation of trigonometric functions and their inverses, exponential and logarithmic functions, higher order derivatives, Leibnitz's rule. Differentiability: Rolle's Theorem, mean-value theorem, approximate methods of solving equations (graphical and Newton-Raphson methods). Integration and its applications: Area under curve, volumes of solids of revolution. Numerical integration: Trapezium and Simpson's rules. Vector function of a single variable: Differentiation and integration of vector functions, kinematics of a single particle in motion. Newton's laws of motion, motion in a straight line and in a plane, projectiles and circular motion, work, energy and power; impulse and momentum, moment of a force, couple, conditions for equilibrium of rigid bodies

FAEN 103: Basic Mechanics I

General principles of mechanics, methods of problem solution, and numerical accuracy. Force vectors and mathematical operations. Static Particles: Coplanar force on a particle, resultant of forces, resolution of forces, conditions for the equilibrium of a particle, Newton's first law, free-body diagram, forces in space. Force System Resultants**. Statics of a rigid body and conditions for equilibrium. Centroids and centers of gravity**

FAEN 104: Basic Mechanics II

Branches of dynamics, Rectilinear Motion of Particles, displacement, velocity, acceleration, uniformity accelerated motion, relative motion, dependent motions and graphical methods. Curvilinear motion of particles; Displacement, velocity, acceleration, rectangular components, tangential and normal components. Kinetics of particles: Newton's second law of motion, equations of motion, Work, Energy, Power and Efficiency: Work done by force, springs, kinetic and potential energy, conservation of energy, principle of work and energy, power, efficiency, impulse and Momentum: Impulse, linear and angular momentum, conservation of momentum, system of particles. Kinematics of rigid bodies. Introduction to vibration:Undamped free vibration, undamped forced vibration, rotational vibration, energy method, damped free vibration, damped force vibration, electric analogue.

FAEN 105: Engineering Drawing with CAD

Technical Drawing**:** Introduction to Engineering Drawing, sketching and line techniques, geometric constructions, multiview drawings and orthographic projection, auxiliary views, descriptive geometry, Engineering Drawing**:** Dimensioning, sectioning, tolerances, fits, Assembly drawings, cross sectional views, half sections. AutoCAD**.** Starting AutoCAD, object construction in AutoCAD, isometric drawings in AutoCAD, 3D AutoCAD and solid modeling, application of AutoCAD to the following: Technical surface finish, measurement, methods of examination and specification.

FAEN 106: Applied Electricity

Foundations of electricity: charge, voltage, current, power and energy, computation of power and energy for electrical gadgets and household, simple billing calculations. Electricity

supply: definition and characteristics of AC and DC voltages and currents and their applications, calculation of Instantaneous, RMS and Average voltage and current values and their relevance. Transformer: definition and components of a transformer, principle of operation, ideal transformer and characteristics, transformer types and ratings used by utilities in Ghana. AC circuit systems: definition of 1-phase 2-phase and 3-phase circuit systems, voltage and current relationship between the circuit systems, sample voltage drop and line loss calculation for electricity supply from source to destination. Electricity supply: electricity utilities and functional roles, electricity generation sources, hydro power generation process, transmission process, distribution process to users in Ghana. Power factor: definition and relevance, active power, reactive power, and apparent power, calculation of power factor and correction. Electric Motors: components of an electric motor, basic principle of operation, motor types and applications. Electrical Safety: importance of electrical safety, shock current, common sources of hazards, safe practices.

FAEN 107: General Chemistry

Atomic Structure: The Schrödinger equation, quantum numbers, solution to the Schrödinger equation for one electron atom. Hund's Rule, Pauli's and Aufau principles. Periodic properties of elements: Overview of general features of S-block, P-block and D-block elements. Thermochemistry: Heat and energy, heat of formation, Hess Law, estimation of bond energies. Acids and Bases: pH, strengths of acids and bases, buffers, salts, electrolytic solutions solubility and solubility products concept. Oxidation: Reduction reactions, standard electrode potential, electrochemical cell, concentration dependence of electrode potential, electrochemical series, corrosion, prevention of corrosion, electrolysis, and Faraday's laws.

FAEN 108: Basic Electronics

History and overview of electronics from vacuum tubes to large scale integration, including reasons for studying electronics, selected important areas of application, role of electronics in computer engineering. Semiconductivity: materials and properties, electrons and holes, concept of doping, acceptors and donors, p and n-type materials, conductivity and resistivity. Diodes and Circuits: symbol and representation, diode operation and characteristics, region of operation and limitations, zener and schottky diodes, diode circuit and load line, diode application in rectifier and dc/dc converter, diode logic functions - AND and OR . Bipolar Junction Transistors (BJT): physical structure of BJT, symbol and circuit representation, NPN and PNP transistor operation, voltage-current characteristics of transistors, transistor region of operation and limitation, transistor circuit analysis, biasing for logic application, transistor operation as logic functions – OR and AND logics.

FAEN 109: General Physics

Vibrations: Simple harmonic motion, damped harmonic motion, forced harmonic motion. Waves: Wave types, wave phenomena – interference and diffraction. Electricity and Magnetism: Coulomb's law, electric field, Gauss's law, electric potential, current electricity – EMF, Kirchhoff's laws, DC circuits, Magnetic field: Bio-Savart's law, Ampere's law. Induction: Faraday and Lenz's law, AC circuits. Introductory Modern Physics: Bohr's atom, quantum theory of atom, electronic transitions, optical spectrum, X-rays, photo-electric effect, motion of charges in electric and magnetic fields

FAEN 112: C Programming

History of the C language. Structure of the C Program. Variables Declarations: Global variables, type and range of variables, declaration of variables, scope of variables, reading and printing of variables. Constants Declarations. The C Operators: Arithmetic, Relational, Logical, and order of operation precedence. Conditional Instructions. Looping and Iterations. Arrays and Strings: Single and multi-dimensional. Functions: VOID function, Functions and Arrays, Function prototyping. Data Types: Unions, type casting, enumerated types, static variables. Pointers: pointers and variable, pointers and functions, pointers and arrays, arrays of

pointers, multi-dimensional arrays and pointers, static initialization of pointer arrays, pointers and structures, common pointer pitfalls. Dynamic Memory Allocation and Dynamic Structures: MALLOC and SIZEOF and FREE, CALLOC and REALLOC, Linked Lists, random number generation, sample full C program

BMEN 102: Internship (Industrial Practice I) OPTIONAL
First year attachment with industry.

Core (Level 200)
FAEN 201: Calculus II
Vector spaces and Subspaces: Linear independence and dependence of vectors, Basis and dimension, linear transformations and matrices, determinants, application to the solution of systems of linear equations. Eigenvalues and eigenvectors. Sequences and Series: Evaluating limits of sequences, tests of convergence of finite series, power series; radius and interval of convergence, Maclaurin and Taylor series. Improper integrals: Convergence, Gamma and Beta functions, Lagrange polynomials, finite differences, and least square approximation

FAEN 202: Differential Equations
Differential Equations: First and Second order ordinary differential equations, series solutions, system of ordinary differential equations. Initial-value problems: Laplace transforms partial differential equations, boundary-value problems, Fourier series and transforms, applications.

FAEN 203: Strength of Materials
Introduction: Basic concepts of material bonding, material structure and material defects. Properties of Materials: Mechanical properties, thermal properties, electronic and ionic conductivity of materials, dielectric and magnetic properties of materials. Simple stress and strain within elastic limit and thermal stress. Tensile bending and shear bending of beams. Torsion of circular shafts. Torsional stress and strain. Strength of solid and hollow shafts. Theories of failure. Compound stress-strain system (Mohr's stress and strain circles). Torsion of circular shafts Torsional stress and strain. Fatigue failure and Struts. Beams of small radius of curvature. Springs (helical, spiral and flat), Strain energy method (Castigliano's theorem). Bending under plastic conditions. Torsion under plastic conditions. Thin walled pressure vessels. Composite shafts

FAEN 204: Fluid Mechanics
Introduction: nature of fluids, analysis of fluid behaviour, viscosity, surface tension and capillary effects. Fluid Statics: hydrostatic forces on submerged plane and curved surfaces; buoyancy and stability; Elementary Fluid Dynamics: static, dynamic and total pressure; energy line and hydraulic grade line. Fluid Kinematics: velocity and acceleration fields; control volume and system representations; Reynolds transport theorem. Control Volume Analysis: continuity equation; linear momentum and moment-of-momentum equations; energy equation; irreversible flow. Differential analysis of fluid flow: fluid element kinematics; conservation of mass; conservation of linear momentum; inviscid flow; plane potential flows. Similitude, dimensional analysis, and modeling: dimensional analysis; Buckingham Pi Theorem; common dimensionless groups; modelling and similitude. Flow in pipes: laminar and turbulent flow; fully developed laminar flow; fully developed turbulent flow; dimensional analysis of pipe flow; pipe networks; flowrate measurement. Flow over immersed bodies: drag and lift; friction and pressure drag; flow over flat plates, across cylinders and spheres. Open-channel flow: general characteristics: surface waves; energy considerations; uniform flow; gradually varied flow; rapidly varied flow; flow measurement. Turbo-machines: basic energy and momentum considerations; centrifugal pumps; dimensional parameters and similarity laws; axial-flow and mixed-flow pumps; fans; turbines; compressible flow turbomachines.

FAEN 205: Thermodynamics
Fundamental concepts of thermodynamics. First and second Laws of Thermodynamics and their applications. Properties of Substances: Properties of pure, simple and compressible substances. Introduction to Gas and Vapor Power Cycles.

FAEN 206: Technical Report Writing
Preparing an outline. Technical Style. Use of abbreviations. Numbering of Headings. Documentation footnotes and alphabetical list of reference. Table and figures, Bar charts, graphs, curves Organization charts and flow sheets. Drawing. Photographs. Case Study

BMEN 201: General Biology
Introduction to the science of life. Characteristics and various levels of organisation of living things. Molecular basis of cellular structure and functions (prokaryotic, eukaryotic). Bioelements. Biomolecules: carbohydrates, amino acids, lipids, nucleotides and nucleic acids. The cell cycle: Interphase and Mitosis. Introduction to protein synthesis. Basic genetics: chromosomes, genes, gene action and inheritance. Brief coverage of major groups of (plant and animal) kingdoms and their characteristics (morphological, anatomical). Brief coverage of animal body organization and plant body organization. Living organisms and disease: introduction to pathogens. Role of the engineer in facilitating biological studies, overview of various equipment used in laboratory and field studies.

BMEN 202: Introduction to Biomedical Engineering
Discussion of application of Science and Engineering to problems in Biology and Medicine. Introduction to the Engineering Design Process. Includes design project.

BIEN 204: Introduction to the Structure and Properties of Materials
Atomic structure and bonding: types of atomic and molecular bonds—ionic, covalent, metallic, secondary and mixed bonding. Crystal structures and crystal geometry: space lattice and unit cells, crystal systems and Bravais lattices, introduction to crystal structure analysis. Classification of solid materials. Structure, properties and processing of metals, polymers, ceramics and composites.

CPEN 203: Digital Circuits (Prerequisite: *FAEN 108)*
Refer to the Computer Engineering Curriculum for course details.

Electives (Level 200)
BMEN 206: Internship – Industrial Practice II (Prerequisite: *Level 200 standing)*
Second year attachment with industry.

Core (Level 300)
FAEN 301: Numerical Methods (Prerequisites: *FAEN 101, FAEN 110, FAEN 201)*
Matrices and vector operations, linear homogeneous systems, Eigen-vectors and values. Numerical errors, absolute and relative errors, stability and convergence of numerical algorithms. Interpolation Methods: Lagrange polynomials, finite differences, least square approximation. Numerical solutions to Nonlinear Equations: Newton Raphson method, secant, false position, bisection, fixed point algorithm. Numerical Integration: Simpson's rule, trapezoidal rule, Newton-Cotes method. Numerical solutions to Ordinary Differential Equations: Taylor series method, Euler method, Runge-Kutta method. Numerical solutions to Partial Differential Equations: Second order quasi-linear equations, numerical solutions.

FAEN 302: Statistics for Engineers (Prerequisites: *FAEN 201, FAEN 202, FAEN 301)*
Probability functions axioms and rules, counting techniques, conditional probability, independence and mutually exclusive events. Discrete Random Variable: Expectation and variance, Binomial distribution, Hypergeometric distribution, Poisson distribution,

relationship between Poisson and Binomial. Continuous Random Variable: Percentiles and cumulative distribution function, expectation and variance, uniform distribution, normal distribution, exponential distribution and other distributions. Joint Distributions. Covariance and Correlation. Sampling Distributions: Distributions of statistics, central limit theorem, samples from normal distribution (t-distribution, X^2 distribution and F-distributions). Estimation: Common point estimators, interval estimators. Hypothesis Testing. Introduction to Regression Analysis. Engineering applications in quality control, process control, communication systems and speech recognition

BMEN 301: Human Biology I (Pre-requisite*: BMEN 201)*
Introduction to anatomy: brief history, divisions of anatomy and anatomical terminologies. Basic tissues of the body (epithelia, connective, muscle and nerve tissues) and histology. Structure and organization of the major systems of the body especially the skeletal and muscular systems.

BMEN 302: Human Biology II - Physiology (2 credits) Pre-requisites: *BMEN 201, BMEN 301*
Basic concepts in human physiology, functional organisation of the human body and homeostasis. Various systems of the human body: integumentary, cardiovascular, digestive, respiratory, urinary, endocrine, nervous and reproductive. Overview of metabolism and sensory organs.

BMEN 303: Bioinstrumentation (Pre-requisites: *FAEN 108, FAEN 109, CPEN 203)*
Design of electronic instrumentation for the recording and analysis of physiological signals. Noise and interference. Design and analysis of simple amplifiers and filters for signal conditioning. Applications of digital filters. Electrical safety requirements (extensive circuit and computer design work required).

BMEN 304: Solution and Colloid Chemistry - Electrochemistry
(Pre-requisites*: FAEN 107, FAEN 205)*
Ideal solutions, non-ideal equilibria, electrochemical cells, surface phenomena and colloids, spectroscopy, transport properties in gases and solutions.

BMEN 305: Biomaterials (Pre-requisites*: FAEN 107, BMEN 204)*
Application of concepts of atomic and molecular structure to understanding the chemical and physical properties of materials. Analysis of both natural and synthetic materials in the biological environment.

BMEN 306: Design and Selection of Biomaterials (Pre-requisites: *BMEN 305, BMEN 307)*
Design and selection of engineering materials for the biomedical environment. Principles of fabrication, processing and clinical application. Students will design a specific device.

BMEN 307: Biomechanics (Pre-requisites: *FAEN 103, FAEN 104, FAEN 203* Co-requisite*: BMEN 301)*
Application of statics and dynamics to do simple force analyses of the musculoskeletal system. Biomechanics of soft and hard tissues. Microstructure, mechanical and viscoelastic properties. Biomechanics of injury.

BMEN 308: Design of Mechanical Systems (Pre-requisites: *BMEN 305, BMEN 307)*
Introduction to the design of biomechanical systems. Design of prostheses for use in orthopaedics and dentistry. Students will design a specific device or system.

BMEN 309: Research Methods (Pre-requisite: *Level 300 standing)*
Definition and goals of Research. The scientific method and research process. Students will submit a research proposal.

BMEN 312 : Medical Imaging (Pre-requisites*: FAEN 109, BMEN 301)*
Radiation (X-ray) imaging, ultrasound, nuclear magnetic resonance (NMR), magnetic resonance imaging (MRI) and biomedical optical imaging. Principles/fundamentals, instrumentation and imaging devices as well as biological effects will be discussed for all the techniques.

BMEN 314: Internship (Industrial Practice III) (Pre-requisite: *Level 300 standing)*
Third year attachment with industry.

Electives (Level 300)

CPEN 201: C++ Programming (Prerequisite: *FAEN 112)*
Refer to the Computer Engineering Curriculum for course details.

CPEN 101: Engineering Computational Tools
Refer to the Computer Engineering Curriculum for course details

Core (Level 400)
BMEN 400: Project (Design/ Research)
Pre-requisite: *Level 400 standing, BMEN 309(for students doing Research projects)*
A design or research project leading to the submission of a project report or design thesis.

BMEN 401: Engineering Principles of Human Physiology and Anatomy
Pre-requisites: *FAEN 202, BMEN 301, BMEN 302*
Application of mathematical methods to the quantitative aspects of Human Physiology. Physiological modeling and its relevance to solving clinical and biomedical engineering problems will be emphasized.

BMEN 402: Tissue Engineering and Biotechnology
(Pre-requisites: *BMEN 305, BMEN 403)*
Cell and Molecular Biology, cellular therapies, delivery of cell therapies in a clinical setting. Basic and core techniques of Biotechnology. Medical applications of Biotechnology.

BMEN 403: Cell and Molecular Biology (Pre-requisites: *BMEN 301, BMEN 302)*
Small molecules and macromolecules. Molecular organization of cells: genetic mechanisms, energy conversion, cellular compartments, control of gene expression, signaling, cell growth and division. Multicellular organisms and systems.

BMEN 404: Biomedical Engineering Systems (Pre-requisites: *FAEN 109, FAEN 202, BMEN 301, BMEN 302)*
Rudiments of linear and control systems theory and their applications to biomedical phenomena. Elements of mathematical modeling as applied to biological/physiological systems. Signals analysis of biomedical systems.

BMEN 405 : Cardiovascular Mechanics (Pre-requisites: *FAEN 204, BMEN 301***,** *BMEN 302, BMEN 307)*
Basic principles of Biofluid mechanics - generation of flow in the cardiovascular system. Flow in elastic vessels. Pulsatile and turbulent flow. Mucociliary and peristaltic flow. Cardiac valve mechanics.

BMEN 406: Transport Processes in Living Systems (Pre-requisite: *BMEN 304)*
Fluid mechanics, energy and mass transport with emphasis on applications to living systems—respiratory, circulatory, renal, etc. Mass, momentum and energy conservation, mass diffusion, convective diffusion.

BMEN 407 : Haemodynamics (Pre-requisites: *FAEN 204, BMEN 301, BMEN 302* Co-requisite: *BMEN 405)*
The structure and operation of the mammalian cardiovascular system. Hemodynamics in vascular channels. Blood rheology and non-Newtonian properties. Red blood cell behaviour in capillaries. Air flow and mixing in lungs.

BMEN 408: Professional Development Seminar (Pre-requisite: *Level 400 standing*)
Preparation for the world of work. Functions, rights and responsibilities of the Engineer: Code of ethics of the Engineer/Honesty and Integrity. Leadership skills and Team work: Effective Communication, Meetings, Resumes/CVs, Interviewing, Negotiation, Job Appraisal.

Electives (Level 400)
FAEN 401: Law for Engineers
Course discussions cover contracts (formation, performance, breach, and termination), corporations and partnerships, insurance, professional liability, risk management, environmental law, torts, property law, evidence and dispute resolution. The course emphasizes those principles necessary to provide engineers with the ability to recognize issues which are likely to arise in the engineering profession and introduces them to the complexities and vagaries of the legal profession.

FAEN 402: Principles of Management and Entrepreneurship
Introduction: Definition of management. Evolution and Perspectives of Management: classical, human relations and management science. Hierarchy of Management, Managerial roles and Management Styles. Inside and Outside an Organization: adapting to change and understanding the environment. Management Functions: Planning and Decision Making, Organizing, Leading and Communicating. Entrepreneurial Process and types of Businesses. Creating New Products/Services and Business plans. Evaluation: Analysis of new ventures, valuation techniques, Intellectual Property Issues. Financing New Ventures. Elements of Marketing Management. Managing Growth and Exit Strategy.

BMEN 409: Local Issues in Biomedical Engineering
Discussion of issues relevant to Ghanaian society and the role of Biomedical Engineers in Ghana.

BMEN 412: Medical Physics (Pre-requisite: *FAEN 109*)
Medical radiation engineering. Electromagnetic and particulate radiation and its interaction with matter. The physics of radiation therapy and nuclear medicine.

<u>Departmental Requirements</u>
In addition to the University and Faculty requirements to graduate with a BSc Engineering (Biomedical Engineering) a student must pass the following courses :

- BMEN 303 Bioinstrumentation
- BMEN 305 Biomaterials
- BMEN 307 Biomechanics
- BMEN 312 Medical Imaging
- BMEN 314 Internship (Industrial Practice III)
- BMEN 400 Project (Design/Research)
- BMEN 402 Tissue Engineering and Biotechnology
- BMEN 404 Biomedical Engineering Systems
- BMEN 406 Transport Processes in Living Systems
- BMEN 407 Haemodynamics

DEPARTMENT OF COMPUTER ENGINEERING

INTRODUCTION

The Department was established in 2004, under the Faculty of Engineering Sciences. The Department runs an intensive four-year programme that culminates in a Bachelor of Science (BSc) degree in Computer Engineering with a strong liberal arts background. The curriculum for the bachelor's programme broadly encompasses studies in hardware, software, computer systems and communication, which are essential in the design, analysis, development, and application of computer and digital systems. The range of courses offered equip students with knowledge and skills adequate to enable them specialize in the various areas of computer engineering in the Department; software systems, communication networks, hardware systems, and computer systems, among others. In addition to the technical courses offered, students are also offered the opportunity to apply their knowledge to practical problems of industry through internship programmes. The Department maintains a minimum requirement of two internships before graduation to strengthen the practical knowledge and industrial exposure of students and to make them suitable for the industry and research. The Department has also instituted an open seminar series held at least twice a semester to offer students the opportunity to interact with industrial experts.

FACULTY

Godfrey A. Mills - Lecturer/**Ag. Head**
BSc (Elect. Eng) Kumasi MSc PhD (Electronics & Comp) Gunma Japan

Isaac K. Nti - Lecturer
BSc (Geod Eng) Kumasi MSc (Geom IT) Karlrushe

Wiafe Owusu Banahene - Lecturer
BSc (Geod Eng) Kumasi MSc (Geom IT) Karlrushe MSc (Res Eng) Karlrushe

Robert A. Sowah - Lecturer
BSc (Elect. Eng) Kumasi MSc PhD (Elect. Eng) Howard, USA

Jacob K. Adopley - Lect./Part-time
BSc (Mech Eng) Kumasi MSc (Mech Eng Delaware MSc PhD (Elect. Eng) Arizona

Prosper Afriyie - Lecturer
*BSc (Electronics) Westminster London **MSc***

Appah Bremang - Assistant Lecturer
BSc (Comp Sci) Kumasi MSc (Comp Eng Dalarna Sweden)

Percy Okae - Assistant Lecturer
BSc (Elect. Eng) Kumasi MSc (Telcom Eng) Louisiana Lafayette

Agyare Debra - Senior Lecturer/Part-time
BSc MSc (Electronics)

Stephen Kanga Armoo - Assistant Lecturer
BSc (KNUST), MSc (Weingarten)

Koudjo Mawuefam Koumadi - Lecturer
BSc (Beijing), MSc, PhD (KAIST)

Barfi Owusu Adomako - Lecturer/Part-time
BSc (Comp Sci)(Ghana) MSc (Telecom Eng) Denmark
Francis Boachie - Lecturer/Part-time
BSc (Elect. Eng) Kumasi MSc (Info Eng) London

PROGRAMME STRUCTURE

Level 100 – Semester I

Course Code	Course Title	Credits
FAEN 101	Algebra	4
FAEN 103	Basic Mechanics I	3
FAEN 105	Engineering Drawing with CAD	3
FAEN 109	General Physics	3
CPEN 101	Engineering Computational Tools	2
UGRC 110	Academic Writing I	3
	Total Credits	**18**

Level 100– Semester II

Course Code	Course Title	Credits
FAEN 102	Calculus I	4
FAEN 106	Applied Electricity	3
FAEN 108	Basic Electronics	3
FAEN 112	C Programming	2
CPEN 102	Introduction to Database Systems	3
UGRC 150	Critical Thinking and Practical Reasoning	3
	Total Credits	**18**

Level 200 – Semester I

Course Code	Course Title	Credits
FAEN 201	Calculus II	4
CPEN 201	C++ Programming	3
CPEN 203	Digital Circuits	3
CPEN 205	Discrete Mathematical Structures	2
CPEN 207	Introduction to Software Engineering	3
UGRC 220	Introduction to African Studies	3
	Total Credits	**18**

Level 200 – Semester II

Course Code	Course Title	Credits
FAEN 202	Differential Equations	4
FAEN 206	Technical Report Writing	3
CPEN 202	Computer Systems Design	2
CPEN 204	Data Structures and Algorithms	3
CPEN 206	Linear Circuits	3
UGRC 130	Understanding Human Societies	3
	Total Credits	**18**

Level 300 – Semester I

Course Code	Course Title	Credits
FAEN 301	Numerical Methods	3
CPEN 301	Signals and Systems	3
CPEN 303	Computer Architecture	3
CPEN 305	Computer Networks	3
CPEN 307	Operating Systems	3
CPEN 309	Programming Language Fundamentals	3
	Total Credits	**18**

Level 300 – Semester II

Course Code	Course Title	Credits
FAEN 302	Statistics for Engineers	3
CPEN 302	Computer Systems Engineering	3
CPEN 304	Digital Signal Processing	3
CPEN 306	Microelectronic Devices and Circuits	3
CPEN 308	Fundamentals of Information Transmission	2
CPEN 312	Object Oriented Programming with Java	3
CPEN 314	Industrial Practice	1
	Total Credits	**18**

Level 400 – Semester I

Course Code	Course Title	Credits
FAEN 401	Law for Engineers	3
CPEN 400	Independent Project	3
CPEN 401	Control Systems Analysis and Design	3
CPEN 403	Embedded Systems	3
CPEN 405	Artificial Intelligence	3
Electives I	**A1. Software Systems**	
CEPN 407	Software Engineering	3
CPEN 409	Computer Graphics	3
	B1. Hardware Systems	
CPEN 411	VLSI Systems Design	3
CPEN 413	Microprocessor Systems and Integration	3
	C1. Computer Systems	
CPEN 415	Distributed Computing	3
CPEN 417	Applications for Parallel Processors	3
	Total Credits	**18**

Level 400– Semester II

Course Code	Course Title	Credits
FAEN 402	Principles of Management and Entrepreneurship	3
CPEN 400	Independent Project	3
CPEN 402	Advanced Computer Architecture	3
CPEN 404	Computer Vision and Robotics	3
CPEN 406	Wireless Communication Systems	3
Electives II	**A2. Software Systems**	
CPEN 408	Human Computer Interface	3
CPEN 412	Web Software Architecture	3
	B2. Hardware Systems	
CPEN 414	DSP System Implementation	3
CPEN 416	Integrated Circuit for Communication	3
	C2. Computer Systems	
CPEN 418	Security in Computer Systems	3
CPEN 422	Multimedia Systems	3
	Total Credits	**18**

COURSE DESCRIPTIONS

FAEN 101: Algebra

Concept of a function of a single variable, graphs of functions - linear, quadratic and higher degree polynomial functions, rational functions, inequalities in one and two variables, binomial theorem, circular measure, trigonometric functions, exponential and logarithmic functions, hyperbolic functions. Algebra of complex numbers. Vectors and matrices, the solution of linear systems of equations, vector spaces and subspaces, orthogonality, determinants, eigenvalues and eigenvectors, linear transformations.

FAEN 102: Calculus I

Limits and Continuity of a function of a single variable. Differentiation: Rules of differentiation, chain rule and parametric differentiation, differentiation of trigonometric functions and their inverses, exponential and logarithmic functions, higher order derivatives, Leibnitz's rule. Differentiability: Rolle's Theorem, mean-value theorem, approximate methods of solving equations (graphical and Newton-Raphson methods). Integration and its applications: Area under curve, volumes of solids of revolution. Numerical integration: Trapezium and Simpson's rules. Vector function of a single variable: Differentiation and integration of vector functions, kinematics of a single particle in motion. Newton's laws of motion, motion in a straight line and in a plane, projectiles and circular motion, work, energy and power; impulse and momentum, moment of a force, couple, conditions for equilibrium of rigid bodies

FAEN 103: Basic Mechanics I

General principles of mechanics, methods of problem solution, and numerical accuracy. Force vectors and mathematical operations. Static Particles: Coplanar force on a particle, resultant of forces, resolution of forces, conditions for the equilibrium of a particle, Newton's first law,

free-body diagram, forces in space. Force System Resultants**.** Statics of a rigid body and conditions for equilibrium. Centroids and centers of gravity

FAEN 105: Engineering Drawing with CAD

Technical Drawing**:** Introduction to Engineering Drawing, sketching and line techniques, geometric constructions, multiview drawings and orthographic projection, auxiliary views, descriptive geometry. Engineering Drawing**:** Dimensioning, sectioning, tolerances, fits, Assembly drawings, cross sectional views, half sections. AutoCAD**.** Starting AutoCAD, object construction in AutoCAD, isometric drawings in AutoCAD, 3D AutoCAD and solid modeling, application of AutoCAD to the following: Technical surface finish, measurement, methods of examination and specification.

FAEN 106: Applied Electricity

Foundations of electricity: charge, voltage, current, power and energy, computation of power and energy for electrical gadgets and household, simple billing calculations. Electricity supply: definition and characteristics of AC and DC voltages and currents and their applications, calculation of Instantaneous, RMS and Average voltage and current values and their relevance. Transformer: definition and components of a transformer, principle of operation, ideal transformer and characteristics, transformer types and ratings used by utilities in Ghana. AC circuit systems: definition of 1-phase 2-phase and 3-phase circuit systems, voltage and current relationship between the circuit systems, sample voltage drop and line loss calculation for electricity supply from source to destination. Electricity supply: electricity utilities and functional roles, electricity generation sources, hydro power generation process, transmission process, distribution process to users in Ghana. Power factor: definition and relevance, active power, reactive power, and apparent power, calculation of power factor and correction. Electric Motors: components of an electric motor, basic principle of operation, motor types and applications. Electrical Safety: importance of electrical safety, shock current, common sources of hazards, safe practices.

FAEN 108: Basic Electronics

History and overview of electronics from vacuum tubes to large scale integration, including reasons for studying electronics, selected important areas of application, role of electronics in computer engineering. Semi-conductivity: materials and properties, electrons and holes, concept of doping, acceptors and donors, *p* and *n*-type materials, conductivity and resistivity. Diodes and Circuits: symbol and representation, diode operation and characteristics, region of operation and limitations, zener and schottky diodes, diode circuit and load line, diode application in rectifier and dc/dc converter, diode logic functions - AND and OR . Bipolar Junction Transistors (BJT): physical structure of BJT, symbol and circuit representation, NPN and PNP transistor operation, voltage-current characteristics of transistors, transistor region of operation and limitation, transistor circuit analysis, biasing for logic application, transistor operation as logic functions – OR and AND logics.

FAEN 109: General Physics

Vibrations: Simple harmonic motion, damped harmonic motion, forced harmonic motion. Waves: Wave types, wave phenomena – interference and diffraction. Electricity and Magnetism: Coulomb's law, electric field, Gauss's law, electric potential, current electricity – EMF, Kirchhoff's laws, DC circuits, Magnetic field: Bio-Savart's law, Ampere's law. Induction: Faraday and Lenz's law, AC circuits. Introductory Modern Physics: Bohr's atom, quantum theory of atom, electronic transitions, optical spectrum, X-rays, photo-electric effect, motion of charges in electric and magnetic fields

FAEN 112: C Programming

History of the C language. Structure of the C Program. Variables Declarations: Global variables, type and range of variables, declaration of variables, scope of variables, reading and

printing of variables. Constants Declarations. The C Operators: Arithmetic, Relational, Logical, and order of operation precedence. Conditional Instructions. Looping and Iterations. Arrays and Strings: Single and multi-dimensional. Functions: VOID function, Functions and Arrays, Function prototyping. Data Types: Unions, type casting, enumerated types, static variables. Pointers: pointers and variable, pointers and functions, pointers and arrays, arrays of pointers, multi-dimensional arrays and pointers, static initialization of pointer arrays, pointers and structures, common pointer pitfalls. Dynamic Memory Allocation and Dynamic Structures: MALLOC and SIZEOF and FREE, CALLOC and REALLOC, Linked Lists, random number generation, sample full C program

CPEN 101: Engineering Computational Tools

Computing systems: computer hardware components and organization, computer software – operating system, types of computer languages, concept for executing a computer program. Engineering problem solving methodology, software tools for solving engineering problems. Spreadsheet: characteristics of spreadsheet, arithmetic operations, common engineering functions and operations, logical operations, plotting capabilities, simple engineering model application with spreadsheet. MATLAB: user interface, characteristics of Matlab program. Working with Variables: creating variables, data import from external sources, data entry, scalars, vector and matrix data, vector and matrix arithmetic, plotting and visualization. MATLAB file: Matlab editor, creating M-files, editing and running files. MATLAB functions: Basic mathematical functions, data analysis functions, random functions, logical functions, relational and logical operators, if statements, loop. Data Input and Output: data types and formats in Matlab, constructing and accessing data types, converting data types, import and export of files types. Matlab applications for solving basic engineering problems.

CPEN 102: Introduction to Database Systems

History and overview of database and management systems including reasons for studying database, database access method, application, role of database in computer engineering. Database Environments: data model hierarchy, network, entity relation, enhanced entity relation, relational database, object oriented database. Relational Data Model: entity relationship modelling. Normalization of Database Tables: data redundancy and associated problems, Normalisation Process, 1NF, 2NF, 3NF, BCNF, 4NF. Query Language: Language paradigms and database languages, user interfaces and graphical query languages, query optimization, data dictionary. Distributed Database System: distributed DBMS concepts and design, distributed relational database, distributed transaction management. Replication and Mobile Databases: basic components of database replication, replication environments, replication servers, mobile databases. Selected database issues: security, concurrency. Introduction to business intelligence, data warehousing, data mining.

Core (Level 200)

FAEN 201: Calculus II

Sequences and Series: Evaluating limits of sequences, tests of convergence of finite series, power series; radius and interval of convergence, Maclaurin and Taylor series. Improper integrals: Convergence, Special functions: Gamma and Beta functions etc, Lagrange polynomials, finite differences, and least square approximation. Functions of Several Variables: Limits and continuity, partial differentiation, critical points and their classifications, increments and differentials, implicit differentiation, the chain rule, directional derivatives. Differential operators: The gradient, the divergence and the curl operators, line integrals, multiple integrals, integration of vector functions, Green's theorem, divergence and Stokes theorem

FAEN 202: Differential Equations
Differential Equations: First and Second order ordinary differential equations, series solutions, system of ordinary differential equations. Initial-value problems: Laplace transform, partial differential equations, boundary-value problems, Fourier series and transforms, applications

FAEN 206: Technical Report Writing
Audience Analysis, Types of Genres, Preparing an outline. Referencing and Documentation. Illustrations: table and figures, bar charts, graphs, organization charts, flow sheets, drawing and photographs. Research proposal writing, Technical Style: use of abbreviations, Numbering of headings. Design of Questionnaires. Oral Presentations. Case Study

CPEN 201: C++ Programming (Prerequisite: *FAEN 112*)
History of C++, ANSI C++, C++ programming environment and programming style. Extensions of C to C++. Creating of Files and Streams in C++, connecting and disconnecting. Arrays as parameter functions, sorting arrays, 2-dimensional arrays, dynamic arrays, automatic and dynamic variables, linked lists. Declaration of Pointers and Addresses and their usage. Functions and Procedural Abstractions: User-defined functions, value and reference parameters, functions using value parameters, reference parameters, procedural abstraction and good programming style, splitting programs into different files. Basic concepts of recursion, mechanics of a recursive call, recursion and iteration, recursive data structures, recursive procedure for sorting. C++ extensions to Object-Oriented Programming: Creating basic classes and objects, constructors and destructors, inheritance, construction, destruction, and multiple inheritances. Polymorphism. Abstract Classes. Operator overloading. A case study: Generic types (templates), shape and traversal, properties of singly linked lists, shape implementation, Iterator implementation and example usage

CPEN 202: Digital Systems Design (*Prerequisite*: *CPEN 203)*
Introduction to VHDL: overview of VHDL and characteristics, user interface and features, assignment statements, signal assignment, conditional signal assignment, statement generation, concurrent and sequential assignment statement, process statement, case statement, VHDL operator. Digital Systems Design: hierarchy and modular design of digital systems, design principles, functional units and building blocks and components, control concepts, timing concepts. Programmable devices: PLD, FPGA, PLA, ROM, PAL, CPLD. Modeling and Simulation: block diagram development, hierarchical schematic modeling, digital system modeling with VHDL, functional simulation of combinational and sequential circuits, flip-flop selection, timing models of digital circuit elements, timing simulation to measure delays, simulation and testing of circuit. Formal Verification: relationship between good design practice and formal verification, verification by model checking, verification by proof, verification by equivalence checking, verification by simulation, verification by testing, economics of verification, other verification – signal integrity, specification, reliability, safety, power, cooling. Fault models and testing of logic circuits: types and characteristics of common faults in digital circuits, single and multiple faults, test coverage, fault equivalence and dominance, fault simulation and grading, test generation algorithms, test generation algorithm for sequential circuits, memory testing and PLA testing.

CPEN 203: Digital Circuits (Prerequisite: *FAEN 108)*
History and overview of digital logic including reasons for studying digital circuits, important areas of application, role of digital circuits in computer engineering. Switching theory: number systems and codes, binary arithmetic and logical operations, Boolean and switching algebra, representation and manipulations of functions, minimization of functions. Combinational Logic: truth tables, basic logic gates, realization of switching functions with networks of logic gates, relations between electronic circuits and Boolean functions. Design of Combinational Circuits: multiplexers, arithmetic functions - half and full adders, subtractors, multipliers and dividers, arithmetic and logic units. Memory Elements: basic circuits for

latches, clocked and unclocked memory devices, basic Flip-Flops (RS, D and JK), asynchronous flip-flop inputs (preset, clear), timing constraints (setup time, hold time), data registers (selection, clocking timing), random access memory. Sequential Logic Circuit: finite state machines (FSM), Mealy and Moore models of FSM, modeling FSM behavior (state diagram, table, timing diagram, algorithm state, machine chart), synchronous and asynchronous circuits and analysis, design of synchronous sequential circuits (state minimization, assignment, next state, output realization), sequential functional units (data registers, shift registers, counters, sequence detectors, synchronizers, debouncers)

CPEN 204: Data Structures and Algorithms

History and overview of data structures and algorithms, role of algorithms in computing. Pointers and Structures: Pointer Data Types and Pointer Variables, Introduction to Structures, Accessing Structure Members, Pointers and Structures as Structure Members. Fundamental concepts: Recursion, *Divide-and-Conquer* , *Backtracking.* Data Abstraction and Abstract Data Types (ADT). Fundamental Data Structures: Arrays and Lists. Linked Lists: Introduction to the concepts of linked lists. Doubly linked-list, circular doubly linked list with a sentinel. Applications of linked list. Queues: Introduction to the concepts of queues and double ended-queues. Applications and implementations of queues. Stacks: Introduction to the concepts of stacks. Applications and implementations of stacks. Analysis of Algorithms: Asymptotic Notation, Performance of searching and sorting algorithms. Searching Algorithms: Search algorithms, sequential search, and binary search. Sorting Algorithms: Quick Sort, Merge sort, Selection sort, Insertion sort, Bubble sort. Graphs: Graph representation, Operations on graphs, Graph Traversals, Shortest Path algorithms, Minimal Spanning Trees. Trees: Concepts of trees, binary trees, binary search trees, binary tree traversal algorithms. *Standard Template Library(STL): Components of STL, containers, iterators, algorithms.

CPEN 205: Discrete Mathematical Structures

History and overview of discrete mathematical structures including reasons for studying the course and application areas, and how computer engineering makes use of the discrete structures. Functions and relations: functions, discrete versus continuous function, relations, continuous and discrete relations, sets – Venn diagram, power sets, complements. Foundations of logic: propositional logic, logical connectives, truth table, normal forms, validity, predicate logic and limitations, universal and existential quantifications. Proof techniques: notion of implication, contradiction, structure of formal proofs, direct proofs, proof by counter example, proof by contraposition and contradiction, mathematical induction. Recursion and Recurrence Relations: concepts of recursion and recurrence, derivation of recurrence equations, initial condition, first order linear recurrence, constant coefficient recurrence, solution to a first order constant coefficient linear recurrence, iterating a recurrence. Counting: permutations and combinations, counting arguments rule of products, rule of sums, generating functions, modeling combinational problems. Graphs and trees: trees, directed and undirected graphs, spanning trees, shortest paths, applications.

CPEN 206: Linear Circuits

History and overview of linear circuits, reasons for studying linear circuits, areas of applications, relevance of linear circuits to computer engineering. Circuit components – resistance, reactance, inductance, capacitance, active and reactive elements, resistance and impedance. Circuit configurations: series, parallel and hybrid configuration of circuits and applications. Circuit laws: Ohm's law, Kirchhoff law, dependent and independent sources, voltage and current divider circuits. Network analysis: nodal analysis and mesh analysis methods. Network theorems: source transformation, superposition, Thevenin, Norton, Maximum power transfer. Operational amplifier: symbol and circuit representation, ideal operational amplifier, inverting and non-inverting amplifiers, integrator and differentiator circuits, design of simple amplifiers. First order circuits: inductance, capacitance, derivation of time constants for RC and RL circuits, response of first order circuits under source-free and

step input conditions, switching in first order circuits and applications. Second order circuits: characteristic equation of series and parallel RLC circuits, response of RLC circuit under source-free and step input conditions. Circuit frequency response: frequency response of RC and RLC circuits, transfer functions, resonance of RC and RLC circuits and applications. Sinusoidal analysis: phase representation of voltage and current, impedance and admittance, forced response to sinusoidal function,

CPEN 207: Introduction to Software Engineering

History and overview of software engineering, reasons for studying the software engineering, and role of software engineering in computer engineering. Introduction to the process of creating software systems. Software processes: software life cycle, process model, process assessment models, and software process metrics. Requirements and specification: software requirements specification, requirements analysis modeling techniques, functional and nonfunctional requirements, prototyping, concepts of formal specification techniques. Software design: design concepts and principles, software architecture, structured design; object oriented analysis and design, component level design, design for reuse. Software testing: validation planning, test plan creation and generation, black-box testing techniques, object oriented testing, inspections. Software evolution: different forms of software maintenance, impact analysis, characteristics of maintainable software, reengineering, and software reuse strengths and weaknesses. Software tools and environment: programming environments, requirements analysis and design modeling tools, testing tools, configuration management tools, software tools based on databases, tool integration mechanisms. Software project management: organization and management of teams including roles and responsibilities of team and tracking, project scheduling, software measurements, risk analysis, software quality assurance, project management tools.

Core (Level 300)

FAEN 301: Numerical Methods

Matrices and Vector operations, linear homogenous systems, Eigen-vectors and values. Numerical errors, absolute and relative errors, stability and convergence of numerical algorithms. Interpolation Methods: Lagrange polynomials, finite differences, least square approximation. Numerical solutions to Nonlinear Equations: Newton Raphson method, secant, false position, bisection, fixed point algorithm. Numerical Integration: Simpson's rule, trapezoidal rule, Newton-Cotes method. Numerical solutions to Ordinary Differential Equations: Taylor series method, Euler method, Runge-Kutta method. Numerical solutions to Partial Differential Equations: Second order quasi-linear equations, numerical solutions

FA**EN 302: Statistics for Engineers**

Probability functions axioms and rules, counting techniques, conditional probability, independence and mutually exclusive events. Discrete Random Variable: Expectation and variance, Binomial distribution, Hypergeometric distribution, Poisson distribution, relationship between Poisson and Binomial. Continuous Random Variable: Percentiles and cumulative distribution function, expectation and variance, uniform distribution, normal distribution, exponential distribution and other distributions. Joint Distributions.

Covariance and Correlation. Sampling Distributions: Distributions of statistics, central limit theorem, samples from normal distribution (t-distribution, X^2 distribution and F-distributions). Estimation: Common point estimators, interval estimators. Hypothesis Testing. Introduction to Regression Analysis. Engineering applications in quality control, process control, communication systems and speech recognition

CPEN 301: Signals and Systems

History and overview of signals and systems including reasons for studying signals and systems, areas of application, and role of signals and systems in computer engineering. Signals: representation and properties, continuous and discrete time signals, signals in

engineering applications. Systems: representation, common system types and classifications, system properties of linearity, causality, BIBO stability, time invariance, memory and invertibility. Difference equation: differential equations, transformation of time domain differential equations to difference equations. Convolution: impulse response, convolution integral, convolution summation, circuit analysis using convolution. Fourier analysis: signal representation by Fourier series, continuous time Fourier series, discrete time Fourier series, discrete Fourier transform, difference between the transformation methods, circuit analysis using Fourier. Fourier transform: continuous time Fourier transform definition, discrete time Fourier transform, transfer functions. Sampling: sampling theorem, Nyquist criteria, sampling of signals, aliasing, up and down sampling, concept of signal quantization and reconstruction of samples. Laplace transform: Laplace transform integral, properties of Laplace, impulse response, step and ramp functions, inverse transform, poles and zeros, circuit analysis using Laplace transform. Filter circuits: passive and active filter circuits, transfer function.

CPEN 302: Computer Systems Engineering

History and overview of computer systems engineering including reasons for studying computer systems, and role of computer systems in computer engineering. Computer system engineering process: life cycle, requirements analysis, specification, architectural design, testing, maintenance, and implementation in computer systems engineering. Packaging in computer systems. Wires in computer systems: electrical properties of transmission lines, models of lines, lossy and lossless lines, and buses. Noise in computer systems: noise characteristics and sources in digital systems, estimation of noise budget. Signaling in computer systems: signaling and associated problems, pseudo-differential signaling, signaling over lumped media, low-voltage signaling, signaling over on-chip and off-chip systems. Timing: timing components in computer systems, timing uncertainties of skew and jitter, sources of timing uncertainties and evaluation, timing uncertainties and data rates, synchronous and pipelining timing systems, synchronization in computer systems. Clock distribution in computer systems: clock distribution and problems associated with distribution in on-chip and off-chip. Power distribution: static and dynamic power consumption, estimation of power consumption in systems, power distribution network, power distribution in on-chip and off-chip systems.

CPEN 303: Computer Architecture

History and general overview of computer architecture and organization, including reasons for studying computer architecture, the contrast between computer organization and computer architecture, and the role of computer architecture in computer engineering. Basics of computer architecture: Von Neumann machine structure, instruction formats, fetch and execute cycle, registers, instruction types and addressing, Interrupts and I/O. Programming in assembly language. Computer arithmetic: integer and real number representations, algorithm for basic mathematical operations, algorithm for floating-point operations, hardware and software implementation of arithmetic unit. Memory system and architecture: memory types and hierarchy, main memory organization and its performance, cache memory, virtual memory, reliability of memory systems. Interfacing and communication: I/O systems and handshaking, I/O techniques of programmed I/O, interrupt-driven I/O and DMA, interrupt structures, memory system design and interfacing, system buses and protocols. Processor system design: CPU interface – clock, control bus, data bus, and address bus; address decoding, memory interfacing, serial and parallel interfaces, timers. CPU organization: single and multiple bus datapaths, instruction set architecture, implementing instructions, instruction pipelining, pipeline hazards and reducing effects of hazards, trends in computer architecture – CISC, RISC, VLIW. Performance: metrics for computer performance – clock rate, MIPS, etc, strengths and weaknesses of performance metrics, averaging metrics – arithmetic, geometric, harmonic, role of Amdahl's law in computer performance.

CPEN 304: Digital Signal Processing (Prerequisites: *CPEN 301)*
History and overview of digital signal processing, reasons for studying digital signal processing, difference between analog and digital signals, application areas of digital signal processing, and benefits of digital signal processing to computer engineering. Foundations: continuous time and discrete signals and spectral analysis, continuous and discrete time systems, sampling and aliasing, decimation and interpolation, Z-Transforms: review of difference equations, z-transform definition, region of convergence, z-transform relation to Fourier transform, zero-pole diagram and stability of systems, inverse z-transform, z-transform application to solving difference equations. Digital filters: transfer function and frequency response of discrete time systems, recursive filter design, non-recursive filter design, and windowing. FIR filter – frequency and phase response; poles and zeros in z-plane. IIR filter – frequency and phase response; design of IIR filters. Filtering random signals. Audio processing: speech coding, audio coding and MPEG algorithms, speech and audio enhancement, noise cancellation, speech recognition. Image processing: analog to digital transformation, sampling and smoothing of images and low-pass filters, reconstruction and enhancement filtering, noise and images, spatial frequency.

CPEN 305: Computer Networks
History and overview of computer networks including reasons for studying the course, description of the key components of network, networking software and hardware, terminologies, and role of networks in computer engineering. Communication network architecture: networks architecture - point-to-point and multi-point configurations, networking topologies – mesh, star, bus, ring; networking and internetworking devices - routers, repeaters, switches, gateways; connection oriented and connectionless services. Network protocols: network protocols – syntax, semantics and timing; TCP/IP protocol, OSI layering protocol software, network standard and standardization bodies. LAN and WAN architecture systems: LAN topologies – star, ring and bus; LAN technologies - Ethernet, token Ring, Gigabit Ethernet; error detection and correction, CSMA networks, circuit and packet switching, protocols – IP addressing, IP assignment and configuration, DNS, HTTP, UDP and STMP, IPv4 and IPv6, connection establishment, congestion control, flow control, virtual circuits, quality of service. Client-server computing: client-server interaction, web technologies, characteristics of web servers, support tools for website creation and web management. Data security: basics of secure networks, encryption and privacy, authentication protocols, packet filtering, firewalls, virtual private networks, transport layer security.

CPEN 306: Microelectronic Devices and Circuits (Prerequisite: *FAEN 108)*
History and overview of microelectronic devices and circuits, reasons for studying microelectronics and its role in computer engineering. Semiconductor physics: overview of basic properties of semiconductors and the p-n junction. MOSFET: physics of NMOS and PMOS transistors, simple fabrication concepts, modelling of MOSFET circuits, load-line analysis, bias circuits, small-signal equivalent circuits, common-source amplifiers, source follower amplifier stages, amplifier characteristics using two-port equivalent circuits, current and voltage gains, input and output impedances, frequency response and transfer function. NMOS and PMOS binary functionality in NAND and NOR logic. Logic circuits: CMOS inverters, NOR and NAND gates, the CMOS pass gates, buffers. Logic circuits: flip-flops, registers, counters, adders, multiplexers.

CPEN 307: Operating Systems (Prerequisite: *FAEN 112)*
History and overview of operating systems including reasons for studying operating systems, description of purpose of operating system, services and characteristics of good operating system, relevance of operating system to computer engineering. Design principles: functions of a typical operating system, mechanisms to support client-server models, design issues, structuring methods, processes and resources, concept of APIs to operating systems, device organization, interrupts and implementations, concepts of user and system states and

protection. Concurrency: states and state diagrams, dispatching and context switching, role of interrupt, concurrency execution, mutual exclusion problem and solution, deadlock and its causes and prevention, semaphores and monitors, producer-consumer problems and synchronization. Process scheduling and dispatch: preemptive and non-preemptive scheduling, schedulers and policies, processes and threads, deadlines and real-time issues. Memory management: memory types and hierarchy, memory management hardware, swapping and partitions, paging and segmentation, placement and replacement policies, working sets and thrashing, caching. File systems: files – data, metadata, operations, organization, sequential and non-sequential; directories – content and structure; file system – partitioning, mount and unmount, virtual file; special purpose file, naming, searching access and backups. Device management: characteristics of parallel and serial devices, buffering strategies, direct memory access, recovery from failure. Security: overview of security systems, security methods and devices, protection, access and authentication, models of protection, memory protection, encryption and recovery management.

CPEN 308: Fundamentals of Information Transmission

History and overview of information transmission, reasons for studying data transmission, modern trends in telecommunication technology for data transmission, role of information transmission in computer engineering. Fundamental principles: telecommunication signals and their representation, building blocks of a telecommunication systems, description of communication systems types - optical fiber system, microwave system, satellite system, mobile communication system, basic concepts of signal transmission in transmission media, time and frequency signal bandwidth, signal-to-noise ratio, channel and channel capacity, sampling theorem. Linear communication techniques: amplitude modulation process, frequency modulation process, phase modulation process, multiplexing strategies. Digital communication principles: analog to digital conversion of voice, process of signal sampling, quantization, pulse code modulation, time division multiplexing, amplitude shift keying, frequency shift keying, phase shift keying, spread spectrum techniques, digital demodulation.

CPEN 309: Programming Language Fundamentals

History and overview of programming language from FORTRAN to modern languages such as Java, including reasons for the study of programming fundamentals, challenges and techniques involved in designing programming languages, and role of programming fundamentals in computer engineering. Programming paradigms: procedural and functional programming, object oriented design, encapsulation and information hiding, separation of behavior and implementation, classes and subclasses and inheritance, event driven programming. Syntax and Semantics of programming: basic syntax and semantics of high level language, variables and types, expressions and assignments, simple input-output, conditional and iterative control structures, functions and parameter passing. Algorithms and problem solving: problem solving strategies, role of algorithms in problem solving, algorithms implementation strategies, debugging strategies, algorithm properties and concepts, structured decomposition. Data structures: primitive types, arrays, records, strings and string processing, data representation in memory, stack and heap allocation, runtime storage management, pointers and references, linked structures, implementation for stacks and queues and hash tables, implementation for graphs and trees, strategies for choosing right data structure. Recursions: concept of recursion, recursive mathematical functions, divide-and-conquer strategies, recursive backtracking, implementation of recursion. Using APIs: API programming, class browsers and related tools, programming by example, debugging in API environment, component based computing, middle ware.

CPEN 312: Object Oriented Programming with Java (Prerequisite: *CPEN 201)*

Programming techniques in unstructured, procedural and modular programming, modular programming problems and strategies. Object-Oriented program development environment tools. Object-Oriented structure and development: classes, inheritance, encapsulation,

polymorphism, class derivation, abstract classes, interfaces, static class members, object construction and destruction, namespaces, exception handling, function overloading and overriding, function name overload resolution, container classes, template classes, multiple treads and synchronization. Generic Classes and methods, Applets and Java Web start, Multimedia: Applets and Applications, GUI components, Multithreading. Applications in artificial intelligence, accessing database with JDBC, and software design and Web Services.

CPEN 314: Industrial Practice
Participation in eight-week duration industrial attachment to work on projects that intend to solve real problems defined by the industry. Students will produce report on activities engaged at the industry.

Core (Level 400)
FAEN 401: Law for Engineers
Course discussions cover contracts (formation, performance, breach, and termination), corporations and partnerships, insurance, professional liability, risk management, environmental law, torts, property law, evidence and dispute resolution. The course emphasizes those principles necessary to provide engineers with the ability to recognize issues which are likely to arise in the engineering profession and introduces them to the complexities and vagaries of the legal profession.

FAEN 402: Principles of Management and Entrepreneurship
Introduction: Definition of management. Evolution and Perspectives of Management: classical, human relations and management science. Hierarchy of Management, Managerial roles and Management Styles. Inside and Outside an Organization: adapting to change and understanding the environment. Management Functions: Planning and Decision Making, Organizing, Leading and Communicating. Entrepreneurial Process and types of Businesses. Creating New Products/Services and Business plans. Evaluation: Analysis of new ventures, valuation techniques, Intellectual Property Issues. Financing New Ventures. Elements of Marketing Management. Managing Growth and Exit Strategy.

CPEN 400: Independent Project (Prerequisite: *Level 400 standing*)
Students work independently on an original, modified or extension of an engineering project under the direction of an approved advisor. Student will apply the knowledge gained from earlier course works to design and test a system, component, or process to meet desired needs using standard engineering design process. At the end of the project student will make oral presentation of the work and submit thesis.

CPEN 401: Control Systems Analysis and Design (Prerequisites: *CPEN 301)*
History and overview including current trends in industrial control systems, reasons for studying control system and its relevance in computer engineering. Control systems: control principle, feed-back and feed-forward, control strategy. Basic operations of a minicomputer data I/O, process control, digital filter design, and optimal control. State space design methods, root locus design methods, simple pole factor, response design methods, translational mechanical system, backward rectangular rule, rotational mechanical system, independent energy storing elements, dynamic system response, root locus form, root locus gain, signal flow chart, forward rectangular rule, desired motor speed, motor position control, integrator factor, interconnection laws, diagonal canonical form, controllable canonical form, transfer functions, decentralized estimation, motor speed control system, advanced control systems, observable canonical form, observability and controllability of control systems. State Space Design Methods, Characteristics of Feedback Control Systems, Frequency Response Design Methods, Bode Diagrams, Nonlinear State Evolution, Laplace Transforms, Nyquist Diagrams, Nyquist Path, Motor Speed Closed-Loop Control, Block Diagram Solution. Analog and digital controller design such as PID, PI, and P controllers Unit step responses of PID.

CPEN 402: Advanced Computer Architecture (Prerequisites: *CPEN 303)*
Performance and cost: CPU performance benchmark, CPI analysis, analysis and cost of computer system. Instruction Set Architecture (ISA) Design: stack accumulator, general register ISA, CISC and RISC ISA design, DSP ISA. Basic pipelining. Advanced pipelining: Instruction-Level Parallelism (ILP), compiling for ILP, dynamic branch prediction, superscalar pipelines, dynamic scheduling. VLIW Architecture: Memory hierarchies, basic caches, memory hierarchy performance, improving time, miss time and penalty, memory interleaving, bandwidth improvement, and virtual memory support. I/O Subsystems. Parallel Architectures. Message Passing Architectures. Shared memory Architectures. Cache Coherence. Synchronization. Convergence Architectures. Introduction to Parallel programming

CPEN 403: Embedded Systems (rerequisites: *CPEN 303)*
History and overview of embedded system, reasons for studying embedded systems, applications, role of embedded systems in computer engineering. Embedded microcontroller: structure of a computer system, Von Newman and Harvard models, CPU families used in microcontrollers, memory and testing algorithms for microcontrollers. Peripherals: basic I/O devices, timers/counters, ADC and DAC, GPIO, interrupt driven I/O and polled I/O, interrupt structure. Interfacing: CPU interfacing, memory interfacing, serial and parallel I/O interfacing, analog and digital interfacing. Embedded software: software architecture, super loop, delays in embedded software, sample applications. Real-time operating system: context switching mechanism, scheduling policies, priority inversion, other scheduling policies, interprocess communication styles. Power management: need for low power computing in embedded systems, sources of power consumption, strategies for level power management. Development tool support: compilers and programming environment, logic analyzers, RTOS tools, power analysis, software management tools. Safety and reliability: sources of faults in embedded computing, strategies to find problems and to minimize effects of faults. Embedded design concepts including demands for soft and hard real time features, hardware and software co-design, and evaluation performance.

CPEN 404: Computer Vision and Robotics (Prerequisites: *CPEN 405*)
Fundamentals of pattern-recognition and image-analysis techniques, low-level representation, intrinsic images, segmentation, texture and motion analysis, and representation of 2-D and 3-D shape. Vision system and components: camera, illumination, optical systems, computer interface, frame stores, structured lighting, software support. Vision algorithm. Fundamentals of Robotic systems: Mechanics of robots including kinematics, dynamics, and trajectories. Robot types, components and subsystems. Robot Position and Motion: Coordinates and transformations, coordinate frames, kinematics of position and inverse kinematics, kinematics of motion, an introduction to Robot statics and dynamics, mobile robots, task planning and programming, accuracy and repeatability. Sensors, actuators and control. Robot application: automated assembly, robotic work cell design, safety Biological analogies and medical applications of Robotics.

CPEN 405: Artificial Intelligence (Prerequisites: *CPEN 206)*
History of artificial intelligence, philosophical questions about nature of intelligence, ethical issues in artificial intelligence, nature of knowledge and knowledge based systems, issues of ordering of information, modeling the world. Artificial intelligence design considerations, challenges and issues in artificial intelligence system design. Introduction to LISP programming. Blind and heuristic search concepts and techniques. Game playing and constraint propagation. Machine learning for classification and pattern recognition. Knowledge representation. Logical Reasoning systems. Uncertainty and Planning. Natural Language Processing. Vision: vision level and segmentation, constraint propagation and matching.

CPEN 406: Wireless Communication Systems (Prerequisites: *CPEN 308*)
History and overview of wireless communication, reasons for studying wireless transmissions, areas of applications, relevance of wireless systems in computer engineering. Wireless transmission issues and challenges. System Design: Basic cellular systems and selection of parameters for system design. Multi-path channels and modulation techniques. Wireless networking, base stations, mobile stations, airlink access, jamming, spoofing, signal intercept, wireless LANs, wireless modems, cellular radiotelephones, optical links, signal modeling, propagation modeling. Wireless security: introduction to physical layer and issues associated with security of the airlink interface. Wireless and mobile computing: wireless standards and compatibility, special problem of wireless and mobile computing, wireless LAN and satellite based networks, mobile internet protocol, mobile aware adaptation, mobile data access, software packages supporting mobile, wireless computing, performance issues, and emerging technologies.

Electives

CPEN 407: Software Engineering (rerequisites: *CPEN 207)*
Introduction: Software Engineering. Professional and ethical responsibility. Socio-Technical Systems: Emergent system properties, Systems engineering, Organizations, people and computer systems, Legacy systems. *Case Study on Socio-Technical Systems* Critical Systems: A simple safety-critical system, System dependability, Availability and reliability, Safety, Security. *Case Study on Critical Systems.* Software Processes: Process Models. Process Iteration. Rational Unified Process. CASE Technology. *Case Study on Software Process Models.* Requirements Engineering: Feasibility studies. Requirements: elicitation and analysis. Requirements validation. Requirements management. System Models: Behavioural Models. Data Models. Object Models. Structured Models. UML Notations. Application Architectures: Data processing systems. Transaction processing Systems. Event processing systems. Language processing systems. Object-Oriented Analysis and Design: Objects and Objects Classes. Object oriented design process. Design Evolution. UML. Rapid Software Development: Agile methods. Extreme programming, Rapid application development. Software prototyping. Software Reuse: The reuse landscape. Design patterns. Generator based reuse. Application frameworks. Application system reuse. Introduction to Project Management: Management activities. Project planning Project scheduling. Risk management. Software costing. Mini Project: Typical software engineering project.

CPEN 408: Human-Computer Interface
History and overview of human computer interaction including reasons for studying human-computer interaction in engineering, and the relevance of human-computer interaction to computer engineering. Foundations of human-computer interaction including strengths and weaknesses of ranges of human interfaces such as text based systems, graphics, sound, animations, human performance models such as perception, movement, cognition, etc., principles of good human computer interaction design in the context of computer engineering. Graphic user interface: developments interface including textual displays, displays that exhibit alarms and interactions; principles of design using GUIs, GUI toolkits, design principles for web interfaces. Intelligent systems: nature of intelligent systems and implication for sensors and software, special case of mobile systems and location aware systems, problems associated with control passing to agent and user losing control. Human centered software development: structure of large systems that embodies human-computer interaction codes, processes associated with human centered software, functionality and usability, specification of presentation and interaction, prototyping techniques and tools, quality considerations, standards and guidelines. Interactive GUI design: choice of interaction styles, human-computer interaction aspects of common widgets and of screen design, handling human failure, interfaces for computer engineering tools, multi-modal interaction, 3D interaction and virtual reality. GUI programming: user interface management systems, kernel based and client

server models for user interface, dialogue independence and level analysis, widget classes and aggregation of widgets, event management and user interaction, geometry management, GUI builders and user interface programming environment, cross platform design.

CPEN 409: Computer Graphics

Fundamentals of display techniques and graphics systems. Display devices, processors, software, introduction to Graphical Kernel System, Programmer's Hierarchical Interactive Graphics System. Representation of primitive objects. Representation of composite objects. Two-and three-dimensional transformations. Polygon mesh, spline surfaces, super-quadradrics, fractal geometry, octrees, visualization of three-dimensional data sets, geometric transformations. Parallel and perspective projections, three-dimensional view volumes. Depth-buffer, scan-line, depth sorting, area subdivision, octree, and ray-casting methods. Hidden lines and surfaces. Shading and coloring. Interactive graphics and the user interface. Structure of graphics packages 2-dimensional viewing, structures and segments, hierarchical model, graphical user interfaces, interactive input methods. Animation techniques. Color models.

CPEN 411: VLSI Systems Design

Historical perspective and future trends of large-scale integrated circuits. Behavioral models and circuit simulation of digital systems. Design methodology. CMOS devices and deep sub-micron manufacturing technology. CMOS inverters and complex gates. Modeling of interconnect wires. Optimization of designs with respect to a number of metrics: cost, reliability, performance, and power dissipation. Designing combinational logic gates in CMOS. Designing sequential circuits. Interconnect and timing considerations, and clocking approaches. Design of large system blocks, including arithmetic, interconnect, memories, and programmable logic arrays. VLSI combinatorial and sequential testing and verification, scan design. Introduction to system design methodologies including hands-on experience

CPEN 412: Web Software Architecture

History and overview of web software architecture models and programming environments pertinent to developing web applications. Web software architecture models. Internet/Web protocols. Web programming environments. Client-server models. Multi-tier software architecture. Front-end design. Client-side scripting. Web server development. Application server development. Server-side programming. Middle ware development. Database servers. Database connectivity. Introduction to XML. Service oriented architecture (SOA). Web services. Web based business Intelligence. Mobile Information systems. Mobile-web applications. Component reuse. Concurrency. Web security. Mini Project.

CPEN 413: Microprocessor Systems and Integration

Historic and overview of microprocessors, reasons for studying microprocessors, application areas, and benefits to computer engineering. Logic design techniques, electrical and timing characteristics of logic components, use of programming logic devices, state machine design. Simple computer architecture: machine instructions and programming; design of a simple computer - ALU, memory system, various internal registers, instruction decoder, basic accumulator-mapped input/output (I/O) design, stack characteristics, context save and subroutine linkage mechanisms, micro-coded control store, additional addressing modes. Programming model of practical microcontroller: inherent/register, immediate, absolute, relative, and indexed/indirect addressing modes; data transfer, arithmetic, logical, branch, and machine control instruction groups. Assembly language programming of microcontrollers: translation of high level language control structures into assembly code, assembly style loop structures, linear and non-linear table lookup techniques, loop control examples, subroutine parameter passing techniques, macros, conditional assembly, structured (top-down, bottom-up) programming techniques. Microprocessor system design. Microcontroller bus signals and timing, address space mapping, memory system timing analysis, external multiplexed bus memory, I/O expansion, interrupts, polled interfaces, I/O ports. Microcontroller peripheral

overview: asynchronous serial communications interface, synchronous peripheral interface, analog-to-digital converter, timer subsystem, design applications and device drivers. Microcontroller system design case study using Texas Instruments TMS320-series or Motorola 68HC12.

CPEN 414: DSP System Implementation (Prerequisites: *CPEN 304)*

Common DSP systems and functional elements. Discrete Fourier transforms, Fast Fourier Transform (FFT) and architecture for the FFT. Digital Filter Structures: Structures for FIR and IIR filters, cascade and parallel realization for higher order filters, introduction to the effect of finite word length. Architecture for signal processing: Computer architectures, implementation of bit-parallel, bit-serial, and digit-serial multiplier and adder structures, Harvard architecture and pipelining, general purpose DSP devices (T1 TMS320 family and Motorola DSP family ADSP2100 family), real-time FIR filtering using the general purpose DSP, FFT processing on a general purpose DSP

CPEN 415: Distributed Computing

History and overview of distributed computing, reasons for studying distributed computing, modern trends in distributing computing and application areas, role of distributed computing in computer engineering. Design, engineering, and evaluation of modern distributed computers. Design: naming, synchronization, latency, and bandwidth. Architectural support: messages versus remote procedure calls versus shared memory models. Structural alternatives: master-slave, client-server, fully distributed, cooperating objects. Coupling: tight versus loose. Distributed filing systems and directory services. Verification, validation and maintenance issues in distributed computing. Fault tolerance and reliability. Replication and avoidabilty. Standards and protocols. Temporal concerns. Data coherence. Load balancing and scheduling. Scalability. Applications. Parallel programming models, communication primitives, programming and compilation techniques, multiprogramming workloads and methodology for quantitative evaluation.

CPEN 416: Integrated Circuits for Communications

Analysis and design of electronic circuits for communication systems, with an emphasis on integrated circuits for wireless communication systems. Analysis of distortion in amplifiers with application to radio receiver design. Power amplifier design with application to wireless radio transmitters. Class A, Class B, and Class C power amplifiers. Radio-frequency mixers, oscillators, phase-locked loops, modulators, and demodulators.

CPEN 417: Applications of Parallel Computers

Models for parallel programming. Fundamental theoretical issues in designing parallel algorithms and architectures for linear algebra, sorting, Fourier Transform, etc. Survey of parallel machines and machine structures. Exiting parallel programming languages, vectorizing compilers, environments, libraries and toolboxes. Data partitioning techniques. Techniques for synchronization and load balancing. Detailed study and algorithm and program development of medium sized applications.

CPEN 418: Security in Computer Systems

History and overview of computer systems security, reasons for studying security in computer systems, modern trends in computer systems security, role of computer system security in computer engineering. Security risk identification: Descriptive account of the value and cost of acquiring information, privacy and integrity, risk assessment and management, information flow and covert channels, malicious software, analysis of the threat to information security. Protection of computer systems: Coding and cryptography, authentication methods, capabilities, access list and protection domain, standards, principles of security audit and control methods, physical and electronic counter measures to minimize threats, legal factors, database and inference control, security kernels, verification methods. Modeling: Algorithm

design, modeling and optimization of secure communication networks, introduction to principles of network management

CPNG 422: Multimedia Systems

Fundamentals concepts in multimedia systems. Resource management issues in distributed/ networked multimedia systems. QoS routing and multicasting. Traffic shaping, Task and message scheduling, Internet QoS. Adaptive multimedia applications over the Internet. Operating system support for multimedia. Storage architecture and scalable media servers. Compression techniques, synchronization techniques, processor architectures for multimedia.

Departmental Requirements for Graduation

In addition to the University and Faculty requirements, to graduate with a Bachelor of Science Degree in Computer Engineering, a student must take and pass the following courses:

FAEN 108	Basic Electronics ***or*** CPEN 306 Microelectronic Devices and Circuits
FAEN 112	C Programming ***or*** CPEN 201 C++ Programming
CPEN 202	Introduction to Software Engineering ***or*** CPEN 407 Software Engineering
CPEN 203	Digital Circuits
CPEN 202	Computer Systems Design ***or*** CPEN 302 Computer Systems Engineering
CPEN 204	Data Structures and Algorithms
CPEN 206	Linear Circuits
CPEN 301	Signals and Systems
CPEN 303	Computer Architecture ***or*** CPEN 402 Advanced Computer Architecture
CPEN 304	Digital Signal Processing
CPEN 305	Computer Networks
CPEN 307	Operating Systems
CENG 400	Independent Project
CPEN 401	Control Systems Analysis and Design
CPEN 403	Embedded Systems ***or*** CPEN 413 Microprocessor Systems and Integration
CPEN 405	CPEN 404 Computer Vision and Robotics ***or*** Artificial Intelligence
CPEN 406	Wireless Communication Systems

DEPARTMENT OF FOOD PROCESS ENGINEERING

INTRODUCTION

The Department of Food Process Engineering offers undergraduate programmes leading to the award of Bachelor of Science in Engineering with specialization in Food Process Engineering. The programme is designed to offer the student a broad engineering education to apply these to the handling, processing, storing, packaging, marketing and distribution of foods. The student is exposed to the application of knowledge of the chemical, biochemical, physical and microbiological characteristics of food. The programme offers the student the opportunity to undertake a capstone design project which addresses critical engineering problems in the food industry.

Faculty

Samuel K. Sefa-Dedeh - Professor
B.Sc. (Ghana), M.Sc. PhD (Guelph)

Henry Mensah-Brown - Lecturer (**Ag. Head of Department**)
B.Sc. (Kumasi), M.Sc. (Ife), MBA (Ghana), DIC, PhD (London)

Emmanuel Sinayobye - Lecturer
Dip (Eng) PhD (France)

George Afrane - Senior Lecturer
B.Sc. (Kumasi), M.Sc. (Vanderbilt), PhD (Rochester)

Nana Benyiwa Ackom - Asst. Lecturer
B.Sc. (Ghana), M.Sc. (Muenster)

Isaac O.A. Hodgson - Part-time Lecturer
B.Sc. (Kumasi), M.Sc. (B. Columbia), PhD (Loughborough)

Kofi Manso Essuman - Part-time Lecturer
B.Sc., M.Sc. (Ghana)

Angela Parry-Hanson - Part-time Lecturer
B.Sc, (Alberta), MSc, PhD (Pretoria)

PROGRAMME STRUCTURE

Level 100– Semester 1

Course Code	Course Title	Credits
FAEN 101	Algebra	4
FAEN 107	General Chemistry	3
FAEN 109	General Physics	3
FAEN 105	Engineering Drawing with CAD	3
FAEN 103	Basic Mechanics I	3
UGRC 110	Academic Writing I	3
	Total	**19**

Level 100 – Semester 2

Course Code	Course Title	Credits
FAEN 102	Calculus I	4
FAEN 104	Basic Mechanics II	2
FAEN 106	Applied Electricity	3
FAEN 108	Basic Electronics	3
FAEN 112	C Programming	3
FPEN 122	Internship (Industrial Practice I)	
UGRC 150	Critical Thinking and Practical Reasoning	3
	Total	**18**

Level 200 – Semester 1

Course Code	Course Title	Credits
FAEN 201	Calculus II	4
FAEN 203	Strength of Materials	3
FAEN 205	Thermodynamics	3
FPEN 201	Introduction to Food Process Engineering	2
CPEN 101	Engineering Computational Tools	2
UGRC 220	African Studies	3
	Total	**17**

Level 200 – Semester 2

Course Code	Course Title	Credits
FAEN 202	Differential Equations	4
FAEN 204	Fluid Mechanics	3
FAEN 206	Technical Report Writing	3
FPEN 202	Food Process Engineering Calculations	2
FPEN 204	Physical and Chemical Properties of Food	3
FPEN 222	Internship (Industrial Practice II)	
UGRC 130	Understanding Human Societies	3
	Total	**18**

Level 300 – Semester I

Course Code	Course Title	Credits
FAEN 301	Numerical Methods	3
FPEN 301	Heat Transfer	2
FPEN 303	Thermodynamics II	2
FPEN 305	Engineering & Design of Food Process I	3
FPEN 307	Introduction to Food Microbiology	3
FPEN 309	Process/Product Development in Food Processing	3
FPEN 311	Introduction to Biotechnology	2
	Total	**18**

Level 300 – Semester II

Course Code	Course Title	Credits
FAEN 302	Statistics for Engineers	3
FPEN 302	Separation Processes	2
FPEN 304	Engineering & Design of Food Process II	3
FPEN 306	Chemical Reaction Engineering	2
FPEN 308	Environmental Engineering in Food Processing	3
FPEN 312	Mass Transfer	2
FPEN 322	Internship	1
FPEN 314	Rheological and Sensory Properties of Food	2
	Total	**18**

Level 400 – Semester I

Course Code	Course Title	Credits
FAEN 401	Law for Engineers	3
FPEN 400	Independent Engineering Study (Capstone Engineering Design)	3
FPEN 401	Food Plant Design & Economics	3
FPEN 405	Engineering and Design of Food Process III (Plant Products)	3
FPEN 403	Engineering Design	2
FPEN 407	Statistical Quality Control in Food Processing	2
FPEN 409	Safety in Food Plants	2
FPEN 411	Professional Development Seminar	2
FPEN 420	Research Project	2
	Total	**18**

Student to take core and electives to make a total of 18 credits

Level 400 – Semester II

Course Code	Course Title	Credits
FAEN 402	Principles of Management and Entrepreneurship	3
FPEN 400	Independent Engineering Study (Capstone Engineering Design)	3
FPEN 402	Engineering and Design of Food Process IV (Animal Products)	3
FPEN 404	Food Process Control	3
FPEN 406	Food Packaging	2
FPEN 408	Microbiological Applications in Food Processing	2
FPEN 420	Research Project	2
FOSC 402	Food Processing Plant Operations and Sanitation.	2
	Total	**18**

Student to take core and electives to make a total of 18 credits

COURSE DESCRIPTIONS

Core (Level 100)

FAEN 101: Algebra

Concept of a function of a single variable, graphs of functions - linear, quadratic and higher degree polynomial functions, rational functions, inequalities in one and two variables, binomial theorem, circular measure, trigonometric functions, exponential and logarithmic functions, hyperbolic functions. Algebra of complex numbers. Vectors and matrices, the solution of linear systems of equations, vector spaces and subspaces, orthogonality, determinants, eigenvalues and eigenvectors, linear transformations.

FAEN 102: Calculus I

Limits and Continuity of a function of a single variable. Differentiation: Rules of differentiation, chain rule and parametric differentiation, differentiation of trigonometric functions and their inverses, exponential and logarithmic functions, higher order derivatives, Leibnitz's rule. Differentiability: Rolle's Theorem, mean-value theorem, approximate methods of solving equations (graphical and Newton-Raphson methods). Integration and its applications: Area under curve, volumes of solids of revolution. Numerical integration: Trapezium and Simpson's rules. Vector function of a single variable: Differentiation and integration of vector functions, kinematics of a single particle in motion. Newton's laws of motion, motion in a straight line and in a plane, projectiles and circular motion, work, energy and power; impulse and momentum, moment of a force, couple, conditions for equilibrium of rigid bodies

FAEN 103: Basic Mechanics I

General principles of mechanics, methods of problem solution, and numerical accuracy. Force vectors and mathematical operations. Static Particles: Coplanar force on a particle, resultant of forces, resolution of forces, conditions for the equilibrium of a particle, Newton's first law, free-body diagram, forces in space. Force System Resultants. Statics of a rigid body and conditions for equilibrium. Centroids and centers of gravity.

FAEN 104: Basic Mechanics II

Branches of dynamics, Rectilinear Motion of Particles: Displacement, velocity, acceleration, uniformly accelerated motion, relative motion, dependent motions, and graphical methods. Curvilinear Motion of Particles: Displacement, velocity, acceleration, rectangular components, tangential and normal components. Kinetics of Particles: Newton's second law of motion, equations of motion. Work, Energy, Power and Efficiency: Work done by a force, springs, kinetic and potential energy, conservation of energy, principle of work and energy, power, efficiency. Impulse and Momentum: Impulse, linear and angular momentum, conservation of momentum, system of particles. Kinematics of Rigid Bodies. Introduction to Vibration: Undamped free vibration, undamped forced vibration, rotational vibration, energy method, damped free vibration, damped force vibration, electric analogue

FAEN 105: Engineering Drawing with CAD

Technical Drawing**:** Introduction to Engineering Drawing, sketching and line techniques, geometric constructions, multiview drawings and orthographic projection, auxiliary views, descriptive geometry. Engineering Drawing**:** Dimensioning, sectioning, tolerances, fits, Assembly drawings, cross sectional views, half sections. AutoCAD**.** Starting AutoCAD, object construction in AutoCAD, isometric drawings in AutoCAD, 3D AutoCAD and solid modeling, application of AutoCAD to the following: Technical surface finish, measurement, methods of examination and specification

FAEN 106: Applied Electricity

Foundations of electricity: voltage, current, resistance, DC and AC, AC waveforms, magnitude and phase, applications of AC and DC systems. Series and Parallel circuits. Transformers: Principle of operations, transformer types, ratings, considerations for transformer selection. AC Circuits: Single and three-phase systems, voltage levels and frequencies used in Ghana, harmonics in power systems. Power Factor and its calculation and correction in power systems, power in resistive and reactive AC circuits, active power, reactive power, and apparent power. Motors and Controls: Principles of operation of motors, control techniques for motors, motor types and applications. Electricity Generation: Generation sources, Power generation process, transmission and distribution in Ghana. Conductors and Insulators: Power transmission and distribution conductors, sizes, choice of conductor sizes, fuses, insulator break-down. Electrical Safety: Importance of electrical safety, shock current, safe practices, common sources of hazards, safe circuit design and safe meter usage.

FAEN 107: General Chemistry

Atomic Structure: The Schrödinger equation, quantum numbers, solution to the Schrödinger equation for one electron atom. Hund's Rule, Pauli's and Aufau principles. Periodic properties of elements: Overview of general features of S-block, P-block and D-block elements. Thermochemistry: Heat and energy, heat of formation, Hess Law, estimation of bond energies. Acids and Bases: pH, strengths of acids and bases, buffers, salts, electrolytic solutions solubility and solubility products concept. Oxidation: Reduction reactions, standard electrode potential, electrochemical cell, concentration dependence of electrode potential, electrochemical series, corrosion, prevention of corrosion, electrolysis, and Faraday's laws

FAEN 108: Basic Electronics

History of electronics from vacuum tubes to large scale integration, classification of electronic signals (digital, analog, role of A/D and D/A converters), electronic components, symbols and identification. Semiconductivity. Diodes and Diode Circuits: diode characteristics, model, and behavior in relation to circuits and analysis. Field-Effect Transistors and Circuits: MOSFET characteristics and model, biasing techniques, circuit symbol, analog MOSFET amplifier. Bipolar Junction Transistors (BJT): Physical structure of the BJT, circuit representation, transistor biasing, and transistor ratings. Fundamentals of Digital Electronics: Ideal logic gates, logic level definition and dynamic response of logic gates, logic gates examples. Signal Amplifiers: Concept of amplification, operational amplifier and its application as a filter, the BJT and MOSFET transistor as amplifiers, small signal behavior of the transistor. Basic Analog and Digital circuit elements, frequency response, signal generator, filters and waveform shaping circuits.

FAEN 109: General Physics

Vibrations: Simple harmonic motion damped harmonic motion, forced harmonic motion, resonance and applications. Waves: Wave types, wave phenomena – interference and diffraction and applications. Electricity: Coulomb's law, electric field, Gauss's law, electric potential, current electricity – EMF, Kirchhoff's laws, DC circuits. Magnetism: Magnetic field, Bio-Savart's law, Ampere's law. Induction: Faraday and Lenz's law. AC Circuits: Reactance, Impedance, power factor, resonance. Introductory Modern Physics: Bohr's atom, quantum theory of atom, electronic transitions, optical spectrum. Photoelectric effect.

FAEN 112: C Programming

History of the C language. Structure of the C Program. Variables Declarations: Global variables, type and range of variables, declaration of variables, scope of variables, reading and printing of variables. Constants Declarations. The C Operators: Arithmetic, Relational, Logical, and order of operation precedence. Conditional Instructions. Looping and Iterations. Arrays and Strings: Single and multi-dimensional. Functions: VOID function, Functions and Arrays, Function prototyping. Data Types: Unions, type casting, enumerated types, static variables. Pointers: pointers and variable, pointers and functions, pointers and arrays, arrays of pointers, multi-dimensional arrays and pointers, static initialization of pointer arrays, pointers and structures, common pointer pitfalls. Dynamic Memory Allocation and Dynamic Structures: MALLOC and SIZEOF and FREE, CALLOC and REALLOC, Linked Lists, sample full C program

FPEN 122: Internship

First year attachment with industry.

Core (Level 200)

FAEN 201: Calculus II

Vector spaces and Subspaces: Linear independence and dependence of vectors, Basis and dimension, linear transformations and matrices, determinants, application to the solution of systems of linear equations. Eigenvalues and eigenvectors. Sequences and Series: Evaluating limits of sequences, tests of convergence of finite series, power series; radius and interval of convergence, Maclaurin and Taylor series. Improper integrals: Convergence, Gamma and Beta functions, Lagrange polynomials, finite differences, and least square approximation

FAEN 202: Differential Equations

Differential Equations: First and Second order ordinary differential equations, series solutions, system of ordinary differential equations. Initial-value problems: Laplace transforms partial differential equations, boundary-value problems, Fourier series and transforms, applications.

FAEN 203: Strength of Materials

Introduction: Basic concepts of material bonding, material structure and material defects. Properties of Materials: Mechanical properties, thermal properties, electronic and ionic conductivity of materials, dielectric and magnetic properties of materials. Simple stress and strain within elastic limit and thermal stress. Tensile bending and shear bending of beams. Torsion of circular shafts. Torsional stress and strain. Strength of solid and hollow shafts. Theories of failure. Compound stress-strain system (Mohr's stress and strain circles). Torsion of circular shafts Torsional stress and strain. Fatigue failure and Struts. Beams of small radius of curvature. Springs (helical, spiral and flat), Strain energy method (Castigliano's theorem). Bending under plastic conditions. Torsion under plastic conditions. Thin walled pressure vessels. Composite shafts

FAEN 204: Fluid Mechanics

Introduction: nature of fluids, analysis of fluid behaviour, viscosity, surface tension and capillary effects. Fluid Statics: hydrostatic forces on submerged plane and curved surfaces; buoyancy and stability; Elementary Fluid Dynamics: static, dynamic and total pressure; energy line and hydraulic grade line. Fluid Kinematics: velocity and acceleration fields; control volume and system representations; Reynolds transport theorem. Control Volume Analysis: continuity equation; linear momentum and moment-of-momentum equations; energy equation; irreversible flow. Differential analysis of fluid flow: fluid element kinematics; conservation of mass; conservation of linear momentum; inviscid flow; plane potential flows. Similitude, dimensional analysis, and modelling: dimensional analysis; Buckingham Pi Theorem; common dimensionless groups; modelling and similitude. Flow in pipes: laminar and turbulent flow; fully developed laminar flow; fully developed turbulent flow; dimensional analysis of pipe flow; pipe networks; flowrate measurement. Flow over immersed bodies: drag and lift; friction and pressure drag; flow over flat plates, across cylinders and spheres. Open-channel flow: general characteristics: surface waves; energy considerations; uniform flow; gradually varied flow; rapidly varied flow; flow measurement. Turbo-machines: basic energy and momentum considerations; centrifugal pumps; dimensional parameters and similarity laws; axial-flow and mixed-flow pumps; fans; turbines; compressible flow turbomachines.

FAEN 205: Thermodynamics

Fundamental concepts of thermodynamics. First and second Laws of Thermodynamics and their applications. Properties of Substances: Properties of pure, simple and compressible substances. Introduction to Gas and Vapor Power Cycles.

FAEN 206: Technical Report Writing

Preparing an outline. Technical Style. Use of abbreviations. Numbering of Headings. Documentation footnotes and alphabetical list of reference. Table and figures, Bar charts, graphs, curves Organization charts and flow sheets. Drawing. Photographs. Case Study

FPEN 201: Introduction to Food Process Engineering

Introduction to Food Process Engineering as the use of engineering and biological principles to the development of products, processes and systems that serve the needs of society. Flow sheeting Basics, types of diagrams, Material and Energy Balances. Precision and dimensional consistency in engineering calculations, Overview of key food properties, introduction of concept of unit operations. The use of spreadsheets and process simulation software for engineering calculations. Seminar on the Food Industry in Ghana

FPEN 202: Food Process Engineering Calculations

Introduction to complex material and energy balances, balances involving chemical reaction, combustion, recycle and purge. Process modelling and simulation, using computers in flow sheeting. Seminar on the Food Industry in Ghana

FPEN 204: Physical and Chemical Properties of Food
Classification of foods. The microstructure, chemistry and physical properties of food commodities in relation to process design and quality assessment. Water, protein, carbohydrates, lipids, vitamins, enzymes and minerals in foods. Flavour, colour, browning reactions and functional properties of foods

UGRC 130: Understanding Human Societies
(Content to be provided)

Elective (Level 200)
FPEN 222: Internship
Second year industrial attachment

CPEN 101: Engineering Computational Tools
Computing systems: computer hardware components and organization, computer software – operating system, types of computer languages, concept for executing a computer program. Engineering problem solving methodology, software tools for solving engineering problems. Spreadsheet: characteristics of spreadsheet, arithmetic operations, common engineering functions and operations, logical operations, plotting capabilities, simple engineering model application with spreadsheet. MATLAB: user interface, characteristics of Matlab program. Working with Variables: creating variables, data import from external sources, data entry, scalars, vector and matrix data, vector and matrix arithmetic, plotting and visualization. MATLAB file: Matlab editor, creating M-files, editing and running files. MATLAB functions: Basic mathematical functions, data analysis functions, random functions, logical functions, relational and logical operators, if statements, loop. Data Input and Output: data types and formats in Matlab, constructing and accessing data types, converting data types, import and export of files types. Matlab applications for solving basic engineering problems.

Core (Level 300)
FAEN 301: Numerical Methods (Prerequisites: *FAEN 101, FAEN 110, FAEN 201)*
Matrices and vector operations, linear homogeneous systems, Eigen-vectors and values. Numerical errors, absolute and relative errors, stability and convergence of numerical algorithms. Interpolation Methods: Lagrange polynomials, finite differences, least square approximation. Numerical solutions to Nonlinear Equations: Newton Raphson method, secant, false position, bisection, fixed point algorithm. Numerical Integration: Simpson's rule, trapezoidal rule, Newton-Cotes method. Numerical solutions to Ordinary Differential Equations: Taylor series method, Euler method, Runge-Kutta method. Numerical solutions to Partial Differential Equations: Second order quasi-linear equations, numerical solutions.

FAEN 302: Statistics for Engineers (Prerequisites: *FAEN 201, FAEN 202, FAEN 301)*
Probability functions axioms and rules, counting techniques, conditional probability, independence and mutually exclusive events. Discrete Random Variable: Expectation and variance, Binomial distribution, Hypergeometric distribution, Poisson distribution, relationship between Poisson and Binomial. Continuous Random Variable: Percentiles and cumulative distribution function, expectation and variance, uniform distribution, normal distribution, exponential distribution and other distributions. Joint Distributions. Covariance and Correlation. Sampling Distributions: Distributions of statistics, central limit theorem, samples from normal distribution (t-distribution, X^2 distribution and F-distributions). Estimation: Common point estimators, interval estimators. Hypothesis Testing. Introduction to Regression Analysis. Engineering applications in quality control, process control, communication systems and speech recognition.

FPEN 301: Heat Transfer (Prerequisite: *FAEN 202, FAEN208*)
Theory of transmission of heat by conduction, convection and radiation. Steady and unsteady state heat transfer and applications in food processing. Analogies between heat and momentum transport. Emphasis on mathematical modelling, solution techniques, and design.

FPEN 302: Separation Process (Prerequisite: *FPEN 201 or FPEN 301)*
Staged separation processes and product recovery, Distillation, Solvent extraction in the food industry. Centrifugation, Filtration, Membrane concentration (hyper-filtration and ultra-filtration), expression.

FPEN 303: Thermodynamics II (Prerequisites: *FAEN 205*)
Solution Thermodynamic Theory and Applications (Gibbs–Duhem), Chemical potential, fugacity and activity coefficient, Volumetric Property of Pure Fluids - PVT behavior of pure substances, ideal gas, Viral equations, etc, Vapour–Liquid equilibrium at low to moderate pressures, vapour- liquid equilibrium from equations of state, General relations for Homogeneous substances. Two phase systems - Phase Equilibria - liquid/liquid equilibrium (LLE), vapor/liquid/liquid equilibrium (VLLE), solid/liquid equilibrium (SLE), solid/vapor equilibrium (SVE), Chemical Reaction Equilibria.

FPEN 304: Engineering and Design of Food Process II
Principles and application of refrigeration and freezing to food systems. Thermal processing of foods; aseptic processing. Fermentations and fermentors. Design and analysis of enzymatic and microbial biological reaction systems. Food fermentations and control systems. Engineering application, design and analysis of processes based on these operations.

FPEN 305: Engineering and Design of Food Process I
Treatment of dehydration, size reduction, mixing and emulsification, filtration, centrifugation and evaporation, irradiation, agglomeration, membrane processes and stantization, Engineering application in food systems. Design and analysis of processing based on these operations. Practical assignments related to each unit operation.

FPEN 306: Chemical Reaction Engineering
Concepts of rate, stoichiometry and equilibrium to the analysis of chemical and biological systems. Derivation of rate expressions from reaction mechanisms and equilibrium or steady state assumption. Batch, plug flow and continuous stirred tank reactor designs, heterogeneous and enzymatic catalysis, heat and mass transport in reactors, including diffusion to and within catalyst particles and cells or immobilized enzymes.

FPEN 307: Introduction to Food Microbiology
Historical background and developments, Habitats, taxonomy and growth parameters, Taxonomy, role and significance of microorganisms in foods, Intrinsic and extrinsic parameters of foods that affect microbial growth. Microorganisms in foods - Spores and their significance, Determining microorganisms and/or their products in foods, Culture, microscopic and sampling methods, Physical, chemical, molecular and immunological methods, Bioassay and related methods, Food preservation and some properties of psychrotrophs, thermophiles and radiation-resistant bacteria, Indicators of food safety and quality, Indicator microorganisms

FPEN 308: Environmental Engineering in Food Processing
Principles of environmental engineering; introduction to environmental pollution control; environmental impact assessment; industrial waste treatment and control; solid waste management.

FPEN 311: Process/Product Development in Food Processing
An independent study on the design or improvement of a food product and/or the process employed for producing the product (under supervision)

FPEN 312: Mass Transfer (Prerequisite: *FAEN 202)*
Applications of mass transfer in chemical engineering science, unit operations and separations. Fundamentals include diffusion and mass transport. Mass transfer applications-non-equilibrium separations including gas absorption and adsorption, membrane processes and devices and crystallization. Microscopic and macroscopic issues. Unsteady-state mass transfer; simultaneous heat and mass transfer-hot air drying, spray drying and freeze drying applications

FPEN 322: Internship
Coordinated and planned work experience with cooperating industries and agencies.

Elective (Level 300)
FPEN 309: Introduction to Biotechnology
Introduction to principles of food biotechnology. Principles and application of genetic engineering in the food industry. Application of biotechnology to improve food quality and yield. Continuous fermentation, agitation mass transfer and scale-up of fermentation systems, enzyme technology. Engineering applications in modern food biotechnology.

FPEN 314: Rheological and Sensory Properties of Food
Introduction to rheology of foods. Modeling rheological behavior of fluids, Methods for measuring flow behavior of food – including tube viscometry, rotational viscometry, extensional flow, Newtonian and non-Newtonian flows, texture and sensory measurements and evaluation of food.

Core (Level 400)
FAEN 401: Law for Engineers
Course discussions cover contracts (formation, performance, breach, and termination), corporations and partnerships, insurance, professional liability, risk management, environmental law, torts, property law, evidence and dispute resolution. The course emphasizes those principles necessary to provide engineers with the ability to recognize issues which are likely to arise in the engineering profession and introduces them to the complexities and vagaries of the legal profession.

FAEN 402: Principles of Management and Entrepreneurship
Introduction: Definition of management. Evolution and Perspectives of Management: classical, human relations and management science. Hierarchy of Management, Managerial roles and Management Styles. Inside and Outside an Organization: adapting to change and understanding the environment. Management Functions: Planning and Decision Making, Organizing, Leading and Communicating. Entrepreneurial Process and types of Businesses. Creating New Products/Services and Business plans. Evaluation: Analysis of new ventures, valuation techniques, Intellectual Property Issues. Financing New Ventures. Elements of Marketing Management. Managing Growth and Exit Strategy.

FPEN 400: Independent Engineering Study
Engineering design experience. Food process problem identification, formulation of proposals and execution. An independent study and design project (under supervision). Project will require submission of a written report and will include oral presentation of report.

FPEN 401: Food Plant Design and Economics
Design systems for food processing. Process simulation or modelling for optimization purposes applied to food processing. Evaluation of food processing plant systems. Utilities and regulatory requirements. Relevant Food Laws. Social impact of the plant. Equipment design and evaluation. Methods of estimating costs of equipment, operating costs, and other financial evaluations for determining profitability

FPEN 402: Engineering and Design of Food Process IV – Animal Products
Animal foodstuffs and their conversion to value-added products. Fish, milk and milk products, meat and poultry and eggs. Applications of low temperature processing and storage, smoking, packaging, dehydration etc. to animal products processing. Design of processes for industrial production.

FPEN 405: Engineering and Design of Food Process III – Plant Products
Plant foodstuffs and their conversion to value-added products. Cereals, roots and tubers, oilseeds, fruits and vegetables, spice and essences. Design of processes for industrial production

Elective (Level 400)
FPEN 403: Engineering Design
Fundamentals of engineering design. Identification of food processing problems and application of design principles to a supervised project. Evaluation of economics and other operational concerns of specific process.

FPEN 404: Food Process Control (Prerequisite *FAEN 202)*
Basics of Monitoring and Control (objectives and types of control, social & economic issues of automation, applications in food processing). Instrumentation in the Food Industry (Instrumentation, and Monitoring, Measurement Devices/sensors and their selection, Data Capture: Data loggers, data historians, data visualisation). Dynamic modelling, Introduction to Automatic Control (Feedback and Feed Forward Control, Controller Tuning). Application to Batch and continuous Food Processing

FPEN 406: Food Packaging
An integrated presentation of the scientific and technical aspects of packaging foods. Principles of food packaging; functions of packaging; properties of packaging materials e.g. metal, glass, paper and plastics. The design, fabrication and applications of food packaging. Packaging of selected food products. Aseptic packaging, food package interactions, handling of packages and modified atmosphere packaging.

FPEN 407: Statistical Quality Control in Food Processing
Quality management principles for the food industry. Total quality management. Development of grades and standards of quality. Quality, processes and control. Methods and philosophy of statistical process control. Attributes control charts, variables control charts, cumulative-sum and exponentially weighted moving-average control charts. Process-capability analysis; process improvement with designed experiments- response surface methodology. Acceptance sampling. Designing the statistical process control system; Six-sigma process quality.

FPEN 408: Microbiological Applications in Food Processing
Microbial spoilage of foods, Foodborne pathogenic bacteria, Mycotoxigenic molds, Viruses, Foodborne and Waterborne parasites, Preservation and preservation methods, Physical methods of food preservation, Chemical preservatives and natural antimicrobial compounds, Biologically based preservation systems and probiotic bacteria, Food fermentations, Fermented diary products, Fermented vegetables, Fermented meat, poultry and fish products,

Traditional fermented foods, Cocoa and coffee, Beer, and Wine. Principles of quality control and microbial criteria, Hazard Analysis Critical Control Point system (HACCP), Good Manufacturing Practices (GMP), Good Hygiene Practice (GHP)

FPEN 409: Safety in Food Processing Plants
Safety principles in food plant design and operations. Hazard evaluation procedures. Process Safety Management (PSM) and the food industry. Principles of Inherently Safer Designs (ISD). Laws and regulations on plant safety. Field evaluation of safety in the Ghanaian Food Industry.

FPEN 411: Professional Development Seminar
Defining career goals and objectives, Code of ethics in engineering. Responsibilities towards employer, your colleagues, subordinates, the community and local businesses. Skills development and continuing education..Leadership, teamwork and trust. Developing your professional profile (Curriculum vitae etc.), Interviewing, Negotiation, Job Appraisal. Understanding the food industry. Career options. Diversifying skills. Consulting and setting up professional practice.

FPEN 420: Research Project
A supervised field or laboratory investigation. Identification of research problem in the food and allied industries**.**

FOSC 402: Food Processing Plant Operations and Sanitation
Refer to the Food Science Curriculum for course details and prerequisites.

Departmental Requirements

In addition to the University and Faculty requirements, to graduate with a BSc Engineering (Food Process Engineering) a student must pass the following courses:

- FPEN 202 Food Process Engineering Calculations
- FPEN 204 Physical and Chemical Properties of Food
- FPEN 302 Separation Processes
- FPEN 304 Engineering and Design of Food Process II
- FPEN 305 Engineering and Design of Food Process I
- FPEN 309 Process/Product Development in Food Processing
- FPEN 400 Independent Engineering Study (Capstone Design Project)
- FPEN 401 Food Plant Design & Economics
- FPEN 402 Engineering and Design of Food Process IV (Animal Products)
- FPEN 405 Engineering and Design of Food Process III (Plant Products)
- FPEN 409 Safety in Food Plants

DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

INTRODUCTION

Materials technology development through engineering science continues to make startling changes in our lives in the 21st century. The Department of Materials Science and Engineering (MSE), a foundation member of the Faculty of Engineering Sciences, trains students in the field of materials science and engineering. There is an abundance of natural resources in Ghana yet to be exploited on commercial scale. Good examples are clays and other ceramic materials. It is the wish of the Department to produce materials engineers with entrepreneurial skills to turn these materials into useful industrial and domestic items.

The programme has been designed to offer three options (ceramics, metals and polymers) after a common programme taken in the six out of eight semesters. The specific goals are such that after going through the programme students should have had a solid background in the fundamental areas of MSE (structure-property relationship, processing, behaviour and performance and characteristics. structural and non structural materials, thermodynamics and kinetics, materials characterization and materials selection and processing, phase diagrams, crystallography, defects) before the specialization.

FACULTY

William A. Asomaning - Associate Professor/**Ag Head**
BSc MSc (Chem) Ghana DPhil (Chem) Sussex

Daniel Y. D. Bensah - Lecturer
BSc (Chem) Kumasi MSc (Mat Sci &Eng) NTNU

Lucas N. W. Damoah - Lecturer
BSc (Mat Eng) (Kumasi) MSc (Mat Sci &Eng) NTNU

Johnson K. Efavi - Lecturer
BSc (Mat Eng) Kumasi MSc (Mat. Sci & Eng) CAU
PhD (Elect Mat Sci & Eng)RWTH AN Germany

David Dodoo-Arhin - Lecturer
BSc (Phys) Cape Coast Post Grad Dip (Edu) Cape Coast PhD
(Mat Sci & Eng) Trento Italy

Abu Yaya - Lecturer
BSc. (Chem) UCC,Ghana MSc. (Mat. Sci) UA/AAU, Portugal/Denmark
PhD. (NanoMat) IMN, France

Benjamin Agyei-Tuffour - Asst Lecturer
BSc (Met Eng) Ksi MSc(Mat Sci &Eng) NTNU

Emmanuel Nyankson - Asst. Lecturer
BSc (Chem Eng) Kumasi MSc (Mat Sci & Eng)NTNU

Ebenezer Annan - Asst. Lecturer
BSc (Phys) Cape Coast MSc (Laser Application) Hull
MSc (Proj Management) Sunderland Post Grad Dip Edu Sthrathclyde

David Sasu Konadu - Asst. Lecturer
BSc (Mat Eng) Kumasi MSc (Mat Eng) WITS South Africa

Kwaku A. Danso - Part-Time Lecturer
BSc (Chem Eng) Kumasi MSc(Nuc Tech) PhD Surrey Post-Grad Dip
(Comp Sc) North London

David M. B. Tetteh - Part-time Lecturer
BSc (Ceramics) MPhil (Mat Eng) Kumasi Lecturer

Sylvanus A. Dogbe - Part-Time Lecturer
BSc (Chem) Kumasi MSc (Polymer Chem & Tech) Loughborough

PROGRAMME STRUCTURE

Level 100 - Semester I

Course Code	Course Title	Credits
FAEN 101	Algebra	4
FAEN 103	Basic Mechanics I	3
FAEN 105	Engineering Drawing with CAD	3
FAEN 107	General Chemistry	3
FAEN 109	General Physics	3
UGRC110	Academic Writing I	3
	Total	**19**

Level 100 - Semester II

Course Code	Course Title	Credits
FAEN 102	Calculus I	4
FAEN 104	Basic Mechanics II	3
FAEN 106	Applied Electricity	3
FAEN 108	Basic Electronics	2
FAEN 112	C Programming	2
MTEN 102	Internship	-
UGRC 150	Critical Thinking and Practical Reasoning	3
	Total	**17**

Level 200 - Semester I

Course Code	Course Title	Credits
FAEN 201	Calculus II	4
FAEN 203	Strength of Materials	3
FAEN 205	Thermodynamics	3
UGRC 220	Introduction to African Studies	3
CPEN 101	Engineering Computational Tools	2
MTEN 201	Fundamentals of Materials Sci. & Engineering	3
	Total	**18**

Level 200 - Semester II

Course Code	Course Title	Credits
FAEN 202	Differential Equations	4
FAEN 204	Fluid Mechanics	3
FAEN 206	Technical Report Writing	3
MTEN 202	Kinetic Processes and Surface Phenomenon	2
MTEN 204	Thermodynamics of Materials	2
MTEN 206	Internship	-
UGRC 130	Understanding Human Societies	3
	Total	**17**

Level 300 - Semester I

Course Code	Course Title	Credits
FAEN 301	Numerical Methods	3
MTEN 301	Materials Laboratory I	1
MTEN 303	Introduction to Materials Processing	2
MTEN 305	Mechanical Behaviour of Materials	2
MTEN 307	Phase Equilibria of Materials	2
MTEN 309	Materials Analyses Techniques	3
MTEN 311	Solid State Technology	3
MTEN 313	Electrical, Magnetic & Optical Properties of Materials	3
	Total	**19**

Level 300- Semester II

Course Code	Course Title	Credits
FAEN 302	Statistics for Engineers	3
MTEN 302	Internship III	1
MTEN 304	Computational Materials Science	2
MTEN 306	Materials Laboratory II	1
MTEN 308	Heat and Mass Transfer	3
Prescribed Elective Courses (8 credits)		
	Ceramic option	
MTEN 312	Crystal Chemistry of Ceramics	3
MTEN 314	Ceramic Processing Principle	3
MTEN 316	Engineering Ceramics I	2
	Metal option	
MTEN 318	Principles of Extractive Metallurgy	3
MTEN 322	Physical Metallurgy	3
MTEN 324	Metal Joining Technology (Welding)	2
	Polymer option	
MTEN 326	Organic Chemistry of Polymers	3
MTEN 328	Polymer Processing Tech I	3
MTEN 332	Physical Properties of Polymers	2
	Total	**18**

Level 400 - Semester I

Course Code	Course Title	Credits
FAEN 401	Law for Engineers	3
MTEN 400	Project Work	3
MTEN 401	Composite Design and Fabrication	3
MTEN 403	Refractories	2
MTEN 405	Process & Quality Control	3
Prescribed Elective Courses (4 Credits)		
	Ceramics	
MTEN 407	Engineering Ceramics II	2
MTEN 409	Glasses, Cements and Concretes	2

Metal		
MTEN 411	Physical Metallurgy II	2
MTEN 413	Foundry Technology	2
Polymer		
MTEN 415	Biodegradable Polymer & Fibrous Materials	2
MTEN 417	Polymer Processing & Technology II	2
	Total	**18**

Level 400 - Semester II

Course Code	Course Title	Credits
FAEN 402	Principles of Management & Entrepreneurship	3
MTEN 400	Project Work	3
MTEN 402	Non-Destructive Evaluation and Failure	2
MTEN 404	Project Management	2
MTEN 408	Professional Development – Seminar	1
MTEN 412	Materials Selection & Design	2
MTEN 414	Environmental Engineering & Waste Management	3
MTEN 416	Corrosion & Corrosion Control	2
	Total	**18**

COURSE DESCRIPTIONS

CORE (LEVEL 100)

FAEN 101: Algebra

Concept of a function of a single variable, graphs of functions - linear, quadratic and higher degree polynomial functions, rational functions, inequalities in one and two variables, binomial theorem, circular measure, trigonometric functions, exponential and logarithmic functions, hyperbolic functions. Algebra of complex numbers. Vectors and matrices, the solution of linear systems of equations, vector spaces and subspaces, orthogonality, determinants, eigenvalues and eigenvectors, linear transformations.

FAEN 103: Basic Mechanics I

General principles of mechanics, methods of problem solution, and numerical accuracy. Force vectors and mathematical operations. Static Particles: Coplanar force on a particle, resultant of forces, resolution of forces, conditions for the equilibrium of a particle, Newton's first law, free-body diagram, forces in space. Force System Resultants**. Statics of a rigid body and conditions for equilibrium. Centroids and centers of gravity**

FAEN 105: Engineering Drawing with CAD

Technical Drawing**:** Introduction to Engineering Drawing, sketching and line techniques, geometric constructions, multiview drawings and orthographic projection, auxiliary views, descriptive geometry. Engineering Drawing**:** Dimensioning, sectioning, tolerances, fits, Assembly drawings, cross sectional views, half sections. AutoCAD**.** Starting AutoCAD, object construction in AutoCAD, isometric drawings in AutoCAD, 3D AutoCAD and solid modeling, application of AutoCAD to the following: Technical surface finish, measurement, methods of examination and specification

FAEN 107: General Chemistry

Atomic Structure: The Schrödinger equation, quantum numbers, solution to the Schrödinger equation for one electron atom. Hund's Rule, Pauli's and Aufau principles. Periodic properties of elements: Overview of general features of S-block, P-block and D-block elements. Thermochemistry: Heat and energy, heat of formation, Hess Law, estimation of bond energies. Acids and Bases: pH, strengths of acids and bases, buffers, salts, electrolytic solutions solubility and solubility products concept. Oxidation: Reduction reactions, standard electrode potential, electrochemical cell, concentration dependence of electrode potential, electrochemical series, corrosion, prevention of corrosion, electrolysis, and Faraday's laws

FAEN 109: General Physics

Vibrations: Simple harmonic motion, damped harmonic motion, forced harmonic motion. Waves: Wave types, wave phenomena – interference and diffraction. Electricity and Magnetism: Coulomb's law, electric field, Gauss's law, electric potential, current electricity – EMF, Kirchhoff's laws, DC circuits, Magnetic field: Bio-Savart's law, Ampere's law. Induction: Faraday and Lenz's law, AC circuits. Introductory Modern Physics: Bohr's atom, quantum theory of atom, electronic transitions, optical spectrum, X-rays, photo-electric effect, motion of charges in electric and magnetic fields

FAEN 102: Calculus I

Limits and Continuity of a function of a single variable. Differentiation: Rules of differentiation, chain rule and parametric differentiation, differentiation of trigonometric functions and their inverses, exponential and logarithmic functions, higher order derivatives, Leibnitz's rule. Differentiability: Rolle's Theorem, mean-value theorem, approximate methods of solving equations (graphical and Newton-Raphson methods). Integration and its applications: Area under curve, volumes of solids of revolution. Numerical integration: Trapezium and Simpson's rules. Vector function of a single variable: Differentiation and integration of vector functions, kinematics of a single particle in motion. Newton's laws of motion, motion in a straight line and in a plane, projectiles and circular motion, work, energy and power; impulse and momentum, moment of a force, couple, conditions for equilibrium of rigid bodies

FAEN 104: Basic Mechanics II

Branches of dynamics, Rectilinear Motion of Particles\; \displacement, velocity, acceleration, uniformity accelerated motion, relative motion, dependent motions and graphical methods. Curvilinear motion of particles; Displacement, velocity, acceleration, rectangular components, tangential and normal components. Kinetics of particles: Newton's second law of motion, equations of motion, Work, Energy, Power and Efficiency: Work done by force, springs, kinetic and potential energy, conservation of energy, principle of work and energy, power, efficiency, impulse and Momentum: Impulse, linear and angular momentum, conservation of momentum, system of particles. Kinematics of rigid bodies. Introduction to vibration:Undamped free vibration, undamped forced vibration, rotational vibration, energy method, damped free vibration, damped force vibration, electric analogue.

FAEN 106: Applied Electricity

Foundations of electricity: charge, voltage, current, power and energy, computation of power and energy for electrical gadgets and household, simple billing calculations. Electricity supply: definition and characteristics of AC and DC voltages and currents and their applications, calculation of Instantaneous, RMS and Average voltage and current values and their relevance. Transformer: definition and components of a transformer, principle of operation, ideal transformer and characteristics, transformer types and ratings used by utilities in Ghana. AC circuit systems: definition of 1-phase 2-phase and 3-phase circuit systems, voltage and current relationship between the circuit systems, sample voltage drop and line loss calculation for electricity supply from source to destination. Electricity supply: electricity

utilities and functional roles, electricity generation sources, hydro power generation process, transmission process, distribution process to users in Ghana. Power factor: definition and relevance, active power, reactive power, and apparent power, calculation of power factor and correction. Electric Motors: components of an electric motor, basic principle of operation, motor types and applications. Electrical Safety: importance of electrical safety, shock current, common sources of hazards, safe practices.

FAEN 108: Basic Electronics

History and overview of electronics from vacuum tubes to large scale integration, including reasons for studying electronics, selected important areas of application, role of electronics in computer engineering. Semiconductivity: materials and properties, electrons and holes, concept of doping, acceptors and donors, p and n-type materials, conductivity and resistivity. Diodes and Circuits: symbol and representation, diode operation and characteristics, region of operation and limitations, zener and schottky diodes, diode circuit and load line, diode application in rectifier and dc/dc converter, diode logic functions - AND and OR . Bipolar Junction Transistors (BJT): physical structure of BJT, symbol and circuit representation, NPN and PNP transistor operation, voltage-current characteristics of transistors, transistor region of operation and limitation, transistor circuit analysis, biasing for logic application, transistor operation as logic functions – OR and AND logics.

ELECTIVES (LEVEL 100)

FAEN 112: C Programming

History of the C language. Structure of the C Program. Variables Declarations: Global variables, type and range of variables, declaration of variables, scope of variables, reading and printing of variables. Constants Declarations. The C Operators: Arithmetic, Relational, Logical, and order of operation precedence. Conditional Instructions. Looping and Iterations. Arrays and Strings: Single and multi-dimensional. Functions: VOID function, Functions and Arrays, Function prototyping. Data Types: Unions, type casting, enumerated types, static variables. Pointers: pointers and variable, pointers and functions, pointers and arrays, arrays of pointers, multi-dimensional arrays and pointers, static initialization of pointer arrays, pointers and structures, common pointer pitfalls. Dynamic Memory Allocation and Dynamic Structures: MALLOC and SIZEOF and FREE, CALLOC and REALLOC, Linked Lists, random number generation, sample full C program

LEVEL 200

FAEN 201: Calculus II

Sequences and Series: Evaluating limits of sequences, tests of convergence of finite series, power series; radius and interval of convergence, Maclaurin and Taylor series. Improper integrals: Convergence, Special functions: Gamma and Beta functions etc, Lagrange polynomials, finite differences, and least square approximation. Functions of Several Variables: Limits and continuity, partial differentiation, critical points and their classifications, increments and differentials, implicit differentiation, the chain rule, directional derivatives.

Differential operators: The gradient, the divergence and the curl operators, line integrals, multiple integrals, integration of vector functions, Green's theorem, divergence and Stoke's theorem.

FAEN 202: Differential Equations

Differential Equations: First and Second order ordinary differential equations, series solutions, system of ordinary differential equations. Initial-value problems: Laplace transforms partial differential equations, boundary-value problems, Fourier series and transforms, applications.

FAEN 203: Strength of Materials

Introduction: Basic concepts of material bonding, material structure and material defects. Properties of Materials: Mechanical properties, thermal properties, electronic and ionic

conductivity of materials, dielectric and magnetic properties of materials. Simple stress and strain within elastic limit and thermal stress. Tensile bending and shear bending of beams. Torsion of circular shafts. Torsional stress and strain. Strength of solid and hollow shafts. Theories of failure. Compound stress-strain system (Mohr's stress and strain circles). Torsion of circular shafts Torsional stress and strain. Fatigue failure and Struts. Beams of small radius of curvature. Springs (helical, spiral and flat), Strain energy method (Castigliano's theorem). Bending under plastic conditions. Torsion under plastic conditions. Thin walled pressure vessels. Composite shafts

FAEN 204: Fluid Mechanics

Introduction: nature of fluids, analysis of fluid behaviour, viscosity, surface tension and capillary effects. Fluid Statics: hydrostatic forces on submerged plane and curved surfaces; buoyancy and stability;

Elementary Fluid Dynamics: static, dynamic and total pressure; energy line and hydraulic grade line. Fluid Kinematics: velocity and acceleration fields; control volume and system representations; Reynolds transport theorem. Control Volume Analysis: continuity equation; linear momentum and moment-of-momentum equations; energy equation; irreversible flow. Differential analysis of fluid flow: fluid element kinematics; conservation of mass; conservation of linear momentum; inviscid flow; plane potential flows. Similitude, dimensional analysis, and modeling: dimensional analysis; Buckingham Pi Theorem; common dimensionless groups; modelling and similitude. Flow in pipes: laminar and turbulent flow; fully developed laminar flow; fully developed turbulent flow; dimensional analysis of pipe flow; pipe networks; flowrate measurement. Flow over immersed bodies: drag and lift; friction and pressure drag; flow over flat plates, across cylinders and spheres. Open-channel flow: general characteristics: surface waves; energy considerations; uniform flow; gradually varied flow; rapidly varied flow; flow measurement. Turbo-machines: basic energy and momentum considerations; centrifugal pumps; dimensional parameters and similarity laws; axial-flow and mixed-flow pumps; fans; turbines; compressible flow turbomachines.

FAEN 205: Thermodynamics

Fundamental concepts of thermodynamics. First and second Laws of Thermodynamics and their applications. Properties of Substances: Properties of pure, simple and compressible substances. Introduction to Gas and Vapor Power Cycles.

FAEN 206: Technical Report Writing

Preparing an outline. Technical Style. Use of abbreviations. Numbering of Headings. Documentation footnotes and alphabetical list of reference. Table and figures, Bar charts, graphs, curves Organization charts and flow sheets. Drawing. Photographs. Case Study

MTEN 201: Fundamentals of Materials Science and Engineering I

This course is designed to introduce students to the structures and properties of metals, ceramics, polymers, composites, and electronic materials. Students will also gain an understanding of the processing and design limitations of materials. Topics fundamental to the further study of materials, such as crystal structures, phase diagrams, and materials design and processing will be emphasized as foundations for future MSE courses. Phase transformations in metals; Introduction to metal alloys and their properties; Applications and processing of ceramics; Cement; Polymers structures; Characteristics, applications and processing of polymers; introduction to composites; introduction to failure of materials; Economic and Environmental issues in materials science & engineering.

MTEN 203: Kinetic Processes and Surface Phenomenon (Prerequisite: FAEN 115, 105)

Serves as an introduction to basic kinetic processes in materials, develops basic mathematical skills necessary for materials research etc. Fundamentals of diffusion, kinetics of reaction including nucleation, growth and phase transformations are discussed. Some topics to be discussed include *Field and Gradient, Driving Forces and flux for diffusion,* irreversible thermodynamics, Diffusion processes, Kinetics and equilibrium theory, Nucleation and Growth Processes; *homogenous and heterogenous nucleation, Nucleation and growth in vapour condensation*. Kinetics of electrochemical reactions, introduction to surface phenomenon; (surface forces *(contact angle, wettability and spreading of melt, capillary flow)*, types and structure of surfaces and interfaces in materials; *friction, wear and lubrication*. Adsorption, Introduction to colloids.

MTEN 204: Thermodynamics of Materials (Prerequisite: FAEN 205)

This course is devoted to analysis of fundamental material properties and processes for near equilibrium conditions. The course starts with the first and second laws of thermodynamics and its applications to the calculations of heat involved in various materials processes such as chemical reactions and phase transformations. The relationships among thermodynamic properties are derived using the Maxwell relations. Applications of thermodynamics to the determination of chemical equilibrium and to the calculation of the voltages of electrochemical reactions are also discussed.

ELECTIVES LEVEL 200

MTEN 206: Internship

Second year internship for students to gain practical experience

CORE (LEVEL 300)

FAEN 301: Numerical Methods (Prerequisites: *FAEN 101, FAEN 110, FAEN 201)*

Matrices and vector operations, linear homogeneous systems, Eigen-vectors and values. Numerical errors, absolute and relative errors, stability and convergence of numerical algorithms. Interpolation Methods: Lagrange polynomials, finite differences, least square approximation. Numerical solutions to Nonlinear Equations: Newton Raphson method, secant, false position, bisection, fixed point algorithm. Numerical Integration: Simpson's rule, trapezoidal rule, Newton-Cotes method. Numerical solutions to Ordinary Differential Equations: Taylor series method, Euler method, Runge-Kutta method. Numerical solutions to Partial Differential Equations: Second order quasi-linear equations, numerical solutions.

FAEN 302: Statistics for Engineers (Prerequisites: *FAEN 201, FAEN 202, FAEN 301)*

Probability functions axioms and rules, counting techniques, conditional probability, independence and mutually exclusive events. Discrete Random Variable: Expectation and variance, Binomial distribution, Hypergeometric distribution, Poisson distribution, relationship between Poisson and Binomial. Continuous Random Variable: Percentiles and cumulative distribution function, expectation and variance, uniform distribution, normal distribution, exponential distribution and other distributions. Joint Distributions. Covariance and Correlation. Sampling Distributions: Distributions of statistics, central limit theorem, samples from normal distribution (t-distribution, X^2 distribution and F-distributions). Estimation: Common point estimators, interval estimators. Hypothesis Testing. Introduction to Regression Analysis. Engineering applications in quality control, process control, communication systems and speech recognition

MTEN 301: Materials Laboratory I

This course treats the fundamental Mechanical testing techniques often used to assess environmental degradation of materials. Students will be introduced to some of the important techniques such as Charpy V-notch impact mechanical test for determining qualitative results

for material properties and performance which are useful in engineering design, analysis of structures, and materials development. Others include Rockwell hardness, superficial hardness, microhardness, durometer hardness etc.

Part I: Laboratory experiments on mechanical properties and behavior of homogeneous and composite engineering materials subjected to static, dynamic, creep, and fatigue loads; behavior of cracked bodies; microstructure-property relationships, and determination of materials properties for use in engineering design.

Part II: Structure and Properties, Phase transformation, Processes of precipitation/ Recovery, Recrystallization and Grain Growth, Diffusion, Heat treatment

MTEN 304: Computational Materials Science (Prerequisite: MTEN 301, FAEN 201, 202)

This course explores the basic concepts of computer modeling and simulation in materials science and engineering. Techniques and software for simulation, data analysis and visualization will be taught. Continuum, mesoscale, atomistic and quantum methods will be applied to study fundamental and applied problems in Materials Science and Engineering. Examples in the core courses will be drawn to understand or characterize complex structures and materials, and to complement experimental observations. Introduction to mathematical modeling (albinitio calculation), thermodynamics basis for phase transformation, Microstructural evolution; Models (Monte-Carlo, Cellular Automater, modelling steady state diffusion, phase field modelling, Finite Element modelling lab, Materials property modelling, semi empirical methods); Possible Application Softwares (Fluent, Gambit, Origin, Facts age, Matlab.)

MTEN 303: Introduction To Materials Processing (Prerequisite: MTEN 206, 203)

Discusses scientific and technological bases of material processing and has a strong focus on materials in general. It provides students with modern as well as inter-disciplinary topics within materials processing. The course is designed to cover the areas of casting, plastic forming, powder processing, polymer processing and metrology. Various methods of heat and surface treatments will also be studied.

MTEN 306: Materials Laboratory II

Introduces student to the specialized experimental techniques used in materials science research. Particular attention is given to the techniques of X-ray diffractions and electron microscopy. The student is also introduced to several of the latest experimental methods such as field ion microscopy, electron spin resonance, low voltage electron diffraction, etc. Laboratory course covering some of the Analysis Techniques used in the Materials industry: Optical and electron microscopy, X-ray diffraction, Electrical and optical measurements; superconducting and Magnetic properties.

MTEN 305: Mechanical Behavior of Materials (Prerequisite: FAEN 205)

Study of the deformation of solids under stress; emphasizing the role of imperfections, state of stress, temperature and strain rate. Description of stress, strain, strain rate and elastic properties of materials comprise the opening topic. Fundamental aspects of crystal plasticity are then considered, along with the methods for strengthening crystals at low temperatures. Deformation at elevated temperatures and deformation maps are also covered. Emphasizes the relationships between microscopic mechanisms and macroscopic behavior of material.

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MTEN 307: Phase Equilibria of Materials (Prerequisite: MTEN 206)

In this course, basic understanding of changes in microstructures of materials with emphasis on chemical thermodynamics is considered. There is also a discussion on the various phase transformations and thermo-effects on the resulting microstructure of materials. In summary, the course looks at the why and how of phase transformations and also controlling

microstructures. The course teaches basic crystal chemical principles in multicomponent inorganic materials. Interpretation of one, two, and three component phase diagrams will be taught. Interrelationships between crystal chemistry, phase equilibra, microstructure, and properties of materials.

MTEN 309: Materials Analysis Techniques (Prerequisite: MTEN 301)
Grain size measurements. X-ray diffraction. X-ray energy dispersive analysis (EDXA). X-ray wavelength dispersive analysis (WDS). X-ray photoelectron spectroscopy (XPS). Auger election spectroscopy (AES). Secondary ion mass spectroscopy (SIMS). Thermal analysis: DTA, DSC, TGA. Imaging: Light Microscopy, Electron Microscopy (SEM, TEM), Atomic Force Microscopy, Scanning Acoustic Microscopy.

MTEN 308: Heat and Mass Transfer (Prerequisite: FAEN 209, Co-requisite: MTEN 302)
The course discuses fundamentals of diffusion processes followed by ionic diffusion and ion exchange, gas diffusion, viscosity, ionic conductivity, dielectric relaxation and mechanical relaxation. Chemical durability and weathering in glasses, glass-ceramics and melts. Effects of both atomic structure and morphology will be discussed for each of the topics.

MTEN 311: Solid State Technology (Prerequisite: MTEN 201, 204, 305, 323)
This course looks at Solid –State Physics: energy bands in materials, carrier statistics and semiconductor technology. The semiconductor technology deals with semiconductor devices and their applications in material studies or processing. Emerging technologies such as biomaterials, smart materials and nanotechnology will be considered as well.

MTEN 313: Electrical, Magnetic and Optical Properties of Materials *(Prerequisite: FAEN 109, 108, MTEN 201)*
This course provides a study of all electrical and magnetic properties of all materials. The differences with regard to the type of magnetic property are discussed. The course also talks about semiconductor Physics: defects and impurities control through physical purification. It is then extended to some semi-conductor devices. Electrical conductivity, Semiconductors, Superconductors, Oxide superconductors, Magnetic Susceptibility, Diamagnetism and Paramagnetism, Ferromagnetism, magnetic materials (alloys, Metals, ceramics); Antiferromagnetic and Ferrimagnetism; Dielectric Materials (Polarisation, capacitors& Insulators, piezoelectric materials, pyroelectric and ferroelectric materials.

ELECTIVES (LEVEL 300)
MTEN 312: Crystal Chemistry of Ceramics (Prerequisite: FAEN 107, MTEN 201)
The course provides introductory knowledge in ceramic structures and progressive advanced knowledge in crystallography. Review of crystal structure (ceramic structure with single element, binary structure and ternary) and bonding in ceramics are considered. Also discussed are Group theory, Space group, Packing structures and Pauling's Rule.

MTEN 314: Ceramic Processing Principles (Prerequisite: MTEN 201, 305)
This course provides a comprehensive study of the perspectives of science in ceramic processing, starting materials, chemical preparation of inorganic materials and advanced materials. It also introduces students to particle packing, characterization and insight to particle mechanics. It will also touch on milling and forming processes.

MTEN 316: Engineering Ceramics I (Prerequisite: MTEN 201)
This course will focus on some history of ceramics and fundamental concepts in ceramic classification and application. It will also increase students' knowledge of the concepts, terminology and properties of ceramic materials. This course is designed to cover the basic

concepts of organic chemistry. It further provides a broad and intensive introduction to bonding types, structure, nature and the formation of organic polymers.

MTEN 318: Principles of Extractive Metallurgy (Prerequisite: MTEN 305)
The course looks at the principles of various industrial processes used to upgrade and extract minerals and metals respectively from their ores. Also considered is the upgrading of mineral concentrates by pyrometallurgical, hydrometallurgical and electrochemical methods. The relevance of thermodynamics, kinetic processes and reactor extractive processes are treated as well.

MTEN 322: Physical Metallurgy I (Prerequisite: MTEN 201)
An introduction reviews metallic structures. It also treats the link between the structure of materials and their properties with an aspect of alloy design and micro-structural engineering. Topics to be considered include structure and stability of alloys, structure of intermetallic compounds and phases, metallurgical thermodynamics; phase diagrams, Diffusion in metal and alloys; Solidification; microstructure; Diffusive and non-diffusive phase transformation in the solid state.

MTEN 324: Metal Joining Technology-Welding (Prerequisite: MTEN 201)
This course treats basically metal joining technology. Heat affected zones, Fusion welding processes, Solid phase welding etc are a few of the topics treated. Also considered is the metallurgical modelling of Welding, heat flow and temperature distribution, chemical reactors in arc welding and solidification mechanism of welding technology and the application of welding technology in various steel, Aluminium and non-ferrous alloys.

MTEN 326: Organic Chemistry of Polymers (Prerequisite: FAEN 107, MTEN 201)
This course covers introduction to polymers and the different bonding mechanism and functional groups. It also covers defects and diffusion in polymeric materials that determines their engineering applications.
Some topics to be treated include bonding in organic molecules. Hybridization and formation of single and multiple bonds; Functional Groups and hydrocarbon molecules; IUPAC naming; Polymer molecules; the chemistry of polymer molecules (Molecular Weight, Molecular Shape, Molecular structures, molecular configurations); thermoplastics and thermosetting polymers; Copolymers; Polymer crystal/crystallinity; Defects in polymers; Diffusion in Polymeric materials; Organic reactions.

MTEN 328: Polymer Processing and Technology I (Prerequisite: MTEN 201, 305)
This course is designed to introduce the student to polymers from the MSE perspective. The basics of polymerisation, polymer synthesis, phase behaviors and various techniques to characterize polymeric materials will be outlined. The course also introduces the fabrication and applications of polymeric materials. The relationship between processing, structure, and properties will be presented with respect to the performance and design requirements of typical polymer applications.
Introduction; Crystallization, melting and Glass transition Phenomena in polymers; types of polymers (Plastics, elastomers and fibres, miscellaneous applications and advanced polymeric materials); Polymer synthesis and processing (Polymerization, polymer additives, forming techniques for plastics, fabrication of elastomers, fibres and films).

MTEN 332: Physical Properties of Polymers (Prerequisite: MTEN 201, 307)
The course covers the study of molecular weight of polymers and the various methods of determining the molecular weight. It also covers the structure of polymer chain, Amorphous and crystalline state viscoelasticity, kinetics, polymer solutions and blends, thermodynamics and statistical mechanics of polymers elasticity.

Some topics include physical (Density; molecular weight, crystallinity & crosslinking) Mechanical Behaviour of polymers; Mechanisms of deformation and strengthening of polymers. Phase behaviour (Melting point, Glass transition temperature (T_g) and decomposition temperature, mixing behavior and inclusion of plasticizer, Microstructure, Morphology (Crystallinity, Chain conformation, and chemical properties); Chemical properties.

CORE LEVEL 400

FENG 401: Law for Engineers

Course discussions cover contracts (formation, performance, breach, and termination), corporations and partnerships, insurance, professional liability, risk management, environmental law, torts, property law, evidence and dispute resolution. The course emphasizes those principles necessary to provide engineers with the ability to recognize issues which are likely to arise in the engineering profession and introduces them to the complexities and vagaries of the legal profession.

FAEN 402: Principles of Management and Entrepreneurship

Definition of management. Evolution and Perspectives of Management: classical, human relations and management science. Hierarchy of Management, Managerial roles and Management Styles. Inside and Outside an Organisation: adapting to change and understanding the environment. Management Functions: Planning and Decision Making, Organising, Leading and Communicating.

The Entrepreneurial Process and Types of Businesses. Creating New Products/Services and Business plans. Evaluation: Analysis of new ventures, valuation techniques, Intellectual Property Issues. Financing New Ventures. Elements of Marketing Management. Managing Growth and Exit Strategy.

MTEN 400: Project Work

An individual design project leading to submission of a project thesis. The results are also presented orally to faculty members and peers.

MTEN 401: Composite Design and Fabrication (*Prerequisite: MTEN 315, 317*)

Influence of materials, design and processing on composite properties. Details of state-of-the-art fabrication technology and performance of continuous fabric-reinforced composites. Approaches toward addressing composite materials limitations.

MTEN 402: Non Destructive Evaluation and Failure Analysis (Prerequisite: MTEN 313)

Important property parameters. Failure: origins of brittle and ductile fractures. Analysis of fatigue failure, fatigue and slips, creep failure, wear failure. Techniques: fractography, penetrant techniques, ultrasonic, radiographic, eddy current, potential drop and magnetic methods of non-destructive testing.

MTEN 403: Refractories (Prerequisite: MTEN 307)

Technical information on raw materials, processing, microstructure, properties and applications of the principal types of refractories and high temperature insulations will be treated as well as Engineering factors pertinent to the manufacture, processing and design of refractory and insulation systems. Focus will be on Refractory needs for design and application including areas for research and development of materials for future applications

MTEN 404: Project Management *(Prerequisite: FAEN 211, 214)*

Fundamental engineering concepts are introduced and applied to planning and managing projects. Critical issues in the management of engineering and high-technology projects are

discussed. Some topics to be discussed includes Value Management; Project Appraisal and Risk Management; Project Quality and Environmental Management; Project Finance and Cost Estimation; Planning; Contract Policy and Documents; Project Organization Design and Chain Management; Implementation of Industrial Project, Project Management in Developing Countries.

MTEN 405: Process and Quality Control *(Prerequisite: FAEN 201, 202)*
Students are introduced to the principle of automation of engineering process for control purposes. Various input-output relationships are discussed in addition to the characteristics of control and control tuning. The concept of quality assurance is taught in the course with various tools for quality management discussed in addition to various quality standards.

MTEN 408: Professional Development Seminar (*Prerequisite: Level 400 standing)*
The course is designed to enable students acquire knowledge and skills that will ultimately make them more employable, both upon graduation and throughout their national service period.
The course covers both fundamental issues at the work place, work ethics, and critical analysis at the work place, leadership and project management. Considerable attention is devoted to developing the soft skill of student with emphasis on CV writing, cover letter, interview preparation necessary to compete in the global work place.

MTEN 412: Materials Selection and Design (Prerequisite: MTEN 201, 204)
This course teaches the general principles and highlights certain case studies in materials selection for engineering materials properties and material selection chart.
Introduction to the Design Process; Engineering Materials and their Properties; Materials Selection Charts; Materials Selection(the basics); Materials Selection (case studies); Selection of Materials and Shape with case study; multiple constraints with compound objectives with Case study; Materials Processing and Design (with case studies); Data Sources and their uses; Failure Analysis and Design Against Failure; Reverse Engineering**;** Environmental, Cultural & Societal impact; Forces for change (Issues that might influence material selection in the future)

MTEN 414: Environmental Engineering and Waste Management (Prerequisite: FAEN 115, *204)*
This course provides knowledge of environmental element and various forms of pollution with insight into quantitative analysis and design where applicable. Recycling of materials waste is a major aspect of this course. Topics include: Need for Sustainable Environmental Management; Environmental Engineering Planning and Impact analysis/Assessment; Water resources Management, Quality analysis, pollution and treatment of water and waste water; Solid Waste Management; Air Pollution and Noise Control; Thermal pollution; Radiation uses and Protection; Environmental ethics.

MTEN 416: Corrosion and Corrosion Control *(Prerequisite: MTEN 203, 326)*
Teaches the effect of environment on the performance of the various materials, highlights the various forms of corrosion and methods of corrosion control. Wet and Dry Corrosion; Thermodynamics; Equilibrium Potential; Electrode Kinetics; Passivity; Environmental effects; Types/ Forms of corrosion; Corrosion testing, monitoring & Inspection; Control of corrosion; (Materials selection/change of Environment/ Proper Design; Cathodic/Anodic protection, Coating); Degradation of Polymers; Corrosion of Ceramics.

ELECTIVES (LEVEL 400)
MTEN 407: Engineering Ceramics II (Prerequisite: MTEN 336)
The course introduces students to the wide range of modern ceramics described in terms of their applications and the key characteristics that they must have to satisfy the application

requirements. The effects of processing are also emphasized. Specific application of ceramics and their peculiar properties

1) High-temperature applications (ceramics in metal processing, Glass Production, Industrial processes, Heat engines). 2) Wear and Corrosion Resistance Application (Seals, Values, Pumps, Bearings, thread guides, ceramics in paper making). 3) Ceramics for Energy production, Cutting tools and abrasive.

MTEN 409: Glasses, Cements & Concretes *(Prerequisites: MTEN 201, 336)*
This course defines glasses and teaches glass forming compositions and introduces students to glass- ceramics materials. Glass forming methods are also described. Students are also introduced to cements and concrete materials and the various types of Portland cements. Glass compositions, raw materials, glass melting, furnace operation and glass-forming. Sheet, tubing and pressed ware. Glass product manufacture, glass-to-metal sealing, annealing and tempering, quality control, glass-ceramics, phase transformation, immiscibility, homogenous and heterogeneous nucleation, crystal growth and industrial glass-ceramic processes. Introduction to cements and concrete materials; Portland cements-types, properties, manufacture and specification; hydration of Portland cements; hydraulic cements; water, admixtures and mineral aggregates for concrete.

MTEN 411: Physical Metallurgy II (Prerequisite: MTEN 326)
This course present the metallurgy of various ferrous and non ferrous metals/alloys including the methods of heat treatment, the phase transformation involved, resulting properties and their applications.
Physical metallurgy of Steels, Heat treatment of steel; Metastable states of alloys; Advanced Alloys *(Commercial Steels, Cast Irons, Superalloys, Al- Alloys, Non metallic alloys)*. Phase transformations, age hardening, heat treatment of steels, TTT diagrams, CT diagrams, martensitic transformation, shape-memory effects. Common ferrous and non-ferrous alloys

MTEN 413: Foundry Technology
The main aim is for students to appreciate the role of castings in design and material selection and thus understand basic founding principles and processes. Orthodox and modern specialized casting processes are considered in detail and compared. Ferrous and non-ferrous foundings are considered on a comparative basis, and the place of castings in design is critically examined and related to other products. Introduction; Liquid Metals and the Gating of Castings; Solidification 1 - Crystallization and cast structure development; Solidification 2 - the Feeding of Castings; The Moulding Material - Properties, Preparation and Testing; Defects in Castings; Quality Assessment and Control; Casting Design; Production Techniques 1 - the Manufacture of Sand Castings; Mould Production; Melting and Casting; Finishing Operations; Production Techniques 2 - Shell, Investment and Die Casting Techniques; Production Techniques 3 - Further Casting techniques; Environmental Protection, Health and Safety

MTEN 415: Biodegradable Polymer and Fibrous Materials (Prerequisite: MTEN 334)
Present the principles of biodegradability of polymers, their general characteristics of biodegradable polymers and their industrial application. Fibrous materials technology is also introduced in this course. Introduction to polymer chemistry and materials selection; biodegradability of polymers (Mechanisms and evaluation methods); Polymer biodegradation in liquid environment and in soils; General characteristics; pioussability, industrial Applications and Market Evaluation of biodegradable polymers; Fibrous materials properties and manufacturing of synthetic fibrous materials. Technology of natural fibres; Natural polymer composite; wood and bamboo technology; design project on fibres; other applications of fibres.

MTEN 417: Polymer Processing and Technology II (Prerequisite: MTEN 305, 334)
This course covers the important characteristics of polymeric materials and in addition the various types and processing techniques. Specific Processing, forming and fabrication techniques such as Pultrusion, extrusion, metal injection moulding will be covered. Also novel techniques for modern polymer processing will be explored. Injection moulding; Polymer melt and rheology/rheometry; Isothermal melt flow; flow modelling of injection moulding, Simulation Methods (FE analysis); PVT data, Isochronal modulus.

DEPARTMENTAL REQUIREMENTS FOR GRADUATION

In addition to the University and Faculty requirements, to graduate with a Bachelor of Science Degree in Materials Science and Engineering, a student must

- take a minimum of two (2) internships out of which one must be at Level 300 i.e. MTEN 302
- take and pass the core courses and the prescribed electives of their study option listed below with a grade with a grade not less D:

Core Courses

- MTEN 203 Kinetic Processes and Surface Phenomenon
- MTEN 206 Thermodynamics of Materials
- MTEN 302 Internship
- MTEN 313 Materials Analysis Techniques
- MTEN 301 Materials Laboratory I
- MTEN 309 Phase Equilibria of Materials
- MTEN 316 Heat and Mass Transfer
- MTEN 400 Design Project
- MTEN 403 Composite Design and Fabrication
- MTEN 424 Materials Selection and Design

Elective Courses
Ceramic Option

- MTEN 314 Crystal Chemistry of Ceramics
- MTEN 342 Ceramic Processing Principles
- MTEN 336 Engineering Ceramics I
- MTEN 419 Engineering Ceramics II
- MTEN 421 Glasses, Glass-Ceramics and Cements

- **Metallurgy Option**
- MTEN 324 Principles of Extractive Metallurgy
- MTEN 326 Physical Metallurgy I
- MTEN 328 Metal Joining Technology
- MTEN 423 Physical Metallurgy II
- MTEN 425 Foundry Technology

Polymers Option

- MTEN 338 Organic Chemistry of Polymers
- MTEN 332 Polymer Processing Technology I
- MTEN 334 Physical Properties of Polymers
- MTEN 427 Biodegradable Polymers and Fibrous Materials
- MTEN 429 Polymer Processing and Technology II

FACULTY OF SCIENCE

ADMINISTRATION

Daniel K. Asiedu *BSc (Ghana) MSc PhD (Okayama)*	-	Dean
Ebenezer O. Owusu *BSc, EMBA (Ghana), MSc, PhD (Japan)*	-	Vice-Dean
Joseph Oduro Nkansah *BSc MSc (Kumasi)*	-	Faculty Officer

INTRODUCTION

The Faculty of Science at the University of Ghana is one of the oldest academic units established within the University. Its mandate is to provide quality science education through teaching, research and dissemination of research findings. Currently, the Faculty consists of twelve departments: Animal Biology and Conservation Science; Biochemistry, Cell, and Molecular Biology; Botany; Chemistry; Computer Science; Earth Science; Mathematics; Nutrition and Food Science; Marine and Fisheries Sciences; Physics; Psychology; Statistics. Our mission is to train innovative scientists with cutting-edge knowledge of discipline, who will drive the national science policy with utmost diligence and excellence, thereby bringing the University and the Nation abreast of current state of knowledge and progress in the field of science.

UNDERGRADUATE PROGRAMMES

The twelve departments offer a wide and diverse range of disciplines in undergraduate courses. Other University of Ghana academic units contribute to science teaching at all levels, allowing students to choose their studies from physical, biological, earth, nuclear, behavioral, environmental, mathematical and computer sciences. Our undergraduate degree programmes are designed to provide students with the fundamental knowledge, competence and skills that will enable them to lead and achieve at the highest level in their chosen profession. The programmes also assist students to develop independence, leadership and life-long learning skills.

STRUCTURE OF UNDERGRADUATE PROGRAMME

Students are admitted at Level 100 into any one of the twelve departments to read three principal subjects from the following: Physics, Chemistry, Biology, Mathematics, Geology, Computer Science, Statistics and Psychology. From Levels 200 – 400 students will continue with the programme in their respective Department (as Single-Major) or can combine with another subject from a different Department. In the situation where student opt for combined degree permission of the departments running the respective programmes must be sought. For practical sessions students will require a white laboratory coat. All students offering computer science will require a laptop.

From Levels 200 – 400 Students shall follow a **1:1:1 (Single Major), 2:2:1 (Major and Minor),** or **2:2:2** (**Combined Major)** Bachelor of Science degree structure. Students shall, with the approval of the concerned Departments, indicate their preference for **Single Major**, **Combined Major** or **Major and Minor** degree by the end of Second Semester of Level 100.

UNIVERSITY AND FACULTY REQUIRED COURSES

In addition, students shall take the following University and Faculty required courses:

i. Academic Writing I (at Level 100 for all students)
ii. Critical Thinking and Practical Reasoning (at Level 100 for all students)
iii. General Mathematics (at Level 100 for all students). Students offering MATH 121: Algebra and Trigonometry are excepted.

iv. Understanding Human Societies (at Level 100 for all students)
v. Introduction to African Studies (at Level 200 for all students)
vi. Academic Writing II (at Level 200 for all students)

WORKLOAD

LEVEL		SCIENCE COURSES		UNIVERSITY REQUIRED COURSES	TOTAL
		MINIMUM	MAXIMUM		
LEVEL 100	1ST SEM	12	14	3	15 – 17
	2ND SEM	9	12	6	15 – 17
LEVEL 200	1ST SEM	12	15	3	15 – 18
	2ND SEM	12	15	3	15 – 18
LEVEL 300	1ST SEM	15	18	–	15 – 18
	2ND SEM	15	18	–	15 – 18
LEVEL 400	1ST SEM	15	18	–	15 – 18
	2ND SEM	15	18	–	15 – 18
TOTAL		**105**	**128**	**15**	**120 – 142**

The maximum credits a student can take for the entire programme is 138.

PROGRESSION TO THE NEXT LEVEL

A student shall be deemed to have satisfied the requirements for progression if he/she has:

i. Satisfied departmental requirements for entry to subjects at the next level
ii. Obtained a CGPA of 1.00 or better in all examinations

GENERAL GRADUATION REQUIREMENTS

A student shall be deemed to have satisfied the requirements for graduation if:

i. He/she has passed all University and Faculty required courses
ii. He/she has passed at least 120 credits
iii. He/she must not failed more than 16 credits of core and prescribed electives, provided the failed grades are not lower than Grade E.

DEPARTMENT OF ANIMAL BIOLOGY AND CONSERVATION SCIENCE

INTRODUCTION

Knowledge of physical and biological characteristics of animals helps in designing tools for their management and conservation. The current undergraduate programme in the Department offers such basic courses as *Ecology, Genetics, Entomology, Evolution, Behaviour, Physiology, Vertebrate Biology, Parasitology, Biometry* and *Aquatic Biology*, in addition to more applied career-oriented courses like *Public Health, Fishery Biology, Conservation Biology, Wildlife Management, Applied Entomology*, and *Advanced Genetics*. The latter focuses largely on modern concepts of molecular biology and genetic engineering.

The programme of the Department of Animal Biology and Conservation Science comprises 5 major (thematic) areas of study and a general cross-cutting area. The thematic areas are: Genetics, Animal Physiology and Radiation Biology; Aquatic Sciences; Conservation Science; Biology and Management of Animal Pests and Vectors and Medical Zoology. The general area consists of courses that cut across all the five thematic areas.

The curriculum of the Department has thematic areas which offer several options for our students to make informed choices of their future careers in the life sciences. Furthermore, the disciplinary approach of the undergraduate programme enables the graduate in Animal Biology and Conservation Science to, more readily identify areas of the Department's postgraduate programmes to pursue for careers at those levels. The student of Animal Biology and Conservation Science will be so adequately equipped with knowledge, directed towards the complex interrelationships among humans, other animals, plants, and the physical environment and how to reduce the negative anthropogenic impact.

Students offering BSc in Animal Biology and Conservation Science as Single Subject Major are expected to take all prescribed core courses (69 credits) from Levels 100 – 400 and make up their credit units from elective courses as per the instructions given. Students offering BSc in Animal Biology and Conservation Science as a Combined Major are expected to take the prescribed core courses (46 credits) from Levels 100 – 400 and make up their credit units from elective courses as per the instructions given.

FACULTY

Daniel K. Attuquayefio *BSc Ghana, MSc (Aberdeen) PhD (Guelph)*	-	Associate Professor/Head of Department/ Co-ordinator, Environmental Science Programme (ESP)
Yaa Ntiamoa-Baidu *BSc (Ghana) PhD (Edinburgh)*	-	Professor (Contract)
Ebenezer O. Owusu *BSc (Agric) (Ghana) MSc (Kochi-Japan) PhD (Ehime-Japan) EMBA* (Ghana)	-	Professor/Vice-Dean- Faculty of Science
Dominic A. Edoh *BSc MPhil (KNUST) PhD (Basel)*	-	Professor
Steven Dadzie *MSc (Leningrad) PhD (Stirling)*	-	Professor (Part-Time)
David D. Wilson *BSc (Ghana) MS (Louisiana) PhD (Georgia)*	-	Senior Lecturer (Contract)
Millicent A. Cobblah *BSc PhD (Ghana) MSc (Cardiff)*	-	Senior Lecturer
Langbong Bimi *BSc MPhil PhD (Ghana)*	-	Senior Lecturer

Rosina I. Kyerematen *BSc MPhil (Ghana) PhD (Bergen)*	-	Senior Lecturer
Francis Gbogbo *BSc (Ghana) MSc (Strathclyde)*	-	Senior Lecturer
Eramus H. Owusu *BSc (KNUST) PhD (Kent)*	-	Senior Lecturer
George A. Darpaah *BSc PhD (Ghana) MSc (Port Harcourt)*	-	Lecturer
Lars H. Holbech *BSc MSc PhD (Copenhagen)*	-	Lecturer
Godfred Futagbi *BSc MPhil (Ghana)*	-	Lecturer
Isaac F. Aboagye *BSc MPhil (Ghana) MPH (Nottingham)*	-	Lecturer
Maxwell .K. Billah *BSc MPhil PhD (Ghana)*	-	Lecturer
Fred Aboagye-Antwi *BSc (UCC) MPhil (Ghana) PhD (Keele)*	-	Lecturer
Juliet Ewool *BSc MPhil (Ghana)*	-	Assistant Lecturer
Benjamin Y. Ofori *BSc MPhil (Ghana)*	-	Assistant Lecturer

DIRECT ADMISSION INTO PROGRAMMES
ANIMAL BIOLOGY AND CONSERVATION SCIENCE

LEVEL 100

FIRST SEMESTER

Core

Code	Title	Credits
UGRC 150	Critical Thinking and Practical Reasoning	3
ABCS 101	Introductory Animal Biology	3
CHEM 111	General Chemistry I	3
PHYS 105	Practical Physics I	1
PHYS 143	Mechanics and Thermal Physics	3
MATH 101	General Mathematics	3
Total		**16**

SECOND SEMESTER

Core

Code	Title	Credits
URGC 110	Academic Writing I	3
UGRC 130	Understanding Human Society	3
BOTN 104	Growth of Flowering Plants	3
CHEM 112	General Chemistry II	3
CHEM 110	Practical Chemistry	1
PHYS 106	Practical Physics II	1
PHYS 144	Electricity and Magnetism	3
Total		**17**

SINGLE MAJOR IN ANIMAL BIOLOGY AND CONSERVATION SCIENCE
LEVEL 100
FIRST SEMESTER
Core

Code	Title	Credits
UGRC 150	Critical Thinking and Practical Reasoning	3
ABCS 101	Introductory Animal Biology	3
CHEM 111	General Chemistry I	3
CHEM 110	Practical Chemistry	1
PHYS 105	Practical Physics I	1
PHYS 143	Mechanics and Thermal Physics	2
MATH 101	General Mathematics	3
Total		**16**

SECOND SEMESTER
Core

Code	Title	Credits
URGC 110	Academic Writing I	3
UGRC 130	Understanding Human Society	3
BOTN 104	Growth of Flowering Plants	3
CHEM 112	General Chemistry II	3
CHEM 110	Practical Chemistry	1
PHYS 106	Practical Physics II	1
PHYS 144	Electricity and Magnetism	2
Total		**16**

LEVEL 200
FIRST SEMESTER
Core

Code	Title	Credits
UGRC 210	Academic Writing II	3
ABCS 201	Zoological Techniques	2
ABCS 203	Principles of Evolution	1
ABCS 205	Vertebrate Anatomy	3
Total		**9**

SECOND SEMESTER
Core

Code	Title	Credits
UGRC 220	Liberal and African Studies	3
BIOL 202	Introductory Cell Biology and Genetics	3
ABCS 204	Introductory Animal Ecology	3
ABCS 206	Introductory Biometry	2
Total		**11**

LEVEL 300
FIRST SEMESTER
Core

Code	Title	Credits
ABCS 301	Comparative Chordate Biology	2
ABCS 303	Comparative Animal Physiology	2
ABCS 307	Venomous Animals	1
ABCS 309	Animal Ecology	2
ABCS 311	Systematics	1
BIOL 315	Principles of Genetics	3
ABCS 321	Comparative Chordate Biology Practical	1
ABCS 323	Comparative Animal Physiology Practical	1
Total		**13**
Electives (Select 2 - 4 credits)		
ABCS 305	Behavioural Ecology	1
ABCS 313	Microbiology and Immunology	2
ABCS 330	Zoological Field Studies	1

SECOND SEMESTER
Core

Code	Title	Credits
ABCS 302	General Entomology	2
ABCS 304	Public Health Zoology	2
ABCS 306	Zoogeography	1
ABCS 314	Principles of Conservation Science	2
BIOL 318	Aquatic Biology	3
ABCS 322	Entomology Practical	1
ABCS 324	Public Health Zoology Practical	1
Total		**12**
Electives		
ABCS 308	Terrestrial Invertebrates	1
ABCS 312	Wetland Ecology	2

LEVEL 400
FIRST SEMESTER
Core

Code	Title	Credits
ABCS 401	Animal Behaviour	2
ABCS 403	Environmental Physiology	2
ABCS 409	Marine Biology	2
ABCS 411	Freshwater Biology	2
ABCS 413	Conservation Biology	2
ABCS 417	Applied Statistics for Biologists	2
ABCS 421	Research and Project Management	2
Total		**14**
Electives		
ABCS 405	Population Ecology	3
ABCS 407	Limnology	2
ABCS 415	Application of Evolutionary Principles	1
ABCS 419	Applied Insect Taxonomy	1

SECOND SEMESTER

Core

Code	Title	Credits
ABCS 410	Field Trips and Reports	2
ABCS 420	Project	6
Total		**8**
Electives		
ABCS 402	Molecular Genetics and Biotechnology	3
ABCS 404	Epidemiology and Tropical Diseases	3
ABCS 406	Vertebrate Biology	2
ABCS 408	Wetland Ecology and Management	3
ABCS 412	Petroleum Ecology	2
ABCS 414	Fishery Biology and Marine Ranching	2
ABCS 416	Wildlife Management	3
ABCS 418	Applied Entomology	3
ABCS 422	Radiation Biology and its Applications	3
ABCS 424	Innovations and Business Plan for Biologists	2

COMBINED MAJOR IN ANIMAL BIOLOGY AND CONSERVATION SCIENCE

LEVEL 200

FIRST SEMESTER

Core

Code	Title	Credits
UGRC 210	Academic Writing II	3
ABCS 201	Zoological Techniques	2
ABCS 203	Principles of Evolution	1
ABCS 205	Vertebrate Anatomy	3
Total		**6**

SECOND SEMESTER

Core

Code	Title	Credits
UGRC 220	Liberal and African Studies	3
BIOL 202	Introductory Cell Biology and Genetics	3
ABCS 204	Introductory Animal Ecology	3
ABCS 206	Introductory Biometry	2
Total		**11**

LEVEL 300
FIRST SEMESTER
Core

Code	Title	Credits
ABCS 301	Comparative Chordate Biology	2
ABCS 303	Comparative Animal Physiology	2
ABCS 309	Animal Ecology	2
ABCS 317	Principles of Conservation Science	2
ABCS 321	Comparative Chordate Biology Practical	1
ABCS 323	Comparative Animal Physiology Practical	1
Total		**10**

SECOND SEMESTER
Core

Code	Title	Credits
ABCS 302	General Entomology	2
ABCS 304	Public Health Zoology	2
BIOL 318	Aquatic Biology	3
ABCS 322	Entomology Practical	1
ABCS 324	Public Health Zoology Practical	1
ABCS 330	Zoological Field Studies	1
Total		**10**

LEVEL 400
FIRST SEMESTER
Core

Code	Title	Credits
ABCS 401	Animal Behaviour	2
ABCS 403	Environmental Physiology	2
ABCS 413	Conservation Biology	2
Total		**6**
Electives (Select 3 credits)		
ABCS 405	Population Ecology	3
ABCS 407	Limnology	2
ABCS 419	Applied Insect Taxonomy	1

SECOND SEMESTER

Core

Code	Title	Credits
ABCS 410	Field Trips and Reports	2
Total		**2**
Electives		
ABCS 420	Project	6
ABCS 402	Molecular Genetics and Biotechnology	3
ABCS 404	Epidemiology and Tropical Diseases	3
ABCS 406	Vertebrate Biology	2
ABCS 408	Wetland Ecology and Management	3
ABCS 412	Petroleum Ecology	2
ABCS 414	Fishery Biology and Marine Ranching	2
ABCS 416	Wildlife Management	3
ABCS 418	Applied Entomology	3
ABCS 422	Radiation Biology and its Applications	3
ABCS 424	Innovations and Business Plan for Biologists	2

COURSE DESCRIPTIONS

ABCS 201: Zoological Techniques

Introduction to basic microscopy. Basic techniques involved in collection, preservation and preparation of zoological material. Microtome work, slide preparation and fixation techniques.

BIOL 202: Introductory Cell Biology and Genetics

Basic cell physiology-bioelements, water, water in cells, method of expressing concentrations of solutions, osmotic phenomena, imbibition, biomolecules, carbohydrates, amino acids, proteins, lipids, nucleotides, nucleic acids, and the role of these in either cell biology and/or structure, enzyme action; photosynthesis, respiration and nitrogen metabolism. Basic principles of genetics; gene interactions, sex and inheritance; chemical basis of heredity; mutation, medical and biochemical genetics.

ABCS 203: Principles of Evolution

History and Development of Evolutionary thought and concepts, synthesis of the modern theory of Evolution. Definitions and Terminologies. Introduction to the species concept. Mechanisms and processes of Evolution. Evidence for Evolution. Importance of evolution to society. Brief evolutionary time line.

ABCS 204: Introductory Animal Ecology

Introduction and Scope of Ecology. Definitions and Concepts. Ecosystem Ecology: Food Chain, Food Web, Ecological Pyramids. Plant and animal interactions. Concept of Niche. Biogeochemical cycles.

ABCS 205: Vertebrate Anatomy

The vertebrate body plan; Functional anatomy of the major vertebrate classes – Fish, amphibians, reptiles, birds and mammals.

ABCS 206: Introductory Biometry

Introduction to statistics. Experimental design (laboratory, field). Sampling methods; data presentation, analysis and interpretation.

ABCS 301: Comparative Chordate Biology
Characteristics, classification and general biology of the chordates. Theories of vertebrate evolution: phylogenetic relationship among the chordates: Myxini, Cephalaspidomorphi, Chondrichthyes, Osteichthytes, Amphibians, Reptilia, Aves and Mammalia. Flight and migration in birds. Interactions of humans with other mammals.

ABCS 302: General Entomology
Insect Diversity. Functional morphology and life styles. Classification and Diagnostic features of major insect orders, Relationships among insect complexes. Insect Collection and curatorial techniques. Physiological processes: Alimentary, respiratory, circulatory, excretory, nervous, muscular, endocrine, exocrine and reproductive systems. Other processes involved in adaptation and survival.

ABCS 303: Comparative Animal Physiology
Comparative physiology of digestion, respiration, circulation, osmoregulation and excretion. Sensory organs, nervous and muscular activity. Hormones, reproduction and related endocrine activities in animals.

ABCS 304: Public Health Zoology
Basic principles in parasitism, survey of animal parasites and vectors with emphasis on morphology, lifecycle, pathogenesis. Parasite and vector control. Diseases of public health importance – HIV and AIDS, Zoonoses.

ABCS 305: Behavioural Ecology
Definitions of terms. Ecological aspects of animal behaviour adaptations: foraging, mating systems and reproductive strategies. Parental care. Social systems in animals. Predator-prey relationships. Life-history strategies.

ABCS 306: Zoogeography
Introduction to zoogeography. Biogeographic zones of the world. Terrestrial Biomes and Faunal Distribution. West African Fauna: Abundance, endemism, diversity and adaptations. West African wetlands: Characteristics, Annual cycle of events, Faunal diversity.

ABCS 307: Venomous Animals
Biology and ecology of venomous animals: aquatic fauna, terrestrial arthropods, amphibians, reptiles and mammals. Nature of venom and structure of venom apparatus. Interaction of humans with venomous animals: nuisance, phobias and allergens. Prevention and management of venomous animal bites and stings. Importance of venomous animals to humans and the ecosystem.

ABCS 308: Terrestrial Invertebrates
Overview of classification. Adaptations of the spiders, scorpions, ticks, mites, (arachnids), centipedes and millipedes (myriapods), nematodes, earthworms and wood lice to terrestrial habitation with special emphasis on water relations, respiration and reproductive biology. Economic importance in the ecosystem.

ABCS 309: Animal Ecology
Community Ecology – Structure, patterns and rules. Ecological diversity and its measurements. Ecological energetics. Invasive alien species.

ABCS 311: Systematics
Definitions and principles. Importance of taxonomy, International Code for Zoological Nomenclature, systems of Classification, Taxonomic characters, techniques and

methodologies. Introduction to bio-informatics. Importance and management of Natural History collections. Introduction to Phylogenetics.

ABCS 312: Wetland Ecology
Definition, types, characteristics and functions of wetlands. Wetland hydrology and soils: physico-chemical properties of wetland soils. Wetland flora and fauna: adaptations, competition and survival strategies. Wetlands in Ghana.

ABCS 313: Microbiology & Immunology
History of microbiology and the development of microscopy; Classification & Structure of bacteria, parasites and viruses; Transmission and Life cycles of protozoan and metazoan parasites; Public health significance of microbial organism; Common microbial infections; Principles of Sterilization and Disinfection; The immune system - Cells and organs of the immune system; Host responses to infections & Types of immunity; Cell receptor proteins and histocompatibitlity antigens; T helper cells, TH1/TH2 dichotomy and disease outcome; Antigen processing, presentation and antigen recognition by B and T cells; Regulation of the immune response; by cellular mechanisms and regulatory role of antibody.

ABCS 314: Principles of Conservation Science
Relation between biological and physical resources; principles of biodiversity conservation, social and economic. Evolutionary processes and biological adaptations. Declining and small populations paradigms. Species extinction. Threats to biological diversity. Principles of management.

BIOL 315: Principles of Genetics
Introduction to the principles of genetics and chromosome cytology from the molecule to the population aspects, including application of the principles in animal breeding, plant breeding and applied human genetics.

BIOL 318: Aquatic Biology
Water properties of biological importance. The seas: the open ocean and coastal waters. Factors determining water circulation. Effects of water circulation upon productivity. Pollution. Utilization and conservation. Lakes: origin of lakes and their biological types. Factors determining water circulation. Rivers: origin and water movement. Biotic communities, adaptations and distribution. Phytoplankton: distribution including temporal and special changes in relation to physico-chemical and biological factor in the environment. Estuaries: optical and physical properties; water movement. Dissolved substances. Mangrove swamps.

ABCS 321: Comparative Chordate Biology Practical
This is the practical component of ABCS 301.

ABCS 322: Entomology Practical
This is the practical component of ABCS 302

ABCS 323: Animal Physiology Practical
This is the practical component of ABCS 303.

ABCS 324: Public Health Zoology Practical
This is the practical component of ABCS 304.

ABCS 330: Zoological Field Studies
Introduction to the ecological biotopes and their faunal associations in the field. Practical field measurements of environmental variables responsible for survival of the biota. Evaluation of survival strategies of biota in freshwater, bractishwater, seawater and terrestrial environments.

ABCS 401: Animal Behaviour
Introduction and definitions. History of ethology; methods of recording animal behaviour; factors affecting the behaviour of animals, with special emphasis on interactions: physiological condition, genome and stimuli. Intervening variables: motivation and learning; communication; analyses of complex behaviour patterns (feeding, reproduction, sociality and migration); sociobiology.

ABCS 402: Molecular Genetics and Biotechnology
Variety of genetic systems as illustrated by micro-organisms; genetic engineering; DNA probes, polymerase chain reaction (PCR), isozymes and articular hydrocarbons for parasite and vector identification, DNA sequencing, DNA barcoding, Gene mapping and its application, DNA fingerprinting and application, Human genome project.

ABCS 403: Environmental Physiology
Physiological adaptations of animals to key environmental factors: temperature, water, light, air and semiochemicals. Adaptation to extreme environments.

ABCS 404: Epidemiology of Tropical Diseases
Basic definitions and principles of epidemiology: The science of epidemiology, objectives, methods and tools. Introduction to modelling in epidemiology. Major parasitic disease systems and their management.

ABCS 405: Population Ecology
Sampling techniques. Dispersion. Population parameters. Methods of animal population estimation. Natural regulation of animal populations. Life table and Key-factor analyses.

ABCS 406: Vertebrate Biology
Evolutionary trends among vertebrates. The Agnatha, Chondrichthyes,Osteichthyes, Amphibia, Reptilia, Aves and Mammalia. Biology, ecology and systematic of vertebrates. Interaction of humans with other vertebrates (e.g. snakes).

ABCS 407: Limnology
Introduction to Limnology. The water cycle. Basic hydrology. Stream classification. Lake formation and morphology. Optical and thermal properties of water. Water movements in lakes. Global geochemistry. Ionic composition of natural waters. Dissolved gases. Nutrients and Nutrient Cycling. Eutrophication. Metals in the Aquatic Environment. Environmental effects of dams.

ABCS 408: Wetland Ecology & Management
Wetland values, human impacts and regulations. Wetland evaluation and delineation. History of wetland management in Ghana. Principles of wetland restoration. Wetlands management for waterfowl. Integrated catchments management: challenges and realities. Current issues in wetland conservation.

ABCS 409: Marine Biology
Marine plants and primary production. Major groups of marine invertebrates and vertebrates: morphology and systematics. Biology, pelagic and benthic life. Ecology. Special ecological habitats. Adaptations to extreme conditions in the marine environment.

ABCS 410: Field Trips and Reports
Field trips to selected areas with potential for vast ecological biodiversity in the major ecological biotopes. Reporting on the form and function of the ecological associations using statistical designs/ model. Presentation of study report.

ABCS 411: Freshwater Biology
Composition, ecology and adaptation of invertebrates in lenthic and lotic systems; plankton, neuston, benthos and aufwuchs; organisms in special environments; groundwater, swamps, and saline water, temporal and thermal waters; role of vertebrates in aquatic systems; pollution- effects of pollutants on aquatic systems and aquatic organisms; secondary production and energy flow.

ABCS 412: Petroleum Ecology
Oil pollution: behavior, characteristics and impact of oil pollution on biota and recreational facilities. Damage estimation methods and management of oil spills in terrestrial and aquatic ecosystems. Impact assessment and clean-up. Ballast water ecology: introduction of invasive species; ecological significance of invasive species transfer, survival strategies of invasive species and implications on biodiversity conservation.

ABCS 413: Conservation Biology
Indigenous conservation strategies and introduction to management systems of forests, rangelands and wildlife; conservation of water catchment and soil; in situ and ex situ conservation practices. Application of ecological principles to the management of biological resources. Community-based natural resource management. Application of ecotourism as a conservation tool. Climate change and conservation; climate change and global environmental problems and their effects on biodiversity. International conservation measures: World Conservation Strategy. Biodiversity Convention and other international conservation treaties. Ghana's Biodiversity policy and strategy.

ABCS 414: Fishery Biology and Marine Ranching
Biological parameters of fish populations: age and growth, food and feeding habits. Ecology of pelagic and demersal species in Ghanaian waters. Theory of fishing (including stock assessment). Fishery management methods: fish population estimation; factors limiting abundance, habitat improvement and legislation. Fishery aspect of water pollution. Aquaculture: Principles and applications. Marine Ranching: principles and techniques.

ABCS 415: Applications of Evolutionary Principles
Modern synthetic theory of evolution. Mechanisms and processes of evolution. Evolutionary Time line and evolution of life's diversity. Evidence of evolution. Relevance of Evolutionary principles. Species concept and speciation. Human evolution. Strategies for adaptation and survival in populations.

ABCS 416: Wildlife Management
Ecology of African game animals; methods of study: aging, identification. Ecology of pastures cropped by game; habitat and harvest management. Management techniques. Population studies of wildlife: game census, wild animal population regulation; capture techniques; threatened species management. Protected area systems; park design, introduction to park management and planning. Law enforcement in protected areas. Public relations. Human-wildlife conflict management. Wildlife utilization, domestication, ranching. Ghana's wildlife conservation policy. International Wildlife Laws.

ABCS 417: Applied Statistics for Biologists
Experimental design - survey, cross-sectional, case control, longitudinal studies, statistical tests. Parametric tests – t-test, F test, Chi-square tests etc. Non parametric tests – U test, H

test. Analysis of variance (ANOVA). Software for data processing (i) SPSS, (ii) Practistats (iii) Sigmastats.

ABCS 418: Applied Entomology
Beneficial and harmful insects. Principles and ecological basis of insect pest control. Control methods; legislative, mechanical, physical, cultural, biological, chemical, antocidal control; use of resistance and semiochemicals in control. Integrated pest management. Biology, control and management of insects of field crops, vegetable crops, tree crops and stored produce.

ABCS 419: Applied Insect Taxonomy
Application of the Biological species concept. Biodiversity informatics. Molecular Systematics. Taxonomic Products. Identification of Bio-indicators and their use in ecosystem analysis Value and Management of reference collections. International Conventions and networks for species conservation. Intellectual Property rights. Insects as commercial resources.

ABCS 421: Research and Project Management
Research proposal writing, thesis/report writing, and introduction to projects, types of projects, project life cycle, experimental design, data collection techniques and analyses, introductory strategic management, basic human resource management, introductory organizational behavior, leadership.

ABCS 422: Radiation Biology and its Applications
Nature of electromagnetic radiation with emphasis on the interaction of ionizing radiation with matter. Direct and indirect action in biological systems. Effects at the cellular, tissue and organ levels and their interactions. Comparative radio sensitivity of living organisms. Genetic and lethal effects of radiation. Applications in breeding, public health and pest/vector management.

ABCS 423: Innovation and Business Plan for Biologists
Concept development. Business proposal writing. Business plan development. Introduction to entrepreneurship and fund management.

DEPARTMENT OF BIOCHEMISTRY, CELL AND MOLECULAR BIOLOGY

Advances in the field of Life Sciences have been propelled by research in Biochemistry, Cell and Molecular biology. Whilst biochemistry studies the chemical processes of the cell, cell biology deals with the structure and function of the cell and molecular biology focuses on the molecular basis of life processes. The aim of these three disciplines is to provide an understanding of the molecular mechanisms of biological processes (life). They are laboratory and research based sciences that apply the concepts of Biology and Chemistry to the vastly different biological systems. Biochemistry in particular is central to all areas of the Life Sciences because it provides an essential foundation for research in the emerging Bioscience and Biotechnology-based disciplines. There are close links with other specialized fields of life sciences, such as Genetics, Immunology, Microbiology, Physiology, Pharmacology, Toxicology and Virology as well as the Physical Sciences such as Chemistry, Mathematics, Computer Science, Physics and Engineering.
Established in 1962, the Department of Biochemistry of the University of Ghana has undergone several transformations in its course content and offerings. The Department is poised to playing an important role in the University's strategic plan for achieving pre-eminence in the Life Sciences and Faculty of Science vision of becoming a leader in cutting-edge Scientific Research.

Programmes: The Department offers a Bachelor of Science in Biochemistry, Cell and Molecular Biology and a Bachelor of Science in Biochemistry combined with a second subject, e. g. BSc Biochemistry and Nutrition.

Admission Requirement: The General Regulations for admission of WASSSCE/SSSCE candidates into undergraduate degree programmes in the University of Ghana shall apply to all students applying to the Department of Biochemistry, Cell and Molecular Biology. The following subjects shall determine candidates' aggregate: Core – English, Mathematics and Integrated Science; Electives – Physics, Chemistry and Biology.

In addition to satisfying the General Regulations for admission of WASSCE candidates into undergraduate degree programmes in the University of Ghana, candidates intending to apply to the Department of Biochemistry, Cell and Molecular Biology must obtain at least Grade B3 in Chemistry.

Requirements for award of Bachelor of Science degree in Biochemistry, Cell and Molecular Biology

A student shall be deemed to have qualified for the award of BSc in Biochemistry, Cell and Molecular Biology or BSc in Biochemistry combined with a second subject if, he/she has passed a minimum of 120 credits including ALL CORE and University Required Courses.

FACULTY

A. Ocloo *BSc (Ghana), PhD (Cambridge)*	-	Senior Lecturer/Head of Department
S. T. Sackey *BSc, MPhil (Ghana), PhD (Adelaide)*	-	Assoc. Professor
Naa A. Adamafio *BSc (Ghana), PhD (Monash)*	-	Assoc Professor
Yaa D. Osei** *MSc (Ghana), PhD (Tenn)*	-	Senior Lecturer
W. S. K. Gbewonyo** *MSc (Ghana), PhD (Birmingham)*	-	Senior Lecturer
J. P. Adjimani *BSc (Kumasi), MSc (Brock), PhD (Utah State)*	-	Senior Lecturer

L. K. N. Okine* *** *BSc (Ghana), PhD (Surrey)*	-	Assoc Professor
W. Peck-Dorleku* *B.Sc., M.Phil. (Ghana)*	-	Lecturer
G. A. Awandare *B.Sc. M.Phil. (Ghana), PhD (Pittsburgh)*	-	Senior Lecturer
P. K. Arthur *BSc (Ghana), PhD (Goettingen)*	-	Lecturer
Anastasia R. Aikins *BSc, MPhil (Ghana)**	-	Assist Lecturer
Lydia Mosi *BSc (Ghana), PhD (Tenn)*	-	Lecturer
Marian Nyako *BSc (Lafayette, Penn.) PhD (Stony Brook)*	-	Lecturer
N. Y. A. Yeboah *BSc (KNUST), MSc (UCL), PhD (Kent)*	-	Lecturer
Theresa Manful *BSc (Ghana), MSc, PhD (Heidelberg)*	-	Lecturer
M. F. Ofori* *** *PhD (Copenhagen)*	-	Lecturer
Dorothy Yeboah Manu * *** *PhD (Basel)*	-	Lecturer
K. Gbewonyo *PhD (MIT)*	-	Lecturer/Visiting Scholar
K. A. Kusi * *** *BSc, MPhil (Ghana), PhD (Leiden)*	-	Lecturer

* On study leave
** On contract
*** Part time

LEVEL 100

Students will follow the programme prescribed for the Biological Sciences in the Faculty of Science.

LEVEL 200

SEMESTER 3
CORE

Course Code	Course Title	Credits
UGRC 210	Academic Writing II	3
BCMB 201	Structure And Function of Biomolecules[1]	3
BCMB 203	Principles of Biochemical Techniques	2
CHEM 231	Physical Chemistry I	2
CHEM 271	Analytical Chemistry I	2
CHEM 233	Organic Chemistry I	2
	Total	**14**

[1]Pre-requisite for all level 300 & 400 courses

SEMESTER 4
CORE

Course Code	Course Title	Credits
UGRC 220	Introduction to African Studies	3
BCMB 200	Practical Biochemistry I	3
BCMB 202	Cell Biology I	2
BCMB 204	Enzymology	2
BCMB 206	Spectroscopic and Radioisotopic Techniques	1
CHEM 252	Inorganic Chemistry I (S-Block Elements)	2
CHEM 234	Organic Chemistry II	2
	Total	**15**

ELECTIVES
In addition to satisfying the *Core* requirements above as well as *Faculty* and *University* prescribed courses, candidates are also required to select electives from other DEPARTMENTS to satisfy the minimum work load of 15 credits per semester as would be permitted by the Time Table.

BIOCHEMISTRY COURSES FOR NON-BIOCHEMISTRY STUDENTS

Course Code	Course Title	Credits
BCMB 205	General Biochemistry	3

BCMB 205 is available ONLY for Agricultural Science or Biological Science who would not study Biochemistry beyond level 200.

Course Code	Course Title	Credits
BCMB 207	Veterinary Biochemistry I	2
BCMB 208	Veterinary Biochemistry II	3
BCMB 212	Veterinary Biochemistry III	3

BCMB207, 208 and 212 are available only to students from the School of Veterinary Medicine.

LEVEL 300

SEMESTER 5
CORE

Course Code	Course Title	Credits
BCMB 301	Intermediary Metabolism	3
BCMB 303	Molecular Biology I	2
BCMB 305	Biochemistry of Hormones	2
BCMB 307	Data Handling & Interpretation	1
BCMB 309	Principles of Lab. Organization & Management	2
BCMB 311	Practical Biochemistry II	3
CHEM 343	Chemistry of Aromatic Compounds	3
	Total	**16**

ELECTIVES (Select a minimum of 2 Credits)

Course Code	Course Title	Credits
BCMB 313	Biochemistry of Viruses	2
BCMB 315	Industrial Microbiology	2

In addition to satisfying the *Faculty, Core* and *Prescribed Elective* requirements above, candidates MAY select electives from other DEPARTMENTS as would be permitted by the Time Table provided the maximum work load of 18 credits per semester is not exceeded.

SEMESTER 6
CORE

Course Code	Course Title	Credits
BCMB 302	Cell Biology II[2]	2
BCMB 304	Molecular Biology II	2
BCMB 306	Integration and Control of Metabolism[3]	3
BCMB 308	Bioenergetics	2
BCMB 312	Cell & Molecular Biology Practical I	3
BCMB 314	Membrane Biochemistry	2
CHEM 346	Molecular Rearrangement Reactions	2
CHEM 344	Carbanions and Their Reactions	2
	Total	**18**

LEVEL 400

SEMESTER 7
CORE

Course Code	Course Title	Credits
BCMB 401	Protein Chemistry I	2
BCMB 403	Molecular Biotechnology & Applications	2
BCMB 405	Cell Signalling	2
BCMB 407	Cell & Molecular Biology Practicals II	3
BCMB 410	Seminar Presentation and Scientific Writing	1
	Total	**10**

ELECTIVES (Select a minimum of 4 Credits)

Course Code	Course Title	Credits
BCMB 409	Biochemistry of Parasites	2
BCMB 411	Clinical Biochemistry	2
BCMB 415	Xenobiotic Metabolism	2

SEMESTER 8
CORE

Course Code	Course Title	Credits
BCMB 400	Research Project	6
BCMB 402	Protein Chemistry II	2
BCMB 404	Immunology and Immunochemistry	2
BCMB 406	Molecular Genetics	2
BCMB 408	Entrepreneurship for Innovations in Biosciences	2
	Total	**14**

[2]Pre-requisite: BCMB 201, 202
Key to new programme: † New subject; * Revised subject

[3] Prerequisite: BCMB 301

ELECTIVES (Select a minimum of 2 Credits)

Course Code	Course Title	Credits
BCMB 414	Plant Biochemistry	2
BCMB 416	Bioremediation	2
BCMB 418	Insect Biochemistry & Chemical Ecology	2

BACHELOR OF SIENCE (COMBINED MAJOR) IN BIOCHEMISTRY

To combine biochemistry with other subjects, candidate must take the following courses.

LEVEL 200

SEMESTER 3
CORE

Course Code	Course Title	Credits
UGRC 210	Academic Writing II	3
BCMB 201	Structure And Function of Biomolecules[4]	3
BCMB 203	Principles of Biochemical Techniques	2
CHEM 231	Physical Chemistry I	2
CHEM 271	Analytical Chemistry I	2
CHEM 233	Organic Chemistry I	2
	Total	**14**

SEMESTER 4
CORE

Course Code	Course Title	Credits
UGRC 220	Introduction to African Studies	3
BCMB 200	Practical Biochemistry I	3
BCMB 204	Enzymology	2
BCMB 206	Spectroscopic and Radioisotopic Techniques	1
CHEM 234	Organic Chemistry II	2
	Total	**11**

LEVEL 300

SEMESTER 5
CORE

Course Code	Course Title	Credits
BCMB 301	Intermediary Metabolism	3
BCMB 303	Molecular Biology I	2
BCMB 305	Biochemistry of Hormones	2
BCMB 307	Data Handling & Interpretation	1
BCMB 311	Practical Biochemistry II	3
	Total	**11**

[4]Pre-requisite for all level 300 & 400 courses

SEMESTER 6
CORE

Course Code	Course Title	Credits
BCMB 304	Molecular Biology II	2
BCMB 306	Integration and Control of Metabolism[5]	3
BCMB 308	Bioenergetics	2
BCMB 314	Membrane Biochemistry	2
	Total	**9**

LEVEL 400

SEMESTER 7
CORE

Course Code	Course Title	Credits
BCMB 401	Protein Chemistry I	2
BCMB 403	Molecular Biotechnology & Applications	2
BCMB 405	Cell Signalling	2
BCMB 410	Seminar Presentation and Scientific Writing	1
	Total	**7**

SEMESTER 8
CORE

Course Code	Course Title	Credits
BCMB 402	Protein Chemistry II	2
BCMB 404	Immunology and Immunochemistry	2
BCMB 408	Entrepreneurship for Innovations in Biosciences	2
	Total	**6**

*Students must select prescribed courses from the other major department to satisfy the total credit requirement.

BACHELOR OF SIENCE (COMBINED MAJOR) IN BIOCHEMISTRY AND NUTRITION

To combine Biochemistry with Nutrition, students must take the following courses.

LEVEL 200

SEMESTER 3
CORE

Course Code	Course Title	Credits
UGRC 210	Academic Writing II	3
NUTN 201	Introductory Nutrition	2
BCMB 201	Structure And Function of Biomolecules[6]	3
BCMB 203	Principles of Biochemical Techniques	2
CHEM 231	Physical Chemistry I	2
CHEM 271	Analytical Chemistry I	2
CHEM 233	Organic Chemistry I	2
	Total	**16**

[5] Prerequisite: BCMB 301
[6]Pre-requisite for all level 300 & 400 courses

SEMESTER 4
CORE

Course Code	Course Title	Credits
UGRC 220	Introduction to African Studies	3
BCMB 200	Practical Biochemistry I	3
BCMB 204	Enzymology	2
BCMB 206	Spectroscopic and Radioisotopic Techniques	1
CHEM 234	Organic Chemistry II	2
	Total	**11**

LEVEL 300

SEMESTER 5
CORE

Course Code	Course Title	Credits
BCMB 301	Intermediary Metabolism	3
BCMB 303	Molecular Biology I	2
BCMB 305	Biochemistry of Hormones	2
BCMB 307	Data Handling & Interpretation	1
BCMB 311	Practical Biochemistry II	3
	Total	**11**

SEMESTER 6
CORE

Course Code	Course Title	Credits
BCMB 304	Molecular Biology II	2
BCMB 306	Integration and Control of Metabolism[7]	3
BCMB 308	Bioenergetics	2
BCMB 314	Membrane Biochemistry	2
	Total	**9**

LEVEL 400

SEMESTER 7
CORE

Course Code	Course Title	Credits
BCMB 401	Protein Chemistry I	2
BCMB 403	Molecular Biotechnology & Applications	2
BCMB 405	Cell Signalling	2
BCMB 410	Seminar Presentation and Scientific Writing	1
	Total	**7**

SEMESTER 8
CORE

Course Code	Course Title	Credits
BCMB 402	Protein Chemistry II	2
BCMB 404	Immunology and Immunochemistry	2
BCMB 408	Entrepreneurship for Innovations in Biosciences	2
	Total	**6**

[7] Prerequisite: BCMB 301

COURSE DESCRIPTIONS

LEVEL 200 COURSE OUTLINES

BCMB 200 PRACTICAL BIOCHEMISTRY I 2 Credits

Acid-Base Reactions: Titration; pH measurement; buffer preparation; determination of pK. Acid-base reactions; buffers, chromatography, qualitative analysis of carbohydrates, proteins and lipids.

Quantitative analysis of proteins: methods for protein estimation (Folin-Lowry, Biuret, Ultraviolet absorption); determination of amino acids (ninhydrin method); preparation, purification and standardization of proteins (serum proteins, cytochrome C).

Separation Methods: Paper and gel electrophoresis; chromatography (Paper, TLC, column).

Quantitative analysis of carbohydrates: Estimation of glucose (Folin-Wu); isolation of glycogen, determination of rate of hydrolysis and chromatography of hydrolysis products.

Quantitative analysis of lipids: Solubility; emulsification; determination of iodine number and acid value; separation of serum lipids.

BCMB 201 STRUCTURE AND FUNCTION OF BIOMOLECULES 3 Credits

Chemistry & Function of Biological Compounds: Biomolecule*s:* - monomers; polymers; macromolecules; supramolecules. **Carbohydrates***:* - mono-, di-, oligo- and polysaccharides (structural and storage); stereoisomerism; mutarotation; reactions of carbohydrates. Other derivatives of monosaccharides. **Lipids***:* - classification (fatty acids, triacylglycerols, phospholipids, sphingolipids, steroids, cholesterol, eicosanoids); simple lipoproteins; glycolipids (cell-cell recognition, receptors etc). **Proteins***:* - amino acids:- basic structure, classification, acid/base properties, essential & non-essential; peptides; protein structure-primary, secondary, tertiary and quaternary structures, classification and properties. Enzymes as proteins. **Nucleic Acids***:* - nitrogenous bases, nucleosides, nucleotides, cyclic nucleotides and nucleic acids DNA and RNAs (brief review of replication, transcription, translation). **Other cellular molecules:** Porphyrins, Vitamins and co-enzymes alkaloids & inorganic ions.

BCMB 202 CELL BIOLOGY I 2 Credits

Cellular Compartments of Prokaryotes and Eukaryotes: Organization, Dynamics, and Functions;

Cellular membrane systems (structure and transport); Nucleus (envelope and matrix), Mitochondria and chloroplasts (including biogenesis and evolution).

Cell Division, Differentiation, and Development: Bacterial division, Meiosis and gametogenesis; Eukaryotic cell cycles; mitosis, and cytokinesis; Fertilization and early embryonic development (including positional information, homeotic genes, tissue-specific expression, nuclear and cytoplasmic interactions, growth factors and induction, environment, and polarity); Differentiation of special cells in tissues of plants and animals.

BCMB 203 PRINCIPLES OF BIOCHEMICAL TECHNIQUES 2 Credits

Chromatography: Partition coefficient and chromatographic systems.

Basis of separation: adsorption and partition (polarity); ion-exchange (ionic nature), exclusion/gel (molecular size and shape). Principles and applications (HPLC, FPLC, GLC, TLC, Paper, Chromatofocusing and two-dimensional electrophoresis). Analytical aspects: retention time and volume, capacity ratio, peak resolution theoretical plates/plate height, peak capacity, internal and external standardization and analyte quantitation.

Centrifugation: Basic principles of sedimentation, RCF value, relationship between v, s and G. Centrifuges and rotors (types and uses). Preparative centrifugation: differential and density gradient; preparation of gradients, recovery and monitoring of fractionates. Analytical centrifugation: determination of relative molar mass (sedimentation velocity and equilibrium methods), purity and shape of macromolecules.

Electrophoresis: General principles. Low voltage thin sheets (paper, cellulose acetate, thin layer) and high voltage gels (agarose, polyacrylamide - native, gradient and SDS-PAGE). Applications; purity and molecular weight determination of proteins and nucleic acids, DNA sequencing. Iso-electric focusing and isotachophoresis.

BCMB 204 ENZYMOLOGY 2 Credits

Introduction to Enzymes: Comparison of chemical and enzyme catalysis, Activation energy and transition state, Free energy change, Chemical equilibria, Active site, Substrate specificity, Enzyme classification, enzyme assays, linked or coupled.

Factors affecting Enzyme Activity: Reaction rate (v), Effect of [S], [E], T, pH on enzyme activity; coenzyme, prosthetic groups.

Enzyme Kinetics and Inhibition: Michaelis - Menten model, Graphical representation of data (e.g. Lineweaver - Burk and Hanes plots)

Enzyme inhibition: Reversible (Competitive, noncompetitive, uncompetitive) and irreversible

Control of Enzyme Activity: Feedback regulation, allosteric enzymes, isozymes, covalent modification, activation, regulation of synthesis and breakdown (eg. lac operon, tryptophan biosynthesis).

Enzyme Purification: Cell disruption techniques, general purification strategy, enzyme assays, units of enzyme activity.

Application of enzymes in health, agriculture and industry

BCMB 205 GENERAL BIOCHEISTRY 3 Credits

Cell Structure and Function and Methods and Techniques of studying the Cell: **General features of prokaryotes & eukaryotes; compartmentalization of cellular processes; Source tissue/cells selection; cell disruption and fractionation.** Structure, Function and Metabolism of Carbohydrates: **- mono-, di-, oligo- and polysaccharides; functions of carbohydrates; stereoisomerism; Glycolysis, substrate level phosphorylation, hexose monophosphate shunt, gluconeogenesis, synthesis of other carbohydrates from monomers, fate of pyruvate in different organisms; the electron transport chain in mitochondria and ATP synthesis.** Structure, Function and Metabolism of Lipids: **Different types and functions of lipids (fatty acids, triacylglycerols, phospholipids, etc); beta oxidation of fatty acids; fate of acetyl CoA units (TCA cycle, ketone bodies, cholesterol); synthesis of fatty acids.** Structure, Function and Metabolism of Proteins: **Amino acids: buffer solutions & buffer capacity; the Henderson-Hasselbach equation in the preparation of buffers in biological assays and systems. pKa and pI. Oxidative deamination; decarboxylation; transamination ; urea cycle; NH_3 assimilation; fate of carbon skeleton (glucogenic and ketogenic amino acids); metabolism of some individual amino acids. Integration of metabolism. Protein structure, classification and functions.** Enzymes: **Properties & classification; factors affecting activity (co-factors & co-enzymes, pH, temp., [S], [E]); control of activity; kinetics; Michaelis-Menten equation.** Nucleic acids and Protein Biosynthesis: **Nitrogenous bases, nucleosides, nucleotides and nucleic acids. General overview of DNA replication, transcription and translation; Molecular basis of mutations.**

BCMB 206 SPECTROSCOPIC AND RADIOISOTOPICTECHNIQUES 1 Credit

Molecular spectroscopy; molecular fluorescence; infra-red, atomic, electron spin resonance and nuclear magnetic resonance spectroscopy, mass spectrometry, X-ray diffraction and radioisotopic techniques in biochemistry, radio/fluorescent labeling (RIA, scintillation counting), autoradiography ELISA.

BCMB 207 VETERINARY BIOCHEMISTRY I 2 Credits

Cell and Tissue: Their principal chemical constituents and main metabolic activities. The characteristics of, and differences between eukaryotes, prokaryotes and viruses. Compartmentalisation and control of cellular environment. Functional role of the main

cellular components; nucleus, ribosomes, Golgi bodies, endoplasmic reticulum, mitochondria and lysosomes. Biochemical technique for investigatin cell structure and function. **Chemistry & Function of Biological Compounds: Biomolecule***s:* - monomers; polymers; macromolecules; supramolecules. **Carbohydrates***:* - mono-, di-, oligo- and polysaccharides (structural and storage); stereoisomerism; mutarotation; reactions of carbohydrates. Other derivatives of monosaccharides. Glycol-congugates: carbohydrates, sorting of molecules into-subcellular compartments, diseases of sorting. **Lipids***:* - classification (fatty acids, triacylglycerols, phospholipids, sphingolipids, steroids, cholesterol, eicosanoids); simple lipoproteins; glycolipids (cell-cell recognition, receptors etc). **Proteins***:* - amino acids:- basic structure, classification, acid/base properties, essential & non-essential; peptides; protein structure- primary, secondary, tertiary and quaternary structures, classification and properties. Enzymes as proteins. **Nucleic Acids***:* - nitrogenous bases, nucleosides, nucleotides, cyclic nucleotides and nucleic acids DNA and RNAs (brief review of replication, transcription, and translation). **Other cellular molecules:** Porphyrins, Vitamins and co-enzymes alkaloids & inorganic ions.

BCMB 208 VETERINARY BIOCHEMISTRY II 3 Credits

Carbohydrates Metabolism: Digestion of carbohydrates, glycolysis and fate of pyruvate in different organisms; tricarboxylic acid (TCA) cycle; pentose phosphate pathway and fate of reduced coenzymes; catabolism of monosaccharides other than glucose; gluconeogenesis, Calvin Benson cycle, Cori cycle, glyoxylate cycle; glycogenesis and glycogenolysis; regulation of carbohydrate metabolism; Diseases of carbohydrate metabolism. Aerobic metabolism of pyruvate, starvation and obesity. The coenzyme role of B vitamins. Changes in nutritional requirement and metabolic rate in injury and disease. **Lipids Metabolism:** Digestion of triacylglycerols; the different lipases (lipoprotein lipase, hormone-sensitive lipase); fate of glycerol; beta-oxidation of fatty acids; fate of products (acetyl and propionyl CoA, ketone bodies, reduced coenzymes); synthesis of fatty acids triacylglycerol, cholesterol; regulation of metabolism. **Protein Metabolism:** Digestion of proteins, transamination, deamination and decarboxylation of amino acids and the fate of ammonia (urea cycle) and carbon skeleton; metabolism of specific amino acids (aromatic and sulphur-containing amino acids); synthesis of amino acids; in-born errors of amino acid metabolism; regulation of metabolism. **Enzymes as biological catalyst:** Enzyme kinetics and concept of rate-determining step. Enzyme specificity and allosteric regulation. Mechanisms of enzyme action and examples. Coenzymes and vitamins. Drugs and their effect on enzymes.

BCMB 412 VETERINARY BIOCHEMISTRY III 3 Credits

Glycosylation of proteins. Fibrous structural proteins. Structure and biosynthesis of collagen and elastin, intra-cellular and extra-cellular modification of proteins after translation. The collagen gene; disturbances in collagen synthesis. Diversity of protein function related to their structure. The relationship between structure and function as exemplified by haemoglobin, myoglobin and collagen. Plasma proteins. Detail of immunoglobin structure. Classes of immnuglobin and their functions. Protein in normal disease situations. Defects in protein structure as basis of disease e. g. sickle cell anaemia. **Lipid and protein components**: Glycoprotein and the cell surface. Erythrocyte membrane as a model system. Blood cells: Haemopoiesi, sites of production, growth inducers, differenciation inducers. Red blood cells (erythrocytes) functions, morphology and and membrane function formation and destruction, haemoglobin. White blood cells (leucocytes) types and morphology, functions, platelet functions. Blood clotting: haemostasis blood coagulation, definitions and components, mechanism of blood coagulation, anti-clotting mechanisms, fibrinolysis and haemostasis. **Energetics:** Chemical energy and concepts of energy transfer within cells; "high energy" compounds as "high energy currency". Principles of energy abstraction. Energy source and utilization. Free energy and biochemical reactions (spontaneity, anabolic and catabolic reactions); metabolic reactions and ATP; energy of hydrolysis of ATP, ADP and phosphorylation products; ATP production (substrate level and oxidative phosphorylation,

photophosphorylation, C_3, C_4); coupling reactions; uncoupling agents. Specific enzymes associated with inner and outer mitochondrial membranes, matrix and intermembrane space.Revrese electron transport, the concept of "high energy pool". Michell's chemiosmotic theory. Mitochondrial transport and inhibitors of mitochondrial function. **Interplay of tissues, pathways and hormones in energy metabolism**: Key regulatory enzymes: allosteric control of pyruvate carboxylase, phosphofructokinase, fructose 1,6-phosphate, pyruvate dehydrogenase. Effect of ATP, AMP, NADH, citrate, relevance of energy status to control. "Futile" cycles and function in thermogenesis and control sensitivity. Covalent modification: beta-adrenergic receptor and cascade processes.

LEVEL 300 COURSE OUTLINES

BCMB 301 INTERMEDIARY METABOLISM 3 Credits

Carbohydrates: Digestion of carbohydrates, glycolysis and fate of pyruvate in different organisms; tricarboxylic acid (TCA) cycle; pentose phosphate pathway and fate of reduced coenzymes; catabolism of monosaccharides other than glucose; gluconeogenesis, Calvin Benson cycle, Cori cycle, glyoxylate cycle; glycogenesis and glycogenolysis; regulation of carbohydrate metabolism; Diseases of carbohydrate metabolism.

Lipids: Digestion of triacylglycerols; the different lipases (lipoprotein lipase, hormone-sensitive lipase); fate of glycerol; beta-oxidation of fatty acids; fate of products (acetyl and propionyl CoA, ketone bodies, reduced coenzymes); synthesis of fatty acids triacylglycerol, cholesterol; regulation of metabolism.

Amino acids: Digestion of proteins, transamination, deamination and decarboxylation of amino acids and the fate of ammonia (urea cycle) and carbon skeleton; metabolism of specific amino acids (aromatic and sulphur-containing amino acids); synthesis of amino acids; in-born errors of amino acid metabolism; regulation of metabolism.

Energetics: Free energy and biochemical reactions (spontaneity, anabolic and catabolic reactions); metabolic reactions and ATP; energy of hydrolysis of ATP, ADP and phosphorylation products; ATP production (substrate level and oxidative phosphorylation, photophosphorylation, C_3, C_4); coupling reactions; uncoupling agents.

BCMB 302 CELL BIOLOGY II 2 Credits

Cell Surface and Communication: Extracellular matrix (including cell walls), Cell adhesion and junctions, Signal transduction, Receptor function, Excitable membrane systems.

Cytoskeleton, Motility, and Shape: Actin-based systems (including muscle contraction), Microtubule-based systems, Intermediate filaments, Prokaryotic systems;

Protein Synthesis and Processing: Regulation of translation, Post-translational modification, Intracellular trafficking, Secretion and endocytosis.

Cells as organisms: bacteria life cycles, protozoa and algae, parasitic protozoa and fungi as free-living and parasitic organisms.

BCMB 303 MOLECULAR BIOLOGY I 2 Credits

Purine and pyrimidine biosynthesis: Regulation of biosynthesis. Structure and properties of nucleosides and nucleotides. Biosynthesis of deoxyribonucleotides; thymidylate biosynthesis. Salvage pathways.

DNA and chromosome structure: Evidence for DNA as carrier of genetic information. Primary and secondary (A, B and Z DNA) and tertiary structure of DNA. Elucidation of DNA structure. Watson and Crick double helix. Structural differences between RNA and DNA. Methods for sequencing DNA. Organisation of DNA in chromosomes, nucleosome structure.

DNA replication: Mechanism of replication (prokaryotic and eukaryotic). Evidence for semi-conservative replication. DNA replicating enzymes. Directionality of replication.

Transcription: Mechanism of transcription (prokaryotic and eukaryotic). Features of a typical transcription unit. Characteristics of different types of RNA. Modification and processing RNA. Reverse transcription.

BCMB 304 MOLECULAR BIOLOGY II 2 Credits

The genetic code: Deciphering the code. Universality and degeneracy of the genetic code. Wobble hypothesis, colinearity of gene polypeptide.

Translation: Ribosome structure. Activation of Amino acids. Initiation, elongation and termination. Eukaryotic and prokaryotic. Post-translational modifications; Polysomes, inhibitors of protein synthesis.

Control of gene expression: Inducible and repressible operons, (lac and trp operons).

Mutation: molecular basis of mutation. Point mutation – transitions, transversions, frameshift mutations. Site-directed mutagenesis, Radiation induced mutation. Chemically induced mutation. DNA repair mechanisms.

Recombinant DNA and genetic engineering: Restriction endonucleases, Methods for recombinant DNA production, transformation, amplification, screening for cloned DNA.

BCMB 305 BIOCHEMISTRY OF HORMONES 2 Credits

General introduction: Coordination in multicellular organisms

Major classes of hormones: Mammalian, plants, insects.

Major endocrine glands: Hypothalamus, pituitary, adrenals, testes, ovaries, pancreas.

Biosynthesis and degradation of hormones: regulation of synthesis/secretion; major biochemical effects and actions.

Hormone receptors: structure, relationship to binding to response, binding characteristics, segregation, auto-phosphorylation/cross-phosphorylation; internalization.

Types of post receptor mechanism: second messenger generation, hormone response elements, gene expression.

BCMB 306 INTEGRATION AND CONTROL OF METABOLISM 3 Credits

Metabolic control: Design of metabolic pathways. Regulatory enzymes fine control (allosteric, substrate/product feed- back and feed-forward controls, covalent modification) and coarse control (induction and repression of enzyme synthesis).

Regulation of fuel metabolism: glycolysis, gluconeogenesis, glyceroneogenesis, glycogenolysis and glycogenesis, Krebs cycle, lipogenesis and lipolysis, β-oxidation, ketogenesis, amino acid metabolism. Role of hormones (e. g. insulin, glucagon, epinephrine) and DNA binding proteins (e. g. Cyclic AMP response element binding protein (CREB), Carbohydrate response element binding protein (ChREBP), Sterol regulatory element binding protein (STREB)).

Integration of metabolism: Glucose homeostasis and glucose transpoters. Interrelationships between carbohydrate, lipid, and protein metabolism. Enzyme profiles of tissues and organs. Interorgan relationships (liver, brain, muscle, adipose tissue) in different physiological states: e. g. Fed, fasted, running athlete and pregnancy.

BCMB 307 DATA HANDLING & INTERPRETATION 1 Credit

Data types; Discrete and ordinate data.

Simple definitions and Descriptive Statistics; mean, standard deviation, standard error of mean etc.

Statistical principles: Importance of statistics; sampling from populations; Gaussian and non-Gaussian distributions; confidence intervals; p-value; statistical significance; statistical power; Baysian perspective on interpreting statistical significance;

Data presentation tools: Tables, graphical types such as histograms, scatter plots, bar graphs, box plots etc

Data analysis: Multiple comparisons; analysis of one group; analysis of two or more groups; Analysis of variant (ANOVA); Analysis of survival data; Categorical data (contingency

tables); odds ratios and proportions tests; correlation and linear regression; choosing the right statistical test.

Experimental Design: Response variables (*measurements of interest*); factors or treatments (*influencing variables*); number of replicates; type of randomization; time and place of the measurements; sources of error.

Statistical packages and their applications: Excel, Minitab etc.

BCMB 308 BIOENERGETICS 2 Credits

Overview of chemical thermodynamics: Internal, energy, enthalpy, entropy, Gibb's free energy, laws of thermodynamics; Spontaneous and non-spontaneous processes; Free energy changes in biochemistry.

Principles of thermodynamics and their application to the energetics of the cell: Redox systems, electron donors and acceptors, redox couples, redox potentials, electromotive force, protonmotive forces.

The concept of high energy compounds: phosphoric acid anhydrides, phosphoric-carboxylic acid anhydrides, phosphoguanidines, enolphosphates and thiol esters; basis for the high standard free energy of hydrolysis; the central role of ATP; (phosphate) group transfer potentials; substrate-level phosphorylation; energetics of coupled reactions.

ATP synthesis: review of structure of mitochondrion and chloroplast; sources of energy; redox complexes for electron transport in mitochondria and in chloroplasts; establishment of proton gradients; coupling of ATP synthesis to dissipation of proton gradient; H^+ -ATPase; couplers (thermogenesis). ATP utilization for the performance of cellular work; active membrane transport and mechanical work such as muscle contraction.

BCMB 309 PRINCIPLES OF LAB ORGANIZATION & MANAGEMENT 2 Credits

Principles of Laboratory Management: Organisational structure: concepts and models; Principles of Leadership: Past, Present, and Future; Management Functions; Managerial Problem Solving and Decision Making.

Human Resource Management: Human Resource Guidelines and Regulations; Job Analysis, Work Descriptions, and Work Groups; Supervision; Performance Evaluation and Professional Development.

Financial Management: Fundamentals of Financial Management; Effective Budgeting in the Laboratory; Cost/Benefit Analysis (Costing of Services; Justification for Introduction/ Continuation/ Discontinuation of a Service; Lease or Purchase decision analysis).

Operations: Laboratory design for different types and sizes of institutions (selection of equipment and systems, concepts of workstation consolidation, work flow analysis, concepts in laboratory automation [sample transportation systems, modular systems, robotics]); Procurement and Inventory Control; Work load statistics; Staffing; Personnel training and development; Equipment and facilities maintenance planning; Marketing Concepts. Public Relations.

General Principles of Quality Assurance and Quality Control: Introduction to Quality Assurance; Quality Management System, Quality Assurance (QA) and Quality Control (QC);

Compliance/Regulations Issues: Laboratory Standards and their Main Features (ISO 9001, ISO/IEC 17025 and ISO 15189), Good Laboratory Practice (GLP).

Ethical Issues in Laboratory Management

BCMB 311 PRACTICAL BIOCHEMISTRY II 3 Credits

Enzyme catalysed reactions: Time course of reaction; effects of various factors on reaction rate: enzyme concentration, pH, temperature, substrate concentration, activators and inhibitors; enzyme specificity; protease activity in plant extracts; purification of enzymes from plant juice; use of enzyme as an analytical tool (e.g. Estimation of urea in urine).

Mini project: Isolation, purification and characterisation of a known enzyme.

BCMB 312 CELL & MOLECULAR BIOLOGY PRACTICAL I 3 Credits

Preparation of microbial cells: Safety precautions; sterility; types of growth media (liquid, solid); identification and classification of microorganisms: morphology, Gram stain, biochemical tests; measurement of microbial concentrations; comparison of growth rate in differently constituted media; selective action of antibiotics.

Cell fractionation: Cytoplasm, Nuclear, Mitochondria, Mitoplast; Assay for enzyme markers e.g. succinate dehydrogenase.

Use of protein assay to monitor cell growth: Cell growth; cell density; centrifugation; protein determination.

Cell Behaviour: Cell interactions; kinetics of cell pairing; phagocytosis; kinetics of phagocytosis; exocytosis.

DNA technology: Isolation, purification and manipulation of DNA; RFLP, PCR, Hybridization.

BCMB 313 BIOCHEMISTRY OF VIRUSES 2 Credits

Viruses: Classification; particle structure and stability; the virus genomes; virus replication, cell to cell movement; virus genetics; virus transmission; virus-host interactions. Tools of virus research: electron microscopy, serology and immunochemistry, molecular methods (hybridization, PCR and RT-PCR). Virus epidemiology and control. Plant viruses (cocoa swollen shoot virus), animal viruses (HIV, bird flu virus) and bacterial viruses (Bacteriophages).

BCMB 314 MEMBRANE BIOCHEMISTRY 2 Credits

Introduction: Membrane types and functions; chemical composition (lipids, proteins and carbohydrates); amphipatic nature of lipids (formation of monolayers, bilayers/liposomes, and micelles); Reactions of phospholipases.

Structure and properties: Models (Dawson and Danielli, Singer and Nicholson); integral (glycophorin A, anion channel ban 3, bacteriorhodopsin), lipid-anchored and peripheral (cytoskeleton of erythroid and non-erythroid cells) proteins; plasma membrane glycocalyx, antigenic properties (RBC M and N, blood group O, A and B); evidence for asymmetric, dynamic and fluid-like character of biomembranes; cell-cell recognition and fusion (eg flu virus and HIV infections); membrane biogenesis (synthesis and transport of membrane lipids).

Preparation and study: Physical, chemical and biochemical methods of study (lipid bilayer and vesicles of eukaryotic and prokaryotic cells).

Transport: Thermodynamics; modes (uniport, symport and antiport systems) and types (simple diffusion, passive-mediated, active, Na/K pump, co-tranport – Na/glucose pump of kidney/intestine, galactose permease of E. coli, exocytosis and endocytosis); channels (ligand gated and voltage-gated) and pores; ionophores (valinomycin, gramicidin A and nigericin).

BCMB 316 INDUSTRIAL MICROBIOLOGY 2 Credits

Introduction: Importance and effects of microorganisms in industry, Nature of industrial microbiology, microorganism of industrial importance; Mutation, strain selection and development, hybridisation; media formulation and economic; optimisation of fermentation media at laboratory scale, perimeter design operation; Antifoams; aspects of biochemical engineering; patents and patent law.

Microbial contamination in industry: Microbial contamination in industry, Regulatory and advisory bodies, Microbiology testing programs, Quality control;

Microbial biotechnology: Properties of an industrial microorganism, growth factors and conditions of industrial microorganisms, Product formation, Aspects of the biology of moulds, yeasts, bacteria, actinomycetes and viruses of importance in various fermentation. Culture techniques and maintenance of selected cultures, Application of modern techniques of genetics and physiology to the large-scale production of microbial products; industrial strain improvement; scale-up of microbial processes; survey of industrial processes using microorganisms.

Industrial processes: Production of pharmaceutical compounds, commercially valuable non-pharmaceutical compounds, food and food supplements. Pollution control.

LEVEL 400 COURSE OUTLINES

BCMB 400 RESEARCH PROJECT 6 Credits

Research project covering a range of subjects utilizing biochemical principles, analytical, cell and molecular biology techniques, demonstrating candidates' ability to identify original subjects for research, plan, execute and report in seminars and a thesis.

BCMB 401 PROTEIN CHEMISTRY I 2 Credits

Primary structure: amino acid composition of proteins, determination of amino acid sequence, importance of primary structure synthesis of peptides, covalent modification of polypeptides.

Secondary structure (regular arrangement of the polypeptide backbone): peptide bond and its structural implications; random polymers; Ramachandran Plot. Regular conformation of polypeptides; □-helix, □-pleated sheets, other helices (3_{10}- helix), super-secondary structures (coiled-coil □□-helix). Examples: fibrous proteins; □-keratins, silk fibroin, collagen.

Tertiary structure (folded conformation of globular proteins): determination of protein structure by X-ray crystallography, evidence for folding, reverse turns (□-turns) super-secondary structures (motifs), domains, interiors and exteriors, unfolding and folding. Example: Myoglobin.

Quaternary structure (aggregation of globular proteins). Example: haemoglobin.

Physical forces responsible for maintaining structure.

BCMB 402 PROTEIN CHEMISTRY II 2 Credits

Protein-ligand Interactions: Binding sites of haemoglobin and myoglobin, binding of oxygen and carbon monoxide, micro-environment of the haem iron, the Hill Plot. Protein engineering.

Allostery: interaction between binding sites. Theoretical models; the Mond-Wyman-Changeux (MWC) concerted mechanism, the Koshland-Nemethy-Filmer (KNF) sequential model. Allosteric properties of haemoglobin; molecular mechanism of cooperative binding of oxygen to haemoglobin, the Bohr effect, binding of 2, 3-bisphosphoglycerate (BPG).

Mechanism of Enzyme Catalysis: General acid-base catalysis and covalent catalysis. Catalysis by coenzymes; pyridoxal phosphate, thiamine pyrophosphate, ATP, coenzyme A, $NAD(P)^+$, FAD/FMN. Structure and mechanism of action of selected enzymes. Examples; dehydrogenases, proteases, ribonuclease, lysozyme, glycolytic enzymes such as phosphofructokinase (PFK).

BCMB 403 MOLECULAR BIOTECHNOLOGY & APPLICATIONS 2 Credits

Tools of molecular biology: Agarose and polyacrylamide gel electrophoresis; Northern and Southern blots and hybridization analysis; Western blots and protein detection; PCR and RAPD, RFLP.

Purification and characterization of nucleic acids: Principles for extraction and purification; concentration and molecular weight determination; species differentiation (RNA/DNA, single/double stranded nucleic acids).

Modifying enzymes: Restriction endonucleases; other nucleases (DNAse, RNAse); ligases; polymerases.

Recombinant DNA technology: Cloning and expression vectors, recombinant molecules and transformation systems (prokaryotic and eukaryotic hosts); colony screening, plasmid isolation and characterisation; transduction and conjugation.

Nucleotide sequencing and mutagenesis: Sequencing of end labelled DNA by base specific chemical cleavage (Maxam and Gilbert) and analysis of primed enzymatic synthesis (Sanger); deletion and insertion mutagenesis.
Gene expression detection: principles of RT-PCR, real time RT-PCR, microarrays.
Applications: medicine, agriculture and industry.

BCMB 404 IMMUNOLOGY AND IMMUNOCHEMISTRY 2 Credits
Defense systems: self and non-self; innate and acquired; cells and organs involved; humoral and cell-mediated.
Antigens: Immunogenicity and antigenicity; chemical nature (bacterial, viral and synthetic)
Antibodies: Structure and function of immunoglobulins; theories of antibody production; polyclonal antibody production; monoclonal antibody production (hybridoma Technology).
Antigen-antibody interactions: Agglutination and precipitation; immunoassays.
The complement system: components, activation (classical and alternative pathways); regulation.
Vaccines: Current methods for development. Immune regulation and tolerance; immunopathology (hypersensitivity, immunodeficiency, autoimmunity); transplantation immunology (mechanisms involved in tissue rejection).
Cytokines: General properties; biological activities of selected cytokines.
Immunology of diseases of public health interest: HIV/AIDS, Malaria, Schistosomiasis.

BCMB 405 CELL SIGNALLING 2 Credits
Types of cellular regulation: endocrine, paracrine, autocrine, direct cell-to-cell communication
Primary signalling molecules: growth factors, hormones, neurotransmitters
Structure and properties of receptors: Cell surface and intracellular receptors, G-protein coupled receptors, receptor tyrosine kinases. Conserved domains, ligand recognition, binding characteristics, receptor dimerization and phosphorylation, docking sites and substrate interactions.
Guanine nucleotide binding-protein switches: Heterotrimeric and monomeric, G-protein regulators - GTPase activating proteins and guanine nucleotide exchange factors e.g. Son of sevenless, neurofibromin.
Second messenger generation: cyclic AMP, cyclic GMP, inositol trisphosphate, diacylglycerol, Ca^{2+}
Examples of major cascades: Ras-mitogen activated protein kinase pathway, phosphatidylinositol-3-kinase and Akt pathway, Janus kinase and Signal transducer and Activator of Transcription pathway (JAK-STAT), Nitric oxide-guanylyl cyclase signaling. Effectors, transcription factors, amplification, signal diversity, cross-talk and signal termination.

BCMB 406 MOLECULAR GENETICS 2 Credits
Genetic Foundations: Overview of Mendelian and non-Mendelian inheritance, Transformation, transduction, and conjugation, Recombination and complementation, Mutational analysis, Genetic mapping and linkage, Analysis.
Chromatin and Chromosomes: Overview of Karyotypes, Translocations, inversions, deletions, and duplications, Aneuploidy and polyploidy Structure.
Genomics: Genome structure, Physical mapping, Repeated DNA and gene families, Gene identification, Transposable elements,
Genome Maintenance: DNA replication, DNA damage and repair, DNA modification, DNA recombination and gene conversion.
Gene Regulation in Eukaryotes: *Cis*-acting regulatory elements, *Trans*-acting regulatory factors, Gene rearrangements and amplifications, Genetic manipulation of bacteria: transposons and plasmids. Large scale genome analysis: the human genome project.

BCMB 407 CELL & MOLECULAR BIOLOGY PRACTICAL II 3 Credits

Cell Biology: Preparation of Cytoskeleton: Reactivation of Ciliary Beat; Cytoskeletal transformation e.g of sea urchins coelomocyles: Induction of Shape Change via Hypotonic Shock; Effect of Colchicine on Coelomocyte Cell Shape Changes; Effect of Ca^{2+} and Ca^{2+} ionophore on Shape Changes of Coelomocytes. Preparation of lymphocytes

DNA technology: Isolation, purification and manipulation of DNA; transformation and screening.

BCMB 408 ENTREPRENEURSHIP FOR INNOVATIONS IN BIOSCIENCES 2 Credits

General Principles of Entrepreneurship: Nature and Importance; The Individual Entrepreneur; Technology Entrepreneurism; Characteristics of Successful Technology Based Businesses; Technical Risk Assessment; Alternative Technology Assessment; Entrepreneurial Process; Entrepreneurial Decision Making; Creativity and the Business Idea; Product Planning and Development System; Resource Needs; Alternative Financing Models; Intellectual Property Protection; Patents, Trademarks, and Copyright in Technology Venturing; Preparing for Venture Launch; Managing Growth and Expansion.

Innovation in Biosciences: Medicine (Diagnosis, Therapeutics, etc); Food & Agriculture (Quality, Safety, Production Efficiency and Processing); Environment (Remediation, Conservation and Restoration); Value added Natural Products;

BCMB 409 BIOCHEMISTRY OF PARASITES 2 Credits

Pathophysiology of the following tropical parasitic diseases: Malaria, trypanosomiasis, filarasis, schistosomiasis and gastrointestinal worm infestations. Biochemistry of the causative parasites with emphasis on host-parasite interrelationships: Molecular basis of chemotherapeutic attack of parasites.

BCMB 410 SEMINARS AND SCIENTIFIC WRITING (Continuous assessment) 1 Credit

Review of language structure and usage.

Types of scientific reports: Seminars, research papers, proposals, posters.

Structure of scientific reports: Title, authors, abstract/summary, Table of content, Glossary; Introuction (context, focus, justification); Materials and Methods; Results; Discussion; Conclusion; References; Appendixes.

Writing style and Rules: Dos and Don'ts; Plagiarism.

In addition, students are required to attend all departmental seminars, (presented by either internal or external speakers), present journal articles (journal club), research proposal and project seminars.

BCMB 411 CLINICAL BIOCHEMISTRY 2 Credits

Introductory practical clinical biochemistry: Laboratory investigations; specimen collection, analytical methods and standardization (calibration standards, precision, accuracy, sensitivity, specificity etc); review of analytical and separation methods used in clinical biochemistry for metabolites, ions and enzymes; report and result interpretation; reference values and factors affecting them.

Organ function disorders and tests: gastrointestinal, liver, kidney, heart, pituitary, pancreas, thyroid, adrenal and gonadal.

Body fluid composition and abnormalities: water and electrolyte balance, acid-base disorders and O_2 transport.

Disorders of metabolism (in-born errors of metabolism): lipids, carbohydrates, amino acids, proteins, purines and porphyrins.

Industrial visits to Clinical Labortaories.

BCMB 414 PLANT BIOCHEMISTRY 2 Credits

Carbohydrates: germination of seeds with carbohyrate stores; storage carbohydrates (starch, sucrose and other reserve carbohydrates); structural carbohydrates (cellulose, hemicellulose, pectin); the biosynthesis of carbohydrates.

Lipids: germination of oil seeds, the glyoxalate pathway and gluconeogenesis; chemistry of plant lipids: cutins, suberins and waxes; fatty acid biosynthesis.

Nitrogen metabolism: nitrogen fixation (dinitrogenase); nitrogen uptake and reduction.

Secondary metabolites: Terpenes (the mevalonic acid pathway); phenolic compounds (the shikimic acid pathway); saponins, cardiac glycosides, cyanogenic glycosides and glucosinades and alkaloids; functions

Photosythesis: Chloroplast structure; photoreceptors and transduction of light into chemical energy (the photosynthesis electron transport chain); carbon fixation; the C3, C2 and C4 cycles; CAM metabolism.

Molecular and biochemical regulation of plant metabolic pathways activated in response to environmental cues: environmental stress, and interaction with pathogenic and symbiotic organisms.

Cell wall formation (primary wall, wood), secondary metabolism (lignin, flavonoids, phenolics), wounding, plant defenses (phytoalexins, oxidative burst, hypersensitivity), responses to drought, flooding, salinity, pollutants (heavy metals, ozones).

BCMB 415 XENOBIOTIC METABOLISM 2 Credits

Pathways of xenobiotic metabolism; Phase I and II reactions. Enzymology and molecular mechanisms of xenobiotic metabolism; cytochrome P-450-dependent mixed-function oxidation reactions, microsomal flavin-containing monooxygenases, prostaglandin synthetase, reduction enzymes, epoxide hydrolase and conjugating enzymes. Factors affecting xenobiotic metabolism; internal and external. Pharmacological and toxicological aspects of xenobiotic metabolism - Pharmacological; activation and deactivation, changes in pharmacological response, drug uptake and distribution, enterohepatic circulation. Toxicological; metabolic activation (increased toxicity) - carcinogenesis, mutagenesis, teratogenesis, pulmonary, hepatic and renal toxicities. Deactivation (decreased toxicity). Balance between toxification and detoxifying pathways.

BCMB 416 BIOREMEDIATION 2 Credits

Review of bacterial genetics and genomics. Microbial diversity, distribution and detection in the environment.

Microbial responses to environmental changes: Direct physical and chemical effects, fine control, coarse control, morphological & genotypic changes.

Biochemical cycling of C*; N;* S, Fe, Hg.

Molecular mechanisms: Selected biochemical pathways in microbes involving Oxygenases and Peroxidases, microbial dechlorination reactions.

Biodegradation of aromatic, aliphatic chlorinated and non-chlorinated hydrocarbons; Polymer metabolism (eg. cellulose, xylan or pectin).

Environmental Applications*:* Replacement of Petroleum Products; Bio-fuels, Industrial Bio products

Prevention and Management of Environmental Contamination: *S*ewage Treatment, Bio-leaching, Biodegradable Materials.

Introduction to Phytoremediation.

BCMB 418 INSECT BIOCHEMISTRY & CHEMICAL ECOLOGY 2 Credits

Distinctive nature of insect metabolism: Energy metabolism; synthesis; storage mobilization; transport and utilization of fuels in flight; regulatory factors.

Insect hormones affecting growth and development: Biochemical activities; insect growth regulators. **Insect control**: Insecticides and their modes of action; detoxification mechanisms; insecticide resistance, synergists; new approaches to insect control.

Chemical ecology: Plant adaptation to environment; chemistry of pollution; plant-insect interactions (insect feeding stimulants, repellents, chemistry of plant defence); animal-animal relationships; pheromones; plant-plant relationships; plant-microorganism relationship-phytoalexi

DEPARTMENT OF BOTANY

INTRODUCTION

Botany as a course is available in the second year to Biological Science students who have a CGPA of 1.00 or better.

Courses offered in the second year are: Introductory Plant Morphology, Introductory Cell Biology and Genetics, Plants and Civilization, Plants and Health. Courses offered in the third year are: Vegetative Plant Anatomy, Phycology, Principles of Genetics, Biometry, Evolution, Principles of Plant Propagation, Conservation and Utilization, Whole Plant Physiology, Taxonomy and Evolution of Seed Plants, Plant Ecology of West Africa, Biology of Lower Plants, Bacteria and Viruses, Aquatic Biology.

Fourth year courses are: Fungi and Lichens, Cell Ultra Structure and Functions, Economic Botany. In the fourth year students are required to:

i. choose electives from one of the following advanced subject areas: Plant Microbiology, Advanced Plant Taxonomy, Plant Ecology, Genetics and Breeding, Fresh Water Biology and Advanced Plant Anatomy.
ii. do projects in their chosen elective areas.

Language for scientists is a course which is offered in both the 3rd and 4th years.

FACULTY

Isaac K. Asante *BSc (Ghana) MPhil PhD (Ghana)*	-	Professor **Head of Department**
George T. Odamtten *MSc (Ghana) PhD (Wageningen)*	-	Professor
Gabriel K. Ameka *MPhil PhD (Ghana)*	-	Professor
Elizabeth Acheampong *BSc (Nott PhD (Birm)*	-	Senior Lecturer
Carol M. Markwei *MSc (Ghana) PhD (Cornell)*	-	Senior Lecturer
Cecilia M. Amoah *BSc (Kumasi) MSc (Ghana*	-	Senior Lecturer
James K. Adomako *BSc MPhil (Ghana) PhD (Ghana)*	-	Senior Lecturer
Ted Y. Annang *BSc MPhil PhD (Ghana)*	-	Research Fellow
Ebenezer Owusu *BSc PhD (Ghana)*	-	Lecturer
Alex Asase *BSc PhD (Ghana)*	-	Senior Lecturer
Eureka E. Adomako *MPhil (Ghana, Camb) PhD (Aberdeen)*	-	Senior Lecturer
Mathew K. Essilfie *Dip SSc Ed (ICC) MPhil , PhD(Ghana)*	-	Lecturer
Vincent V. Vordzogbe *BSc MPhil, PhD (Ghana)*	-	Lecturer
Samuel S. Koranteng *BSc (Cape Coast) MPhil (Cape Coast*	-	Research Fellow (VBRP)
Mona Sunish *BSc MSc PhD (MSU)*	-	Lecturer

Lewis Enu-Kwesi *MSc (Cape Coast) PhD (Waterloo)*	-	Associate Professor
Alfred A. Oteng-Yeboah *BSc (Ghana) PhD (Edinburgh)*	-	Associate. Professor
***James A. Ampofo**	-	Part-time
***Mary Obodai**	-	Part-time
Ebenezer Laing *BSc (Lond) PhD (Camb)*	-	Emeritus Professor
George C. Clerk *BSc DIC PhD (Lond)*	-	Emeritus Professor

PROGRAMME STRUCTURE

SINGLE MAJOR IN BOTANY

LEVEL 200
FIRST SEMESTER
Core

Course Code	Course Title	Credits
UGRC 210	Academic Writing II	3
BOTN 201	Introductory Plant Morphology	3
BOTN 203	Plants and Civilization	3
Total		**9**

Select 3 credits from other Departments to make a maximum credit of 12

SECOND SEMESTER
Core

Course Code	Course Title	Credits
UGRC 220	Liberal and African Studies	3
BOIL 202	Introductory Cell Biology and Genetics	3
BOTN 204	Plants and Health	3
Total		**9**

Select 3 credits from other Departments to make a maximum credit of 12

LEVEL 300
FIRST SEMESTER
Core

Course Code	Course Title	Credits
BOTN 310	Language for Scientists I	1
BOTN 311	Vegetative Anatomy of Seed Plants	3
BOTN 313	Phychology	3
BOIL 315	Principles of Genetics	3
BOTN 317	Biometry I	2
BOTN 321	Evolution	3
Total		**15**
BOTN 323	Principles of Plant Propagation, Conservation and Utilization	3

SECOND SEMESTER

Core

Course Code	Course Title	Credits
BOTN 312	Whole Plant Physiology	3
BOTN 314	Taxonomy and Evolution of Seed Plants	3
BOTN 316	Plant Ecology of West Africa	3
BOTN 318	Aquatic Biology	3
BOTN 322	Biology of Lower Plants	3
Total		**15**
BOTN 324	Bacteria and Viruses	3

LEVEL 400

FIRST SEMESTER

Core

Course Code	Course Title	Credits
BOTN 400	Project Work	3
BOTN 411	Fungi and Lichens	3
BOTN 413	Cell Ultra Structure and Functions	3
Total		**9**

Electives (Select 9 credits from any of the following groups)

Course Code	Course Title	Credits
Group A		
BOTN 417	Microbiology	3
BOTN 439	Physiology of Fungi	3
Group B		
BOTN 419	Advanced Taxonomy	3
Group C		
BOTN 425	Quantitative Plant Ecology	3
BOTN 427	Conservation and Environmental Studies	3
BOTN 437	Biometry II	2
Group D		
BOTN 429	Population and Biometrical Genetics	3
BOTN 437	Biometry II	3
Group E		
BOTN 431	Hormones	3
Group F		
BOTN 433	Fresh Water Biology	3
Group G		
BOTN 435	Developmental Plant Anatomy	3

SECOND SEMESTER

Core

Course Code	Course Title	Credits
BOTN 400	Project Work	3
BOTN 410	Language for Scientists II	1
BOTN 414	Economic Botany	3
BOTN 422	Floral and Reproductive Biology	3
Total		**10**

Electives (Select 2 courses from any of the following groups)

Course Code	Course Title	Credits
Group A		
BOTN 418	Plant Pathology	3
Group B		
BOTN 426	Production Ecology	3
Group C		
BOTN 428	Molecular Genetics, Plant Breeding and Cytogenetics	3
Group D		
BOTN 432	Whole Plant Physiology	3
Group E		
BOTN 434	Watershed Management	3
Group F		
BOTN 436	Applied Plant Anatomy	3

COMBINED MAJOR IN BOTANY

LEVEL 200

FIRST SEMESTER

Core

Course Code	Course Title	Credits
UGRC 210	Academic Writing II	3
BOTN 201	Introductory Plant Morphology	3
BOTN 203	Flowering Plants and Civilization	3
Total		**9**

SECOND SEMESTER

Core

Course Code	Course Title	Credits
UGRC 220	Liberal and African Studies	3
BOIL 202	Introductory Cell Biology and Genetics	3
BOTN 204	Plants and Health	3
Total		**9**

LEVEL 300
FIRST SEMESTER
Core

Course Code	Course Title	Credits
BOTN 311	Vegetative Anatomy of Seed Plants	3
BOTN 313	Phychology	3
BOIL 315	Principles of Genetics	3
Total		**9**

SECOND SEMESTER
Core

Course Code	Course Title	Credits
BOTN 312	Whole Plant Physiology	3
BOTN 314	Taxonomy and Evolution of Seed Plants	3
BOTN 316	Plant Ecology of West Africa	3
Total		**9**

LEVEL 400
FIRST SEMESTER
Core

Course Code	Course Title	Credits
BOTN 411	Fungi and Lichens	3
BOTN 413	Cell Ultra Structure and Functions	3
BOTN 415	Evolution	2
Total		**8**
Electives		
BOTN 400	Project Work	3

SECOND SEMESTER
Core

Course Code	Course Title	Credits
BOTN 414	Economic Botany	3
BOTN 422	Floral and Reproductive Biology	3
BOTN 410	Language for Scientists II	1
Total		**7**
Electives		
BOTN 400	Project Work	3

COURSE DESCRIPTIONS

BIOL 201: Introductory Plant Morphology
Survey of the form of the vegetative and reproductive body of seed plants. Primary meristems and development of the primary vegetative body of angiosperms; internal organization of the primary vegetative body and the relationship between structure and function of tissues; mechanism and importance of secondary growth in dicotyledons; brief survey of the relationship between structure and industrial uses of secondary tissues.

BIOL 202: Introductory Cell Biology and Genetics

Basic cell physiology-bioelements, water, water in cells, method of expressing concentrations of solutions, osmotic phenomena, imbibitions, biomolecules, carbohydrates, amino acids, proteins, lipids, nucleotides, nucleic acids, and the role of these in either cell biology and/or structure, enzyme action; photosynthesis, respiration and nitrogen metabolism. Basic principles of genetics; gene interactions, sex and inheritance; chemical basis of heredity; mutations, medical and biochemical genetics.

BOTN 203: Flowering Plants and Civilization

A theoretical and field work approaches to the knowledge of society's historical connection to plants. Plants and history: Greek and Roman pioneers in the history of plants in medicine, age of herbals and Doctrine of Signatures; Origin of cultivated plants. Plants as stimuli of exploration and exploitation: spices, New World spices, timber, the potato famine and Irish migration; early history of marijuana in China and India and its spread to the West; South American Origins of the coca plant, history of opium and heroin. Early history of plant classification and introduction to how plants are named: common names, scientific names, the language of flowers, genus names and their meanings. The past uses of the following well-known plant families: buttercup family, Laurel family, Poppy family, mustard family, rose family, legume family, spurge family cactus family, mint family, nightshade family, carrot family, pumpkin family, sunflower family, grass family, lily family, orchid family.

BOTN 204: Plants and Health

A theoretical and practical study of medicinal, psychoactive, poisonous and allergic plants. Why the study of medicinal plants. Description and uses of some selected plant species. Preparations of medicinal plants for the treatment of specific diseases. General treatment of the importance of secondary plant metabolites: alkaloids and polyphenolic compounds, with examples from common medicinal plants. Elementary treatment of the effects of caffeine, ephedrine and cocaine on the central nervous system. Mention of free radicals and antioxidant properties of medicinal plants. Brief treatment of each of the following: poisonous plants in the home, plant causing mechanical injury, insecticides from plants, allergy and the immune system.

BOTN 310: Language for Scientists I

Most scientific materials are written in French. These materials are sometimes vital to the research and academic needs of the science student. For the student with an Anglophone background and little or no knowledge in French, such information needs to be translated into English.

Language for scientists I is a course designed to guide students to the knowledge of basic French grammar.

BOTN 311: Vegetative Anatomy of Seed Plants

A theoretical and practical light-microscope study of the anatomy of vegetative parts of the seed plants, with some reference to economic importance of some of the tissues, and use of some of the anatomical features in taxonomy and phylogeny.

BOTN 312: Whole Plant Physiology

Treatment of biophysical concepts: plant water relations; absorption of water; transpiration; stomatal physiology; ion uptake; transport systems in plants; survey of phytohormones; brief coverage of dormancy, germination and growth, flowering and fruiting.

BOTN 313: Phychology
Classification, structure and reproduction of the major algae divisions. Littoral zonation of the larger benthic algae and the factors affecting their distribution. Economic importance of algae, their use inagriculture and as food and feed source.

BOTN 314: Taxonomy and Evolution of Seed Plants
Comparative morphology and/or evolutionary trends in seed plants, with special reference to common seed plant families in Ghana. Basic principles of taxonomy to include classification, nomenclature and identification.

BIOL 315: Principles of Genetics
An introduction to the principles of genetics and chromosome cytology from the molecular aspects to population aspects, including applications of the principles in animal breeding, plant breeding and applied human genetics. Some of the practical techniques in formal genetics and cytogenetics are introduced.

BOTN 3I6: Plant Ecology of West Africa
Introduction to description and classification of plant communities; climax vegetation; the West African environment. Basic concepts in plant ecology; *biological* associations: mutualism commensalism, parasitism, predation. Pollination mechanisms; social insects. General distribution of vegetation types in relation to climate and soils. Forest and savanna types and their interrelationships. Strand, mangrove, lagoon and montane vegetation types. Accra plains. Human ecology in hese vegetation types. Introduction to quantitative ecology. Species diversity indices.

BOTN 317: Biometry I
The course is designed to equip students with the skills to use biometry as a tool for quantitative scientific research. The binomial theories and its application to probability (Pascal's triangle). Introduction to linear, logarithmic and exponential functions. Description of methods used in biology in biometry. Sets application in biology . Data collection and data management. Sampling, Basic statistical methods Basic experimental design. Report writing. Computers and data analysis. Systems approach.

BIOL 318: Aquatic Biology
Water properties of biological importance. The seas: the open ocean and coastal waters. Factors determining water circulation. Effects of water circulation upon productivity. Pollution. Utilization and conservation. Lakes: Origins of lakes and their biological types. Factors determining water circulation. Rivers: Origins and water movement. Biotic communities, adaptations and distribution. Phytoplankton: Distribution including temporal and special changes in relation to physico-chemical and biological factors in the environment. Estuaries: Optical and physical properties; water movement. Dissolved substances. Mangrove swamps.

BOTN 321: Evolution
The synthetic theory of evolution and is historical developments. Sources of variation. Selection and its types of selection. Polymorphisms. Speciation, isolating mechanisms. Hybridization and introgression. Evolution at the molecular level.

BOTN 322: Biology of Lower Plants
The life cycle of archegoniates. Classification of the bryophytes and pteridophytes. Morphology, anatomy and life cycle of representatives of the principal orders of bryophytes and pteridophytes.

Water relations and ecology of bryophytes and pteridophytes. Evolution of thallus structure in the Hepaticae.

BOTN 323: Principles of Plant Propagation, Conservation and Utilization
The course is designed to introduce the student to the principles and practices of plant conservation and utilization. The course will cover the following: Propagation structures and media. Sexual propagation: methods and importance. Asexual propagation methods: cuttings, layering, budding and grafting, specialized organs. Anatomical basis of asexual propagation and propagation of selected plant species. Nurseries. Germplasm collection and utilization. Introductory tissue culture techniques.

BOTN 325: Bacteria and Viruses
Morphology of bacteria, distinguishing between Gram-positive and Gram-negative bacteria. Growth and recombination in bacteria. Formation, structure and function of endospores. Characteristics of Aerobic and Anaerobic bacteria. Physical and chemical anti-bacterial agents. Structure and composition of viruses, bacteriophages and viroids: classification of plant viruses, and culturing of plant and animal viruses.. The symptoms and economic effects of the Cocoa Swollen Shoot Virus disease. African Cassava Mosaic virus disease. Cassava Mosaic Virus disease and Groundnut Rosette Virus disease, and the control of the viruses.

BOTN 400: Project Work
A year-long project to be carried out by the student under the supervision of senior member(s) of the Department.

BOTN 410: Language for Scientists II
Language for Scientists II is designed to help students to acquire translation skills to be able to translate scientific French materials into English. Students will therefore be: (i) taken through scientific terms in French and (ii) given a number of French scientific materials for translation into English with the use of dictionaries.

BOTN 411: Fungi and Lichens
The course is designed to give students an understanding of the structure, including ultrastructure, reproductive processes and ecology of fungi. It will also bring to students an appreciation of fungal roles in agriculture, forestry and industry. In the treatment of lichens, emphasis will be laid on the structure, reproduction and the physiological relationship between the mycobiont and phycobiont components of Ascolichenes.

BOTN 413: Cell Ultra Structure and Function
Detailed coverage of the ultra structure and functions of the cell and cell organelles in relation to their chemical constituents; bio-energetics; enzyme classification and kinetics; photosynthesis; respiration; nitrogen metabolism.

BOTN 414: Economic Botany
The origins, distribution and ecology (botany and cultivation) of crop plants in Ghana. Ethnobotany. The elements of silviculture and forest utilization in Ghana (timber, fuel etc.)

BOTN 417: Microbiology
The course gives a general knowledge of microbiology, microorganisms and viruses. The emphasis is on their structure, physiology and ecological relationships and on the activities of interest to man that

they carry out. Prokaryotic microorganisms and viruses will be more emphasized as the eukaryotes are extensively treated in other courses.

BOTN 418: Plant Pathology
This course is designed to give a wide approach to plant diseases caused by parasites (fungi, bacteria, nematodes and flowering plants) and viruses and by nutritional disbalance. Consideration of diseases caused by parasites and viruses will fall into four interrelated phases: aetiology, interaction of plant and pathogen, interactions of populations of plants and pathogens and environment, and control of plant diseases.

BOTN 419: Advanced Plant Taxonomy
The taxonomic character, sources and uses. Chemotaxonomy. Modern methods in assessing relationships. Numerical taxonomy and cladistics.

BOTN 422: Floral and Reproductive Biology
Types of pollination; pollen and animals; nectar, nectaries and animals. Fertilization and changes in ovary and ovule Isolating mechanisms in flowers; limitations naturally placed on variations in populations. Place of floral biology in plant breeding.

BOTN 425: Quantitative Plant Ecology
Description and measurement of vegetation and environment. Sampling methods; accuracy and significance tests. Species diversity; diversity indices. Spatial arrangement of organisms. Pattern. Association between species. Association analysis and other classificatory analyses. Ordination. Interpretation of taxonomic and ecological data by multivariate methods. Field collection of samples for the herbarium; field notes; Photography.

BOTN 426: Production Ecology
The ecosystem concept. Variations of ecosystem structure. Turnover of energy, organic matter, water, mineral nutrients in the ecosystem. Productivity of terrestrial ecosystem; control and measurement of primary and secondary productivity. Ecological mechanisms controlling distribution of plants and animals. Interaction between organisms; interaction between organisms and environment, Floral ecology.

BOTN 427: Conservation and Environmental Studies
Principles of conservation and plant and animal protection and their application to the West African environment. Management of renewable natural resources. Conservation of Plant Genetic Resources. Pollution of the Environment. Ghana's Environmental Action Plan. Environmental management for vector control; the Volta sand Weija experience. Climate change and other global environmental problems.

BOTN 428: Molecular Genetics, Plant Breeding and Cytogenetics
Molecular Genetics: Haemoglobin variants in man. Genetic engineering and biotechnology, Recombinant DNA technology and its application in Biology, Medicine and Agriculture. Plant Breeding: Sex determination in plants. Incompatibility in flowering plants. Principles of plant breeding. Cytogenetics: Chromosome structure. Chromosomal aberrations. Karyotype evolution. Advanced topics in Meiosis. Cytogenetics of the Nucleolus.

BOTN 429: Population and Biometrical Genetics
History of population genetics. Hardy-weinberg law and its use, including cases of sex linkage and multiple alleles. Coefficient of inbreeding. Inbreeding: Mutation, Selection, Equilibria, Evolution of

dominance. Polymorphism and balanced polymorphism. Chromosome frequencies and recombination, Polymorphism and multiple alleles. Alternative theories to natural selection. History of biometrical genetics. Genotype-environment interaction. Scaling. Components of means: additive and dominant effects; interaction and heterosis. Components of variation. Interaction, Linkage. Randomly breeding populations. Dialleles, special races: sex linkage, maternal effects, haploide, polyploids. Number of effective factors. Concepts of biometrical genetics. Artificial selection experiments, and responses to selection.

BOTN 431: Plant Hormones

Introduction to methods of studying phytohormones: extraction, isolation, identification and quantification; determination of sequence of amino acids in proteins; biosynthesis of amino acids, lignin and phytohormones including a brief treatment of their mode of action.

BOTN 432: Whole Plant Physiology

Growth, developmental and environmental physiology: dynamics of growth, detailed coverage of flowering and fruiting, regulation of organ longevity, senescence and death; introduction to the effects of light, temperature, water, pollution and climate change on plant growth and development; the physiology of plants under stress; biological clocks; allelopathy.

BOTN 433: Fresh Water Biology

Chemical aspects of rain water, ionic composition of lakes and rivers; oxygen, carbon dioxide and p^H and chemical stratification. Biological aspects: primary production, population dynamics and correlation with physico-chemical aspects. Pollution: effects of pollution on inland waters; eutrophication. Fresh water macrophytes: types/classification, zonation, biological adaptations of hydrophytes; succession; production. Algal physiology. Bacteria morphology and physiology. Aquatic fungi. Economic aspects of fresh water plants (micro-and macrophytes): aquatic weed problems including toxic algae; aquatic weed control; value of aquatic plants (algae and macrophytes); beneficial and harmful bacteria and fungi in fresh water.

BOTN 435: Developmental Plant Anatomy

Quantitative description of growth. Phyllotaxy and leaf development. Experimental observation of leaf growth and development in some elected plants. Developmental and differentiation of (i) the cell wall (ii) vascular system and reproductive structures of seed plants. Embryology. Systematic anatomy of useful plant products: fibres, seeds, latex, osmophores. Cell wall structure.

BOTN 436: Applied Plant Anatomy

Anatomy in plant identification, classification and phylogeny. Anatomy in plant pathology. Forensic plant anatomy. Food adulterants and contaminants. Dendrochronology. Ecological plant anatomy. Wood in archaeology. Forensic applications.

BOTN 437: Biometry II

Calculus: Differentiation. Matrix algebra (latent roots and latent vectors). Maximum likelihood of statistical estimation. Analysis of variance (Duncan's multiple range test). Factorial experiments. Correlation and regression. Multivariant methods. Use of the computer.

BOTN 439: Physiology of Fungi

This course is designed as a sequel to course BOTN 411 to relate the functioning of the fungus to its structure. The course, therefore, covers the function of the fungus spore, growth and metabolism of the vegetative thallus and the physiology of reproduction. Discussions at relevant places of the course will

include associations of fungi with other organisms other than parasitism. Attention will also be drawn to the involvement of fungi in agriculture, industry and human welfare.

DEPARTMENT OF CHEMISTRY

Introduction

Chemistry is one of the subjects for which man developed early awareness. It found its roots in man's quest to understand the composition of things. The Department of Chemistry at the University of Ghana is one of the largest in the country with a reputation for excellence in both teaching and research. Our undergraduate teaching programmes provide quality, up-to-date training in chemistry by experts in their field. Our teaching programme is strongly supported by local industries with many of them sponsoring undergraduate prizes awarded annually for outstanding achievement. Our teaching laboratories are standard and equipped with appropriate instrumentation.

FACULTY

Robert Kingsford-Adaboh *BSc.(Cape Coast) MSc. Ph.D (Okayama)*	-	Associate Professor (**Head of Department**)
Ivan Addae-Mensah *BSc.(Ghana) M.Sc.(Ghana) Ph.D (Camb)*	-	Professor
William A. Asomaning *M.Sc. (Ghana) DPhil (Sussex)*	-	Associate Professor
William R. Phillips *MSc. (Ghana) Ph.D DIC (Camb)*	-	Associate Professor
Mumuni Dakubu *BSc. Ph.D. (Lond)*	-	Associate Professor
Cornelius K. Akpabli *BSc.(Educ.) (Cape Coast) MSc. (Ghana) Ph.D (CUNY)*	-	Associate Professor
Vincent K. Nartey *BSc.(Cape coast) M.Sc.(Kumasi) Ph.D (Graz)*	-	Associate Professor
Derick Carboo *Diploma Chem. Dr rer Nat (Hamburg)*	-	Associate Professor
Frederick L. Phillips *BSc.(Ghana) Ph.D (Lond)*	-	Senior Lecturer
Isaac V. Oppong *BSc. MSc. (Ghana) Ph.D (Alta)*	-	Senior Lecturer
Charles T. Beni *MSc.(Merseburg) Ph.D (Tuebingen)*	-	Senior Lecturer
Abdul K. Brimah MSc. Ph.D (Hamburg)	-	Senior Lecturer
Louis K. Doamekpor *M.Phil (Ghana) Ph.D (Saga, Japan)*	-	Senior Lecturer
Augustine K. Donkor *BSc. Kumasi MSc. Ph.D (Florida Gainsville)*	-	Senior Lecturer
Dorcas Osei-Sarfo *M.Phil Ph.D (Ghana)*	-	Senior Lecturer
Walter Affo *BSc. (Ghana) Ph.D (Nottingham)*	-	Lecturer
Kwaku Kyeremeh *BSc. (Ghana) Ph.D (Abendeen)*	-	Lecturer

Mary Anti Chama - Lecturer
BSc. Ph.D (Ghana)
Klake Raphael Kwaku - Lecturer
Dip. Ed. BSc. (Cape Coast) M.Phil (Ghana) Ph.D New York
Enock Dankyi - Assistant Lecturer
BSc. M.Phil (Ghana)
J.J.E.K. Harrison - Assistant Lecturer
BSc. MPhil (Ghana)

SINGLE MAJOR IN CHEMISTRY

LEVEL 100
SEMESTER 1
Core

Code	Title	Credits
CHEM 111	General Chemistry I	3
CHEM 113	Practical Chemistry I	1
Total		**4**

SEMESTER 11

Code	Title	Credits
CHEM 112	General Chemistry I1	3
CHEM 114	Practical Chemistry I1	1
Total		**4**

LEVEL 200
SEMESTER 1
Core

Code	Title	Credits
CHEM 213	Physical Chemistry I	2
CHEM 233	Organic Chemistry I	2
CHEM 271	Analytical Chemistry I	2
CHEM 203	Practical I	1
Total		**7**

SEMESTER 11
Core

Code	Title	Credits
CHEM 234	Organic Chemistry II	2
CHEM 252	Inorganic Chemistry I (s-block Elements)	2
CHEM 204	Practical II	1
Total		**5**

LEVEL 300
SEMESTER 1
Core

Code	Title	Credits
CHEM 301	Mathematics for Chemists	2
CHEM 341	Spectroscopy and Structure Elucidation	3
CHEM 343	Chemistry of Aromatic Compounds	3
CHEM 355	Inorganic Chemistry (p-block Elements)	3
CHEM 311	Physical Practical	2
CHEM 351	Inorganic Practical	2
CHEM 301	Mathematics for Chemists	2
Total		**15**

SEMESTER 2
Core

Code	Title	Credits
CHEM 312	Thermodynamics I	2
CHEM 344	Carbanions and their Reactions	2
CHEM 346	Molecular Rearrangement Reactions	2
CHEM 352	Coordination Chemistry	2
CHEM 374	Analytical Chemistry	3
CHEM 332	Organic Practical	2
CHEM 372	Analytical Practical	2
Total		**15**

LEVEL 400
SEMESTER 1
Core

Code	Title	Credits
CHEM 400	Project	3
CHEM 401	Thermodynamics II	2
CHEM 403	Symmetry, Group Theory, and Applications	2
CHEM 405	Reaction Kinetics	2
CHEM 441	Chemistry of Natural Products	3
Total		**12**

ELECTIVES (Select 2 credits from each Group)

Group A		
CHEM 439	Organometallic Chemistry	2
CHEM 471	Nuclear Chemistry	2
CHEM 473	X-ray Crystallography	2
Group B		
CHEM 423	Polymer Chemistry and Technology	2
CHEM 491	Petroleum Chemistry and Technology	2
CHEM 493	Mineral Processing	2
CHEM 495	Pulp and Paper Chemistry and Technology	2

SEMESTER 11

Core

Code	Title	Credits
CHEM 400	Project	3
CHEM 402	Quantum Chemistry	2
CHEM 412	Surface Chemistry and Colloids	2
CHEM 454	Transition Metal Chemistry	3
CHEM 472	Instrumental Methods of Chemical Analysis	3
Total		**13**

ELECTIVES (Select 2 credits from each Group)

Group A		
CHEM 418	Photochemistry	2
CHEM 424	Molecular Spectroscopy	2
CHEM 452	Solid state Chemistry	2
CHEM 474	Elements of Forensic Chemistry	
Group B		
CHEM 438	Medicinal Chemistry	2
CHEM 492	Industrial Chemistry	2
CHEM 494	Textile Chemistry and Technology	2
CHEM 496	Environmental Chemistry	2

COURSE OUTLINES

CHEM 111 General Chemistry I

Uncertainty in measurements, significant figures; Normal distributions, standard deviations; Precision, Accuracy; Propagation of errors in calculations;Bronsted-Lowry concept of acids and bases ($\geq 10^{-6}$ M); strong and weak acids/bases; levelling effect of water. pX scale. Hydrolysis of salts (cations and anions). Simple pH calculations for solutions of acids, bases and their salts. Indicators as weak acids/bases and their choice in acid/base titrations, including polyprotic acids/bases; Calculations of pH throughout such titrations;Redox systems: Oxidation states, formal charges. Balancing of Redox reactions; applications. ;Solubility, ionic product constants and K_{sp}; common-ion effect. Selective precipitation; principles of Mohr and Volhard titrations.

CHEM 112 General Chemistry II

Short introduction to organic chemistry; what is meant by the structure of an organic molecule; Functional groups;Test for purity of organic molecules; Brief description of purification processes; Qualitative analysis; Quantitative analysis; Empirical formula; Molecular formula;Mention of the use of spectroscopic methods in determining structure; Alkanes and Cycloalkanes: Sources of hydrocarbons; fractional distillation of petroleum and uses of the different products; cracking, reforming; octane number; additives; Reactions of alkanes.Alkenes: Isomerism in alkenes; Preparation of alkenes; Reactions of alkenes; commercial uses of some polymers; alkynes: Lab preparation; Chemical reactions; Optical Isomerism; importance of stereoisomers in natural products, drugs etc.

CHEM 113 Practical I

A selection of titration experiments illustrating the lecture course CHEM 111

CHEM 114 Practical II

Functional group identification; simple preparations of organic compounds with exercises in purification and recrystallization.

CHEM 203 Practical I
Titrimetric analysis involving redox systems, kinetics, acid-base buffer and solubility systems.

CHEM 204 Practical II
Purification processes; Tests for Functional groups; Simple syntheses

CHEM 213 Physical Chemistry I
Atomic structure: A *qualitative* treatment of the Quantum Mechanical Model of the atom; quantum numbers; shape of orbitals. Electronic configuration of atoms; chemical periodicity;Models of chemical bonding: Review of ionic and covalent (including dative) bonds; polar bonds; van der Waals forces, hydrogen bonding; **Valence Bond** concepts – orbital overlaps; electron-pair sharing; sigma- and pi-bonds; Hybridization (as mathematical combination of atomic orbitals LCAO); sp, sp^2, sp^3, dsp^2, sp^3d^2 hybridized orbitals and the resulting molecular shapes; Resonance and canonical structures; Valence bond description of simple molecules;

VSEPR; Qualitative **Molecular Orbital** model (homogeneous and heterogeneous diatomic molecules only).;Chemical Reactions and equilibrium: Enthalphy, exothermic and endothermic reactions; heat capacities C_p, C_v. Born-Haber cycle (Hess' law); Bond energies, standard enthalpies of formation; effect of temperature on enthalpy changes; Simple ideas on Entropy; entropy as a driving force; (*No calculations on entropy*). Gibbs Free Energy and spontaneity, standard free energies. Relationship between free energy, enthalpy and entropy. **Kinetics**: differential rate law, rate constants, order of reactions, effects of concentration, temperature (Arrhenius equation); mechanical slope method (*No integrated rate laws*); concept of reaction mechanism.

CHEM 233 Organic Chemistry I
Review of stereochemistry; Stereochemistry of compounds with more than one chiral centre; Racemic mixtures, and their resolution; Stereoisomerism in cyclic compounds.
Alkenes - ozonolysis; Preparation and reactions of Alcohols; Preparation and reactions of Ethers.

CHEM 234 Organic Chemistry II
Aldehydes and Ketones: Nucleophilic addition reactions; Carbanions. Carboxylic acids: Preparations and reactions. Carboxylic acid derivatives: Preparations;Amines: Preparations and Reactions

CHEM 252 Inorganic Chemistry I (s-block Elements)
Systematic chemistry of the s-block elements {Groups I^A, II^A, and II^B (Zn, Cu, Hg)}, including their organometallic compounds.

CHEM 271 Analytical Chemistry I
Quantitative treatment of ampholytes, (salts and amino acids), Buffer solutions, and very dilute solutions ($\leq 10^{-6}$M) of Bronsted-Lowry acids and bases; the Method of Successive Approximations; Electrochemistry - Electrode and galvanic cells; Nernst Equation; Concentration cells; applications of emf measurements in the determination of e.g. standard potentials, solubility and K_{sp}, dissociation constants; Potentiometric titrations; Conductance and applications of conductivity measurements.

CHEM 301 Mathematics for Chemists
Calculus of functions of several variables, partial differentiation, total differentials, Euler's theorem on homogeneous functions. Differentiation and Integration skills; Solution of ordinary

and partial differential equations. Matrices and determinants. Fourier analysis and transformation, applied to spectroscopy and transport processes. Regression analysis. Some numerical techniques e.g. Newton-Raphson method.

CHEM 311 Physical Practical
Experiments involving refractometry, potentiometry, conductimetry, spectrophotometry, and polarimetry; Adsorption Isotherms.

CHEM 312 Thermodynamics I
The Gas laws; grammar and vocabulary of thermodynamics; state variables and equations of state; the First, Second and Third Laws. Thermochemistry; Spontaneity and equilibria.

CHEM 332 Organic Practical
Synthesis of organic compounds requiring basic skills such as heating under reflux, distillation, crystallization, extraction, filtration, chromatography, melting point determination and spectroscopic (ir, uv) analysis.

CHEM 341 Spectroscopy and Structure Elucidation
Study of infrared spectroscopy, ultraviolet-visible spectroscopy, mass spectrometry, and ^{1}H- and ^{13}C-nuclear magnetic resonance spectroscopy, electron spin resonance spectroscopy. Joint use of these spectroscopic methods in structure elucidation.

CHEM 343 Chemistry of Aromatic Compounds
Aromaticity. Mechanisms and synthetic applications of substitution reactions in mono-nuclear aromatic compounds. Synthesis and reactions of selected polynuclear aromatic compounds.

CHEM 344 Carbanions and their Reactions
Mechanisms, stereochemistry, and synthetic applications of reactions involving carbanions or potential carbanions with a variety of carbonyl compounds.

CHEM 346 Molecular Rearrangement Reactions
Kinetic and stereochemical considerations of the effect of neighbouring groups in reactions. Rearrangement reactions involving the migration of groups to electron deficient sites (carbon, nitrogen, oxygen) and electron rich sites (carbon).

CHEM 351 Inorganic Practical
Synthesis of inorganic complexes; analysis of inorganic complexes and materials; Flame-photometry; Use of ion-exchange resins.

CHEM 352 Coordination Chemistry
Nomenclature, stereochemistry, isomerism in complexes; stability of complexes, statistical and chelate effects. Theories of bonding in coordination compounds: VBT, MOT, CFT/LFT, Crystal field Stablilization energies, distortions from regular geometry/symmetry. Electronic spectra of transition metal complexes; magnetic properties of transition metal complexes. Introduction to Bioinorganic chemistry.

CHEM 355 Inorganic Chemistry (p-block Elements)
Systematic study of the p-block elements and the chemistry of the Non-Metals, including the Noble gases.

CHEM 372 Analytical Practical
Application of various analytical methods to specific problems.

CHEM 374 Analytical ChemistryII
Classical analytical chemistry, (including complexometric and non-aqueous solvent titrations); Gravimetric methods, Separation methods. Principles of chromatography, Spectrophotometry. Sampling. Evaluation of analytical data. Quality assurance of analytical measurements;

CHEM 400 Project

CHEM 401 Thermodynamics II
Applications of thermodynamics – chemical potential and equilibria; Solutions and colligative properties; Electrolytes and the Debye-Huckel theory; electrochemical cells e.g. storage, photovoltaic cells; Electrolysis

CHEM 402 Quantum Chemistry
The mathematical and physical principles of quantum chemistry, including operators, and operator algebra, eigenvalue problems; Postulates of quantum mechanics; the Schrodinger equation - Hydrogen atom, Simple Harmonic Oscillator and diatomic molecules; the Rigid Rotator and angular momentum. Approximation methods - Variation method, Perturbation method; Multi-electron atoms, Hartree-Fock Self-Consistent Field Method; Born-Oppenheimer approximation; Huckel Molecular Orbital Theory, Slater determinants, conjugated *pi*-electron systems; Ab-initio methods.

CHEM 403 Symmetry, Group Theory, and Applications
Introduction to the principles of symmetry and group theory, and their application to the description of molecular structure, symmetry, and spectroscopy.

CHEM 405 Reaction Kinetics
General dynamics; kinetics of reactions; determination of order; application of the steady-state approximation; homogeneous and heterogeneous catalysis; photochemical sources of energy for kinetic reactions.

CHEM 412 Surface Chemistry and Colloids
Physical chemistry of surfaces; adsorption; catalytic behavior. Colloids.

CHEM 418 Photochemistry
Laws of photochemistry. Interaction of light with atoms; primary photophysical processes of polyatomic molecules; Photochemistry of carbonyl compounds and alkenes. Photochemical techniques.

CHEM 423 Polymer Chemistry and Technology
Functionality concepts and applications in industrial synthesis of polymers, with reference to e.g. rubber, plastics, fibres, coatings and adhesives industries. Mechanism and kinetics of polymerisation; Co-polymerisation; relationship between structure and physico-chemical properties. Brief mention of polymers in pharmaceutical formulations and drug delivery systems.

CHEM 424 Molecular Spectroscopy
Electrical and magnetic properties of molecules in relation to molecular structure and spectra – pure rotational, infra-red, Raman, electronic, nuclear magnetic resonance.

CHEM 438 Medicinal Chemistry

Definition of Medicinal Chemistry. Classification of Drugs. Principles of drug action: Pharmacodynamics, pharmacokinetics and pharmacogenetics. Agonists and Antagonists; the Receptor Theory. Drug absorption, distribution and excretion; Bioavailability and bioequivalence. Drug Metabolism - Phase I and Phase II reactions, toxicity (ADMET). Structure-Activity Relationships (excluding quantitative SAR). Specific Drug Types - their chemistry and pharmacology. (*A selection will be made each year from the following*: Barbiturates, Antibacterial Agents - sulphonamides, Antibiotics including Penicillins and Tetracyclines; Antiviral drugs, including anti-retrovirals (anti-HIV drugs); Antimalarials including the artemisinin-based drugs.);Pesticides - Pyrethroids, DDT and related compounds, organophosphates, naturally occurring pesticides;Drug Development, including development from natural sources. Quality Assurance and good manufacturing practices.

CHEM 439 Organometallic Chemistry

Definition and classification. Preparation and reactions of the organometallic compounds of the Main Group elements, and of the d-block Transition elements; Organometallics as useful synthetic intermediates.

CHEM 441 Chemistry of Natural Products

Structure, reactions and synthesis of carbohydrates, amino acids and proteins, nucleotides and nucleic acids, oxygen heterocycles, alkaloids, terpenoids and steroids.

CHEM 452 Solid State Chemistry

Crystal structure; Solid Solutions, Defect structures. Solid state reactions and control. Electronic structure of Solids – metals, insulators and semi-conductors; electrically conducting organic solids; superconductivity. Magnetic properties; Optical properties. Glass, metallic glasses, glass ceramics. Cement and Concrete.

CHEM 454 Transition Metal Chemistry

Systematic chemistry of the transition and inner-transition elements. Bioinorganic compounds.

CHEM 471 Nuclear & Radiochemistry

Radioactive Decay and Nuclear Stability; The components of the nucleus, terms and notations, the discovery of radioactivity and the types of emissions ; types of radioactive decay, balancing nuclear equations, nuclear stability and the mode of decay; the Kinetics of radioactive decay**: t**he rate of radioactive decay. radioisotope dating; the interconversion of matter and energy**:** The mass defect, nuclear binding energy, natural radioactivity; nuclear transmission: discovery of the neutron, particle accelerators and the tramsuranium elements; the effect of nuclear radiation on matter**:** excitation and ionization emissions; the effect of ionizing radiation on living matter; application of radioisopes: application of non-ionizing radiation (radioactive tracers), application of ionizing radiation; Nuclear fission and fusion and their applications.

CHEM 472 Instrumental Methods of Chemical Analysis

Measurement and instrumentation; resolution, sensitivity, selectivity, detection limits; Sample pre-treatment techniques. Detailed consideration and applications of some selected methods e.g. AAS, XRF, XRD, Neutron Activation, voltammetric stripping analysis, HPLC, GLC, etc.

CHEM 473 X-ray Crystallography

Interaction of x-rays with matter. Qualitative and quantitative aspects of x-ray powder diffraction methods. Introductory single-crystal structure analysis.

CHEM 474 Elements of Forensic Chemistry

Introduction; Legal aspects of forensic science, drug analysis, forensic toxicology explosives and arson investigation, physical evidence analysis, soil examination, questioned document examination, and firearm examination. Instrumentation and laboratory techniques.

CHEM 491 Petroleum Chemistry and Technology

The origin and chemistry of petroleum. Petroleum refinery – primary and secondary processes, quality assessment of some of the petroleum fractions. Petrochemicals.

CHEM 492 Industrial Chemistry

Principles of industrial chemistry: the economic importance of the chemical industry; conversion, efficiency and yield of a chemical process; economic and technical feasibilities of a chemical process; material and energy balance in chemical processes.

Major inorganic chemical processes: Gases (N_2, O_2, NH_3 and Cl_2); acids/bases (H_2SO_4, H2PO3, NaOH, Na_2CO_3), Major organic chemical processes: fossil fuel and petrochemicals (ethylene, propylene, vinyl chloride);Major commercial products: food additives, anionic, cationic and non-ionic surfactants; pharmaceuticals.

Industrial activities and their environmental impact; global warming, acid rain, smog, ozone depletion, eutrophication, toxic metals, carcinogens.

CHEM 493 Mineral Processing

Fundamentals of mineral processing: Characterization of particles; analysis of separation processes; fluid dynamics; mechanisms and processes of particulate separations; Size reduction: mechanisms of fracture; crashing and grinding; Size separations: screening and sieving; classification; gravity and dense medium separations; dewatering; sedimentation; filtration; Concentrate separation: surfaces and interfaces; ore sorting; flotation and other separation methods(magnetic separations, electrostatic separation); Gold refining technology.

CHEM 494 Textile Chemistry and Technology

Physical and chemical properties of raw materials; changes in these properties during preparation of yarns for weaving; treatment of fabric after weaving (dyes, dyestuffs, printing etc.); treatment of textile industry waste.

CHEM 495 Pulp and Paper Chemistry and Technology

The conversion of wood to paper with particular emphasis on the organic, physical and surface chemistries involved. Paper properties and uses.

CHEM 496 Environmental Chemistry

Introduction to Environmental Chemistry, Air Pollution-sources, effect and control of Greenhouse effect and global warming; Ozone depletion Chemistry of Natural Waters, Municipal solid waste, soil and sediment contamination, The Science of Poisons, Renewable Energy and Alternative fuels.

DEPARTMENT OF COMPUTER SCIENCE

INTRODUCTION

The Department runs Single-Major and Major-Minor degree programmes in Computer Science. To qualify for admission into Computer Science programmes at Level 200, candidates must have taken the following courses at Level 100:

MATH 121: Algebra and Trigonometry
MATH 122: Calculus I
CSCD 101: Introduction to Computer Science I
CSCD 102: Introduction to Computer Science II

Every Computer Science Student must own his or her own laptop. Students should consult the Department for the appropriate specification.

FACULTY

Ferdinand Apietu Katsriku *PhD (City, Lond)*		**Acting Head of Department**
Matilda S. Wilson *Bsc(Kumasi),MBA-MIS(Ghana,Belgium), PGDAC(India) MSC(U.S.A)*	-	(Study Leave)
Philip Nukpe *PhD*		Visiting Scholar
Ernest B.B. Gyebi *BSc (Kumasi) MSc MCP (South Bank Lond)*	-	Lecturer
Jacob A. Aryeetey *BSc (Kumasi) MSc (Lagos)*	-	Lecturer
Benjamin S-K. Wiredu *BSc MSc PGCE (South Bank) MBA (Lond)*	-	Lecturer
Joseph K. Ecklu *BSc MBA (Ghana)*	-	Tutor
Richard D. Appiah *BSc Comp Sc (Ghana) MSc UK) PGD in Advanced Computing (India)*	-	Assistant Lecturer
Kwesi A. Debrah *BSc (Kumasi) MSc (UK)*	-	Assistant Lecturer
Adomako Owusu-Barfi BSc *(Ghana) MSc (Denmark)*	-	Part-Time Lecturer
Charles Nartey *BSc (Caltech) MSc PGCE (Sanford) MGHIE MIEEE SMISA*	-	Part-Time Lecturer
Peter Ndajah *Bsc(Nigeria), MSc(Nigeria), PhD(Japan)*	-	Lecturer
Theophilus Ansah-Narh *Bsc(Ghana), Mphil(Ghana)*	-	Part-Time Lecturer

PROGRAMME STRUCTURE

COMPUTER SCIENCE

SINGLE MAJOR IN COMPUTER SCIENCE

LEVEL 200

SEMESTER I

Core

Course Code	Course Title	Credits
UGRC 210	Academic Writing II	3
CSCD 201	Information Systems	3
MATH 223	Calculus II	3
CSCD 205	Programming I (with C++)	3
CSCD 211	Computer Organization and Architecture	3
CSCD 207	Numerical Methods	3
Total		18

SEMESTER II

Core

Code	Title	Credits
UGRC 220	Introduction to African Studies	3
CSCD 202	Programming II (Java)	3
CSCD 216	Data Structures & Algorithms	3
CSCD 218	Data Communications & Networking I	3
CSCD 212	Computer Ethics	1
CSCD 214	Digital Electronics	2
Electives (Select 3 credits)		
MATH 224	Introductory Abstract Algebra	3
MATH 226	Introductory Computational Mathematics	3
Total		18

LEVEL 300

SEMESTER I

Core

Code	**Title**	**Credits**
CSCD 301	Object Oriented Analysis & Design	3
MATH 355 55355#CSCD	Discrete Mathematics	3
CSCD 311	Web Technologies & Development	3
CSCD 313	Database Management Systems	3
CSCD 315	Operating Systems	3
Electives (Select 3 credits)		
CSCD 317	Embedded Systems	3
CSCD 319	Computer Vision	3
CSCD 321	Introduction to Computer Graphics	3
Total		**18**

Comment [A1]: Need to check this course code

Comment [A2]: Remove the I

SEMESTER II

Core

Code	Title	Credits
CSCD 302	Programming III (VB .NET)	3
CSCD 304	Design and Analysis of Algorithms	3
CSCD 306	Software Engineering	3
CSCD 312	Introduction to Artificial Intelligence	3
CSCD 314	Research Methods in Computing	3
Electives (Select 3 credits)		
CSCD 316	Introduction to Robotics	3
CSCD 318	Introduction to Parallel Computing	3
CSCD 322	Advanced Web Technologies	3
Total		**18**

Comment [A3]: Remove I

LEVEL 400

SEMESTER I

Core

Code	Title	Credits
CSCD 415	Compilers	3
CSCD 417	Theory and Survey of Programming Languages	3
CSCD 419	Formal Methods and Models	3
CSCD 421	Accounting Principles in Computing	3
CSCD 400	Project	3
Electives (Select 3 credits)		
CSCD 423	Software Modeling and Simulation	3
CSCD 409	Data Mining & Warehousing	3
CSCD 427	Data Communication & Networking II	3
Total		**18**

SEMESTER II

Core

Code	Title	Credits
CSCD 416	System Programming	3
CSCD 418	Computer Systems Security	3
CSCD 422	Human Computer Interaction	3
CSCD 424	Management Principles in Computing	3
CSCD 400	Project	3
Electives (Select 3 credits)		
CSCD 426	Multimedia Applications	3
CSCD 428	Expert Systems	3
CSCD 432	Concurrent & Distributed Systems	3
CSCD 434	Mobile Computing	3
Total		**18**

MAJOR-MINOR IN COMPUTER SCIENCE

Students offering a Major in Computer Science and a minor in another subject will select from the following list of courses the appropriate number of credits. At level 300 they need 9 credits from the core computer courses and 6 credits from their minor subject. At level 400 they will offer the same core courses as single major students.

Students offering a minor in Computer Science and a Major in another subject will select the appropriate number credits from the listed courses. At level 300 they need 6 credits from the core computer courses and 9 credits from their Major subject. They do not register any credits at level 400.

LEVEL 200

SEMESTER I

Core

Code	Title	Credits
UGRC 210	Academic Writing II	3
CSCD 205	Programming I (with C ++)	3
CSCD 211	Computer Organization and Architecture	3
CSCD 207	Numerical Methods	3
Total		12

SEMESTER II

Core

Code	Title	Credits
UGRC 220	Introduction to African Studies	3
CSCD 202	Programming II (with Java)	3
CSCD 216	Data Structures & Algorithms	3
CSCD 218	Data Communication & Networking I	3
Total		12

LEVEL 300

SEMESTER I

Core

Code	**Title**	**Credits**
CSCD 301	Object Oriented Analysis & Design	3
CSCD 311	Web Technologies & Development	3
CSCD 313	Database Management Systems	3
CSCD 315	Operating Systems	3
Total		**12**

SEMESTER II

Core

Code	**Title**	**Credits**
CSCD 302	Programming III (with VB .NET)	3
CSCD 304	Design and Analysis of Algorithms	3
CSCD 306	Software Engineering	3
CSCD 312	Introduction to Artificial Intelligence	3
Electives (Select 3 credits)		
CSCD 314	Research Methods in Computing	3
CSCD 318	Introduction to Parallel Computing	3
CSCD 322	Advanced Web Technologies	3
Total		**12**

LEVEL 400

SEMESTER I

Core

Code	**Title**	**Credits**
CSCD 415	Compilers	3
CSCD 417	Theory and Survey of Programming Languages	3
CSCD 419	Formal Methods and Models	3
CSCD 421	Accounting Principles in Computing	3
CSCD 400	Project	3
Electives (Select 3 credits)		
CSCD 423	Software Modeling and Simulation	3
CSCD 409	Data Mining & Warehousing	3
CSCD 427	Data Communication & Networking II	3
Total		**18**

SEMESTER II

Core

Code	**Title**	**Credits**
CSCD 416	System Programming	3
CSCD 418	Computer Systems Security	3
CSCD 422	Human Computer Interaction	3
CSCD 424	Management Principles in Computing	3
CSCD 400	Project	3
Electives (Select 3 credits)		
CSCD 426	Multimedia Applications	3
CSCD 428	Expert Systems	3
CSCD 432	Concurrent & Distributed Systems	3
CSCD 434	Mobile Computing	3
Total		**18**

COURSE DESCRIPTIONS

CSCD 101 Introduction to Computer Science I **3 CREDITS**

An introduction to computers and how they work. Types and Historical Development of Computers. Number systems: binary, octal, hexadecimal, integer and fractional representations, Signed and Unsigned numbers, 1's complement, 2's complement and Arithmetic Overflows. Integer and floating point arithmetic (IEEE standard 754 Floating point Formats). Data Representation and Manipulation: Bits, bytes and words: Logic operations and Logic gates applications. The Central Processor: its main elements and their functions. Machine organization: ALU, registers, main memory, fetch/decode/execute cycle, machine language design and usage, Input/Output devices. The concept of a Computer Program: the use of algorithms and flowcharts.

CSCD 102 Introduction to Computer Science II 3 CREDITS

This course is to introduce the students to fundamental programming concepts. It will focus on an ability to use procedural programming language concepts including input/output, simple data types, expressions, control structures – selection and loop constructs, Boolean logic, and procedures. Revision of algorithms and flowcharts and interpretation of simple pseudo codes. Programming languages, Compilers and interpreters. Computer Networks: The Internet and TCP/IP protocols. **Practical applications of switching theory: logic elements, Boolean algebra and Number systems; Laboratory work on basic discrete and peripheral components of a computer system.** Identifying and selecting the various hardware components like the hard disk, motherboard, memories, etc. for a computer system. **General overview of system software, programming languages and application software (the use of computers for data processing and generating information). Operating system - importance, characteristics and types.**

CSCD 201 Information Systems (IS) 3 CREDITS

Differentiating IS from Related Disciplines; Types of information systems: **Transaction processing, Systems (TPS), Management Information Systems (MIS), Executive Information Systems (EIS), Decision Support Systems (DSS), Expert Systems (ES), etc** Information systems development; Foundations of Information Systems in Business, Competing with Information Technology, Computer Hardware, Computer Software; Data Resource Management; Telecommunications and Networks; Electronic Business systems; Electronic Commerce Systems; Decision Support Systems.

CSCD 202 Programming II (with Java) 3 CREDITS

This course teaches the fundamental ideas behind the object-oriented approach to programming through the widely-used Java programming language. Concentrating on aspects of Java that best demonstrate object-oriented principles and good practice, students will gain solid basis for further study of the Java language, and other object-oriented software development. Students will be able to grasp concepts of problem-solving and programming. Control statements, methods, and arrays before learning to create classes. Introduction to graphical user interface, exception handling, I/O, and data structures.

CSCD 205 Programming I (with C ++) 3 CREDITS

This course will provide in-depth study of software design and implementation using a modern, object-oriented language with support for graphical user interfaces and complex data structures. Topics covered will be specifications, design patterns, and abstraction techniques, including typing, access control, inheritance, and polymorphism. Students will learn the proper engineering use of techniques such as information hiding, classes, objects, inheritance, exception handling,

event-based systems, and concurrency. Students will use C++ to implement the basic concepts in object-oriented programming (OOP). Topics include: the OOP programming paradigm including analysis and design; a survey of related languages; data hiding and encapsulation; inheritance; and polymorphism.

CSCD 207 Numerical Methods 3 CREDITS

This course will study iterative methods for solving nonlinear equations; direct and iterative methods for solving linear systems; approximations of functions, derivatives, and integrals; error analysis. The course will take students through solving numerical algebraic and transcendental equations, bisection methods, false position method, Newton Raphson method, Successive approximation method, Simultaneous linear algebraic equations, Gauss elimination method, Jacobi method, Pivotal condensation, Gauss seidal, Gauss Jordan, Eigen Values and Eigen Vectors, Numerical differentiation, Newton's forward and Backward difference formulae. Integration, Trapezoidal rule, simpson's one third rule, Newton's three eighth rule. Solutions of differential equations, Tailor's series, Euler's series, Euler's methods, predictor, corrector method, runge-Kutta method.

CSCD 211 Computer Organization and Architecture 3 CREDITS

This course will study topics such as : Computer system specification ; Performance issues ; Instruction set selection ; ALU design ; Architecture design ; Data path selection ; Control systems ; Single and multiple clocks Pipelines ; Memory hierarchy ; I/O architectures. Digital logic: transistors, gates, and combinatorial circuits; clocks; registers and register banks; arithmetic-logic units; data representation: big-endian and little-endian integers; ones and twos complement arithmetic; signed and unsigned values; Von-Neumann architecture and bottleneck; instruction sets.

CSCD 212 Computer Ethics **1** CREDITS

This course will study legal, social, and ethical issues surrounding software development and computer use. Professional conduct, social responsibility and rigorous standards for software testing and reliability will be stressed. Issues such as liability, intellectual property rights, security and crime will be examined in the context of computer use. Students are expected to be able to conduct research on the Internet.

CSCD 214 Digital Electronics 3 CREDITS

This course exposes students to basic analogue and digital electronics as related to hardware. Topic covered include: Electric field and potential; capacitors and Dielectrics; Newton Theorems: Kirchhoff's laws, Superposition, Thevenin's, Norton's and reciprocity theorems, Delta-star and star-delta transformations; magnetic induction: Ampere's law, Boit-Savart law, self and mutual inductance, electronic oscillation; alternating currents; Power and resonance in ac circuits. Boolean Algebra and logic gates, simplification of logic functions, Truth Tables; Karnaugh graphs, DeMorgan's rules; synchronous flip flops: D, T and JK flip flops; asynchronous state machines in terms of RS flip flops; characteristics of diodes, NMOS and PMOS field effect transistors; structure and use of programmable logic arrays (PLAs) etc

CSCD 216 Data Structures & Algorithms 3 CREDITS

This course will study the analysis of algorithms and the effects of data structures on them. Algorithms selected from areas such as sorting, searching, shortest paths, greedy algorithms, backtracking, divide- and-conquer, and dynamic programming. Data structures include heaps and search, splay, and spanning trees. Analysis techniques include asymptotic worst case, expected

time, amortized analysis, and reductions between problems. Include Generic types , Linked lists , Stacks and queues , Binary trees, Balanced binary trees , Multi-way trees , B-trees and B+-trees, File organization , Searching and sorting , Hashing . Running time analysis of algorithms and their implementations, one-dimensional data structures, trees, heaps, additional sorting algorithms, binary search trees, hash tables, graphs, directed graphs, weighted graph algorithms, additional topics.

CSCD 218 Data Communication & Networking I 3 CREDITS

This course will focus on the field of data communications and the basic concept in networking. It includes fundamentals of data and signals, analog signal digital signal, the media; conducted. The basic modem operating principles, Bandwidth limitations, and alternatives traditional modems: Channels Service Unit/ Data Service Unit, Cable Modems, ISDN, DSL. Other topics Include: LAN and WAN applications, Internet and intranet, e-mail, FTP and Web applications, distributed systems, standards; communication concepts, media, coding of data, error control, LAN topologies and protocols, bridges, routers and gateways; TCP/IP, client server paradigm; network configuration, performance monitoring, management, security, and reliability.

CSCD 301 Object Oriented Analysis & Design 3 CREDITS

This course teaches the OOP programming paradigm including analysis and design; data hiding and encapsulation; inheritance; and polymorphism. It requires implementation of these concepts using appropriate programming language constructs and extensive programming. Topics Include: Introduction to object orientation, UML 2.0, the Unified Process, overviews a minimalist approach to Object-Oriented Systems Analysis and Design with UML 2.0. the basic characteristics of object-oriented systems; the relevant UML 2.0 are covered with diagrams where applicable, e.g., class diagrams, Structural Models as well as the fourteen diagrams included in UML; the activity diagrams to support business process modeling and deployment diagrams to provide for modeling the physical architecture of the system ; user interface design; class and method design ;object storage design ; user interface design , the design of the physical architecture of the system.

CSCD 302 Programming III (with VB.NET) 3 CREDITS

Basics of .NET framework, Introducing Intermediate Language, Intermediate Language: Digging Deeper, Inside the CLR, Assemblies, Garbage Collect, Improving Performance, Profiling and Performance Counters, Dynamic Code Generation, Threading, Management Instrumentation, Advanced Windows Forms, Code Access Security and Cryptography.

CSCD 304 Design and Analysis of Algorithms 3 CREDITS

Introduction to a variety of algorithms which illustrate principles for both the design and analysis of efficient algorithms. Includes: classical problems in Computer Science; classical algorithm design and analysis strategies ; analyze the computability of a problem; design and analyze new algorithms to solve a computational problem .

CSCD 306 Software Engineering 3 CREDITS

In-depth study of software design and implementation using a modern, object-oriented language with support for graphical user interfaces and complex data structures. Topics covered will be specifications, design patterns, and abstraction techniques, including typing, access control, inheritance, and polymorphism. Students will learn the proper engineering use of techniques such as information hiding, classes, objects, inheritance, exception handling, event-based systems, and concurrency. This course equips students with practical set of skills for the development of software. The software crisis; why software fail (case studies); Design as modeling; The Unified

Modeling Language, Concepts and techniques for testing and modifying software in evolving environments. Topics include software testing at the unit, module, subsystem, and system levels; developer testing; automatic and manual techniques for generating test data; testing concurrent and distributed software; designing and implementing software to increase maintainability and reuse; evaluating software for change; and validating software changes.

CSCD 313 Databases Management Systems 3 CREDITS

This course will study overview of database systems, Introduction to Database Design; The Relational Model Relational Algebra SQL Database Application Development; Storage and Indexing; Tree-Structured Indexing; Hash-Based Indexing; Schema Refinement and Normalisation object oriented database languages; the relational database model with introductions to SQL and DBMS; hierarchical models and network models with introductions to HDDL, HDML, and DBTG Codasyl; data mining; data warehousing; database connectivity; distributed databases; the client/server paradigm; middleware, including ODBC, JDBC, CORBA, and MOM.

CSCD 311 Web Technologies & Development 3 CREDITS

This course is designed to enable students understand the fundamentals of web technologies, the conceptual foundations that underpin them, and to provide experience in the design and implementation of web-based distributed systems. Students are expected to understand the fundamentals of the World Wide Web (www), HTTP and web browsers, variety of multimedia formats including image and sound; design and construct web pages using HTML, FrontPage and Dreamweaver. Topics such as XHTML, Cascading Style Sheets, JavaScript, DOM, XML, RSS, and AJAX are presented. Students will learn to develop attractive and interactive web pages and applications and use client-side web-scripting languages to solve problems both with a text editor and more powerful WYSIWYG HTML editor. They will explore Active Server Pages, Java Serves Pages, Java servlets, Extensible Markup Language (XML) and website security.

CSCD 312 Introduction to Artificial Intelligence 3 CREDITS

This course will cover the theory and practice of developing systems that exhibit the characteristics we associate with intelligence in human behavior such as reasoning, planning and problem solving, learning and adaptation, natural language processing, and perception. Basic problem-solving strategies, heuristic search, problem reduction and AND/OR graphs, knowledge representation, uncertainty reasoning, game playing, planning, machine learning, computer vision, and programming systems such as Lisp or Prolog. Core material includes state space search, logic, and resolution theorem proving. Application areas may include expert systems, natural language understanding, planning, machine learning, or machine perception. Provides exposure to AI implementation methods, emphasizing programming in Common LISP.

CSCD 315 Operating Systems 3 CREDITS

This course will study basic principles of operating systems: addressing modes, indexing, relative addressing, indirect addressing, stack maintenance; implementation of multitask systems; control and coordination of tasks, deadlocks, synchronization, mutual exclusion; storage management, segmentation, paging, virtual memory; protection, sharing, access control; file systems; resource management; evaluation and prediction of performance. Introduction to operating systems. Topics Include: Threads and Processes ; Interprocess Communication, Synchronization ; CPU Scheduling; Memory Management ; File and I/0 Systems ; Protection and Security ; Distributed System Structures ; Distributed Coordination ; Fault Tolerance, Real-time Computing .

CSCD 317 Embedded Systems 3 CREDITS

Topics Include: An introduction to embedded Systems Architecture; An introduction to embedded system design; Middleware and Application Software; Embedded software ; Embedded hardware; Embedded Processor, Board Memory, Board Buses, Board Input/Output

CSCD 314 Research Methods in Computing 3 CREDITS

This course examines different methods of acquiring knowledge, role of economic research, identification of a research problem and stating of research questions and hypotheses. Also review of literature, meaning, purpose and principles of research designs and the measurement design will be examined. The course further acquaints students with the method of data collection and analysis; descriptive and inferential statistics; interpretation of data and proposal and research writing.

CSCD 319 Computer Vision 3 CREDITS

This course will cover essentials of computer vision. We will learn basic principles of image formation, image processing algorithms and different algorithms for 3D reconstruction and recognition from single or multiple images (video). Apllications to 3D modelling, video analysis, video surveillance, object recognition and vision based control will be discussed.

CSCD 316 Introduction to Robotics 3 CREDITS

This course will cover: basic components of robotic systems; selection of coordinate frames; homogeneous transformations; solutions to kinematic equations; velocity and force/torque relations; manipulator dynamics in Lagrange's formulation; digital simulation of manipulator motion; motion planning; obstacle avoidance; controller design using the computed torque method; and classical controllers for manipulators

CSCD 321 Introduction to Computer Graphics 3 CREDITS

This course will study the principles of computer graphics and interactive graphical methods for problem solving. Emphasis placed on both development and use of graphical tools for various display devices. Several classes of graphics hardware considered in detail. Topics include pen plotting, storage tubes, refresh, dynamic techniques, three dimensions, color, modeling of geometry, and hidden surface removal. Part of the laboratory involves use of an interactive minicomputer graphics system. Introduces the fundamentals of three-dimensional computer graphics: rendering, modeling, and animation. Students learn how to represent three-dimensional objects (modeling) and the movement of those objects over time (animation).

CSCD 318 Introduction to Parallel Computing 3 CREDITS

This course will introduce the student to the basics of high-performance parallel computing and the national cyber-infrastructure. This course is designed to provide an introduction to the field of parallel computation. Topics Include: Architectural, algorithmic, and language requirements for parallel computing and the lectures will emphasize the relationships between these requirements. Parallel algorithm design and analysis as well as parallel programming languages will be examined in the context of specific parallel systems and models.

CSCD 322 Advanced Web Technologies 3 CREDITS

The course content will focus on client-side and server-side software design and development. Topics include: **HTML**, JavaScript **the J2EE platform, JDBC**, and **XML**; Component software development using specific technologies including PHP, Java servlets, Java Server Pages, JavaScript, XML and JDBC etc.

CSCD 400 Project 3 CREDITS
Undertake any piece of system work with extensive programming using system methodology.

CSCD 409 Data Mining & Warehousing 3 CREDITS
Introduction to data mining and motivating challenges. Types of data, measures of similarity and distance. Data exploration and warehousing. Supervised learning. Bias and variance. Classification techniques and their evaluation. Clustering. Association and sequence rule mining.
This course will apply computing principles, probability and statistics relevant to the data mining discipline to analyze data. A thorough understanding of model programming with data mining tools, algorithms for estimation, prediction, and pattern discovery. Analyze a problem, identifying and defining the computing requirements appropriate to its solution: data collection and preparation, functional requirements, selection of models and prediction algorithms, software, and performance evaluation

CSCD 415 Compilers 3 CREDITS
This course will provide introduction to the field of compilers, which translate programs written in high-level languages to a form that can be executed. The course covers the theories and mechanisms of compilation tools. Students will learn the core ideas behind compilation and how to use software tools such as lex/flex, yacc/bison to build a compiler for a non-trivial programming language. The theory and practice of programming language translation, compilation, and run-time systems, organized around a significant programming project to build a compiler for a simple but nontrivial programming language. Modules, interfaces, tools. Data structures for tree languages. Topics Include: Compiler Design ; Lexical Analysis ; Syntax Analysis - grammars, LL(1) parsers, LR(1) parsers ; Semantic Processing ; Code generation and optimization

CSCD 416 System Programming 3 CREDITS
Low-level programming; review of addresses, pointers, memory layout, and data representation; text, data, and bss segments; debugging and hex dumps; concurrent execution with threads and processes; address spaces; file names; descriptors and file pointers; inheritance; system calls and library functions; standard I/O and string libraries; simplified socket programming; building tools to help programmers; make and make files; shell scripts and quoting; unix tools including sed, echo, test, and find; scripting languages such as awk; version control; object and executable files (.o and a.out); symbol tables; pointers to functions; hierarchical directories; and DNS hierarchy; programming embedded systems.

CSCD 417 Theory and Survey of Programming Languages 3 CREDITS
This course will study an exploration of modern or unconventional concepts of programming languages, their semantics, and their implementations; abstract data types; axiomatic semantics using Hoare's logic and Dijkstra's predicate transformers; denotational semantics; functional, object-oriented, and logic programming; concurrency and Owicki-Gries theory. Example languages include ML, Ada, Oberon, LISP, PROLOG, and CSP. Presents the fundamental concepts of programming language design and implementation. Emphasizes language paradigms and implementation issues. Develops working programs in languages representing different language paradigms. Many programs oriented toward language implementation issues. Concepts for structuring data, computation, and whole programs

CSCD 418 Computer Systems Security 3 CREDITS
This course will study the survey of the fundamentals of information security. Risks and vulnerabilities, policy formation, controls and protection methods, database security, encryption,

authentication technologies, host-based and network-based security issues, personnel and physical security issues, issues of law and privacy. The objective of this course to is provide comprehensive introduction to the network security problems, and the principles, techniques and their applications in securing network. Topics include secret key and public key cryptography, Hash algorithms, basic number theory, authentication, IPSEC/VPN, IPSEC key exchange, SSL/TLS, firewall, anonymous communication and VoIP Security.

CSCD 419 Formal Methods and Models 3 CREDITS

This course is an introduction to two kinds of formal systems—languages and logics that are crucial to large numbers of areas in computer science. The study of formal languages underlies important aspects of compilers and other language processing systems, software engineering, agents and multiagent systems, game development, robotics, and networking. Formal logics and automatic reasoning are put to use in artificial intelligence, database theory, and software engineering. The course gives students practice in precise thinking and proof methods that play a role in the analysis of algorithms. Topics include: Propositional Logic and Proofs; Predicate Logic and Proofs; Program Verification; Prolog; Finite Automata, Regular Expressions; Context-Free Grammars; Turing Machines and Solvability.

CSCD 421 Accounting Principles in Computing 3 CREDITS

This is a foundation course and it is designed to equip candidates with the basic knowledge and tools that will enable them appreciate business transactions, their analysis and the primary financial statements and reports that are produced from such transactions.
Topics Include: The Nature and Function of Accounting, Generally Accepted Principles (GAAP), Fundamentals of Accounting Method, Manufacturing Account, Departmental Accounts, Partnership Accounts – Introductory Consideration, Company Accounts, Incomplete Records of Business, Correction of Errors and Elementary Analysis and Interpretation of Financial Statements.

CSCD 422 Human Computer Interaction 3 CREDITS

This course will introduce Human-Computer Interaction (HCI) and user-centered design in the context of software engineering. Examines the fundamental principles of human-computer interaction. Includes evaluating a system's usability based on well-defined criteria; user and task analysis, as well as conceptual models and metaphors; the use of prototyping for evaluating design alternatives; and physical design of software user-interfaces, including windows, menus, and commands.

CSCD 423 Software Modeling and Simulation 3 CREDITS

This course will introduce students to the general principles of simulation model design and concepts of the computer simulation. The course introduces mathematical and statistical models, simulation languages, gives a thorough review of queuing systems and a hands-on experience with the object-oriented simulation. Applications of simulation methods and techniques are focused mainly on the area of computer science. ProModel for Windows will be used for projects including production systems, inventory, finance, and transportation. Statistical analysis of simulation input/output data, model validation, design of simulation experiments, and optimization are also covered. Emphasis is placed on the study and development of models of computer systems. Both analytical and discrete-event simulation models are studied. Data gathered from actual systems is used to parameterize and validate these models. Use of models to predict system performance is discussed.

CSCD 424 Management Principles in Computing 3 CREDITS

This course presents the basics of the theory and science of management. It emphasizes the essentials of management that are pertinent to the effective work of practicing managers. Students will understand the fact that managing is a part of a larger system interacting with a manager's total environment – economic, technological, social, political and ethnical. The functions of management – planning, organizing, staffing and leading, and controlling will provide the conceptual framework for students to increase their understanding of Ghanaian and global management challenges, ethical decision-making, technology management and emerging workplace issues. This course lays the foundation for an understanding of the nature and importance of managing and of management as a developed and important science.

CSCD 426 Multimedia Applications 3 CREDITS

This course is designed to introduce students to e-business. Topics covered include: e-business evc & opportunities; categories of e-business; e-business models; network infrastructure & web based t e-business; e-business risks & risks management; network security and firewall; cryptography envi of e-business; ERP/SCM/CRM and web based marketing; intelligence .This provides a study of multimedia systems and applications in the business world. Topics include: multimedia application hypertext and hypermedia, audio, graphics, images, and full motion video; multimedia-ready perso computers and workstations, storage devices, operating systems and graphical user interfaces; communication and networking requirements, multimedia applications on the Internet; file formats, compression and streaming audio/video.

CSCD 427 Data Communication & Networking II 3 CREDITS

The course will present data communications fundamentals and computer networking methods, using the ISO 7-layer reference model. Attention will be focused on the protocols of the physical, data link control, network, and transport layers, for local and wide area networks. Emphasis will be given to the Internet Protocol Suite. Some advanced topics, such as network security, wireless and mobile computing networks, will also be covered. Topics include the design of modern communication networks; point-to-point and broadcast network solutions; advanced issues such as Gigabit networks; ATM networks; and real-time communications.

CSCD 428 Expert Systems 3 CREDITS

This course provides an overview on Decision Support Systems (DSS) and its subsystems. Topics include: DSS overview, modeling and analysis using linear programming, decision tables, trees, AHP, etc., group decision support systems, fundamentals of AI, expert systems, expert system building tools, and validation, knowledge representation. Classical Approaches to the Design and Development of Expert Systems, Ontology Design and Development, Learning-Oriented Knowledge Representation, Problem Reduction and Solution Synthesis, Modeling Expert's Reasoning, Agent Teaching and Multi-strategy Rule Learning, Mixed-Initiative Problem Solving and Knowledge Base Refinement, Tutoring Expert Problem Solving Knowledge. Design Principles for Expert Systems. Frontier Research Problems.

CSCD 432 Concurrent & Distributed Systems 3 CREDITS

Threads, Seamphores, Monitors ;Message Passing ;Distributed Systems ;Client-Server Applications ;Middleware technologies; TCP/IP Sockets ; RPC/RMI ;Web Services (SOAP, XML), J2EE. Foundations for building reliable distributed systems, including failure and system models, and basic communication and agreement problems; crash failures, recovery, partition, Byzantine failures; asynchronous systems, failure detectors, communication channels, wireless and sensor networks; software clocks, causality, and cuts. Examples of problems include reliable

broadcast consensus, leader election, group communication, and replication. Introduction to Distributed Systems, Multi-threaded/Concurrent Programming, Client-Server, Applications, Middleware technologies: TCP/IP Sockets, RPC/RMI, Web Services (SOAP, XML), Peer to Peer Computing, Parallel Programming.

CSCD 434 Mobile Computing 3 CREDITS

This course studies the design and implementation of mobile applications for popular platforms including Blackberry, Android and Apple devices. The course will provide an overview of the various mobile platforms but will focus on developing applications for iPhone, iPod Touch and iPad. Programming topics covered will include an introduction to Objective-C, the XCode IDE and will focus on designing, implementing and running applications using the simulator for the various Apple devices. Students will leverage their object oriented programming skills for such things classes, objects, inheritance, exception handling, and graphical user interface design.

DEPARTMENT OF EARTH SCIENCE

INTRODUCTION

The Earth Sciences programme concentrates on topic areas which (i) enhance employment prospects, (ii) develop the role of Earth Science in society and its importance to environmental issues, and (iii) provide a background of knowledge, practical skills and field experience in the Earth Sciences. This is achieved by providing a broad foundation for Earth Science study and opportunities for subsequent specialisation. The programme provides a strong field-based culture in all topics in the Earth Sciences and offers a specialisation in one of these fields in the final year: Geology, Hydrogeology, Mineral Exploration, Petroleum Geoscience, Engineering Geology and Environmental Earth Science.

Students engage in a range of learning and teaching opportunities including lectures, laboratory-based practical classes, and fieldwork including field-based classes and guided independent study. Compulsory inter-semester fieldwork at Levels 200 to 400 provides opportunities for guided investigations within small groups and in environments substantially contrasting to the lecture room and laboratory. Practical skills are also acquired by students through industrial attachment during the long vacation.

Students have the option of participating on a Single-Major degree as well as Combined degree programme; the latter option, offering the opportunity of studying two subjects may open up additional employment opportunities. For example, a joint degree in Chemistry and Geology may lead to a career in the ceramics or glass industry. Academically, Single-Major Earth Science students take more coursework in the subspecialties in Earth Science, while Combined students take more coursework in related disciplines of Chemistry, Physics, Oceanography or Mathematics. As a result, Single-Major Earth Science graduates typically have a firm understanding of all aspects of earth systems and research, while Combined Geology graduates have a firm understanding of the inter-relationships between Geology and the other science disciplines. The course work completed as part of a degree is the most important difference that will dictate the skill set and possible job opportunities available to either major.

Faculty Members

P.M. Nude *BSc, MPhil, PhD (Ghana)*	-	Senior Lecturer/ (HOD)
***B.K. Banoeng-Yakubo** *BSc. (Ghana), MSc (Ife), MPhil, PhD (Ghana)*	-	Professor
D.K. Asiedu *BSc (Ghana), MSc, PhD (Okayama)*	-	Professor
D. Atta-Peters *BSc, MPhil, PhD (Ghana)*	-	Associate Professor
***T.M. Akabzaa** *BSc, PhD (Ghana), MEng (McGill)*	-	Associate Professor
J. Manu *BSc, MBA (Ghana), MSc, PhD (Braunscheig)*	-	Senior Lecturer
F.K. Nyame *BSc (Ghana), MSc, PhD (Okayama)*	-	Senior Lecturer
****M.A. Akoto** *BSc (K'si), MPhil (Lond)*	-	Senior Lecturer
****E.K. Hayford** *BSc (Bochem), MSc (Bonn), Dr rer nat (Berlin)*	-	Senior Lecturer
T.E.K. Armah *BSc, MPhil, PhD (Ghana)*	-	Lecturer
J.M. Kutu BSc, MPhil, PhD (Ghana)	-	Lecturer
*****Yvonne A.S. Loh** *BSc, MPhil (Ghana)*	-	Lecturer
P.A. Sakyi *BSc, MPhil (Ghana), MSc (DTU), PhD (Okayama)*	-	Lecturer
Mark Sandow Yidana *BSc((Ghana), PhD (Montclair)*	-	Lecturer
Dr. Chris Yao Anani *BSc (Ghana), MSc (Shinshu), PhD (Niigata)*	-	Lecturer
L.P. Chegbeleh *BSc (Ghana), PhD (Okayama)*	-	Lecturer
F. Achampong, *BSc (Ghana), MASc (Windsor), PhD (Detroit)*	-	Lecturer
I. A. Oppong *BSc (Ghana), PGD (TU Delft), MSc (Greenwich)*	-	Lecturer

*Sabbatical Leave
** Post Retirement Contract
*** Study leave

COURSE OUTLINE

LEVEL 100
FIRST SEMESTER
Core

Code	Title	Credits
UGRC 150	Critical Thinking and Practical Reasoning	3
EASC 101	Physical Geology	3
CHEM 111	General Chemistry I	3
CHEM 110	Practical Chemistry	1
PHYS 105	Practical Physics I	1
PHYS 143	Mechanics and Thermal Physics	3

Select 3 credits		
MATH 101	General Mathematics	3
MATH 121	Algebra and Trigonometry	3
Total		16

SECOND SEMESTER

Core

Code	Title	Credits
URGC 110	Academic Writing I	3
UGRC 130	Understanding Human Society	3
EASC 102	Geological Map Work	1
EASC 104	Historical Geology	2
Select 6 – 7 credits		
CHEM 112	General Chemistry II	3
PHYS 106	Practical Physics II	1
PHYS 144	Electricity and Magnetism	3
MATH 122	Calculus I	3
Total		15 - 16

SINGLE MAJOR IN EARTH SCIENCE

LEVEL 200

FIRST SEMESTER

Core

Code	Title	Credits
UGRC 210	Academic Writing II	3
EASC 219	Practical Crystallography	1
EASC 213	Geological Structures	2
EASC 215	Stratigraphy and Sedimentation	3
EASC 217	Optical Mineralogy	2
EASC 209	Earth’s Materials and Resources	2
Total		13
Electives		
EASC 211	Natural Hazards and Disasters	2
PHYS 241	Atomic Physics and Quantum Phenomena	2
CHEM 213	Physical Chemistry I	2
CHEM 271	Analytical Chemistry I	2
MATH 223	Calculus	3

SECOND SEMESTER

Core

Code	Title	Credits
UGRC 220	Introduction to African Studies	3
EASC 210	Geological Field Methods I	3
EASC 222	Petrography	2
EASC 214	Principles of Geochemistry	2
EASC 216	Fundamentals of Geophysics	2
Total		12

Electives		
EASC 218	Introduction to Paleontology	2
EASC 280	Internship in Earth Science I	1
PHYS 246	Nuclear Physics I	2
PHYS 248	Introduction to Physics of Materials	2
CHEM 252	Inorganic Chemistry I	2
MATH 222	Vector Mechanics	3

LEVEL 300
FIRST SEMESTER
Core

Code	Title	Credits
EASC 310	Geological Field Methods II	3
EASC 321	Introduction to Igneous and Metamorphic Petrology	3
EASC 325	Fundamentals of Hydrogeology and Hydrology	2
EASC 317	Environmental Geochemistry	2
Total		10
Electives (Select 5 – 8 credits)		
EASC 323	Soil Mechanics	3
EASC 331	Computer Applications in the Earth Sciences	3
EASC 333	Environmental Impact Assessment	2
EASC 335	Applied Geophysics	3
EASC 380	Internship in Earth Science II	1

SECOND SEMESTER
Core

Code	Title	Credits
EASC 342	Geology of Ghana	3
EASC 326	Aerial Photo Interpretation	2
EASC 328	Structural Geology and Tectonics	3
EASC 324	Economic Geology	3
Total		11
Electives (Select 4 – 7 credits)		
EASC 332	Introduction to Petroleum Geology	2
EASC 334	Organic Geochemistry	2
EASC 336	Mineral Economics	2
EASC 338	Earthquake Seismology and Disaster Risk Reduction	3
EASC 322	Environmental Pollution	2

LEVEL 400
FIRST SEMESTER
Core

Code	Title	Credits
EASC 400	Project	3
EASC 401	Remote Sensing and Geographic Information Systems	3
EASC 440	Communication and Entrepreneurship in the Earth Sciences	1
Total		7

Electives (Select minimum of 2 courses from any one Group)

Code	Title	Credits
Group A: Geology		
EASC 411	Mineralogy	3
EASC 413	Igneous and Metamorphic Petrology	3
EASC 415	Geochemistry and Cosmochemistry	3
EASC 445	Micropaleontology/Palynology	3
Group B: Water Resources Studies		
EASC 421	Hydrology	3
EASC 423	Hydrogeology	3
EASC 427	Integrated Water Resources Management	2
Group C: Mineral Exploration and Management		
EASC 431	Exploration Methods, Planning and Management	3
EASC 433	Mineral Projects Feasibility Studies	2
EASC 435	Geostatistical Ore Reserve Estimation	2
Group D: Petroleum Geoscience		
EASC 441	Basin Analysis	3
EASC 443	Basin Tectonics	3
EASC 445	Micropaleontology/Palynology	3
Group E: Engineering Geology		
EASC 451	Rock Mechanics	3
EASC 453	Bearing Capacity and Slope Stability Analysis	3
EASC 455	Geology of Civil Engineering Projects	3
Group F: Environmental Earth Science		
EASC 415	Geochemistry and Cosmochemistry	3
EASC 421	Hydrology	3
EASC 427	Integrated Water Resources Management	2

SECOND SEMESTER

Core

Code	Title	Credits
EASC 400	Project	3
EASC 402	Statistical Methods in Earth Science	2
EASC 440	Communication and Entrepreneurship in the Earth Sciences	1
EASC 430	Field Exercises in Earth Science	1
Total		7

Electives (Select minimum of 2 courses from one Group)

Code	Title	Credits
Group A: Geology		
EASC 414	Sedimentary Petrology	3
EASC 416	Geology of Africa	3
EASC 418	Geochronology	2
Group B: Water Resources Studies		
EASC 422	Rural Water Supply	2
EASC 424	Water Quality and Hydrochemistry	2
EASC 428	Exploration Geophysics	3

Group C: Mineral Exploration and Management		
EASC 428	Exploration Geophysics	3
EASC 432	Exploration Geochemistry	3
EASC 436	Mining, Oil and Gas, and the Environment	3
Group D: Petroleum Geoscience		
EASC 414	Sedimentary Petrology	3
EASC 442	Petroleum Reservoir Geophysics	3
EASC 444	Reservoir Engineering	2
EASC 436	Mining, Oil and Gas, and the Environment	3
Group E: Engineering Geology		
EASC 428	Exploration Geophysics	3
EASC 444	Reservoir Engineering	2
EASC 452	Site Investigations	3
EASC 456	Rocks as a Construction Material	2
Group F: Environmental Earth Science		
EASC 424	Water Quality and Hydrochemistry	2
EASC 428	Exploration Geophysics	3
EASC 436	Mining, Oil and Gas, and the Environment	3

MAJOR – MINOR IN GEOLOGY

LEVEL 200
FIRST SEMESTER
Core

Code	Title	Credits
UGRC 210	Academic Writing II	3
EASC 219	Practical Crystallography	1
EASC 213	Geological Structures	2
EASC 215	Stratigraphy and Sedimentation	3
EASC 217	Optical Mineralogy	2
Total		11

SECOND SEMESTER
Core

Code	Title	Credits
UGRC 220	Introduction to African Studies	3
EASC 210	Geological Field Methods I	3
EASC 222	Petrography	2
Total		8

LEVEL 300
FIRST SEMESTER
Core

Code	Title	Credits
EASC 310	Geological Field Methods II	3
EASC 321	Introduction to Igneous and Metamorphic Petrology	3
Total		6

Electives		
EASC 323	Soil Mechanics	3
EASC 325	Fundamentals of Hydrogeology and Hydrology	2
EASC 317	Environmental Geochemistry	2
EASC 335	Applied Geophysics	3

SECOND SEMESTER

Core

Code	Title	Credits
EASC 342	Geology of Ghana	3
EASC 328	Structural Geology and Tectonics	3
Total		6
Electives		
EASC 324	Economic Geology	3
EASC 326	Aerial Photo Interpretation	2
EASC 332	Introduction to Petroleum Geology	2
EASC 334	Organic Geochemistry	2
EASC 338	Earthquake Seismology and Disaster Risk Reduction	3

LEVEL 400

FIRST SEMESTER

Core

Code	Title	Credits
EASC 400	Project	3
EASC 401	Remote Sensing and Geographic Information Systems	3
EASC 440	Communication and Entrepreneurship in the Earth Sciences	1
EASC 413	Igneous and Metamorphic Petrology	3
Total		10
Electives (Select minimum of 6 credits)		
EASC 411	Mineralogy	3
EASC 415	Geochemistry and Cosmochemistry	3
EASC 423	Hydrogeology	3
EASC 431	Exploration Methods, Planning and Management	3
EASC 451	Rock Mechanics	3

SECOND SEMESTER

Core

Code	Title	Credits
EASC 402	Statistical Methods in Earth Science	2
EASC 400	Project	3
EASC 440	Communication and Entrepreneurship in the Earth Sciences	1
EASC 430	Field Exercises in Earth Science	1
EASC 414	Sedimentary Petrology	3
Total		10

Electives (Select 5-6 Credits)		
EASC 416	Geology of Africa	3
EASC 418	Geochronology	2
EASC 428	Exploration Geophysics	3
EASC 432	Exploration Geochemistry	3
EASC 456	Rocks as a Construction Material	2

COURSE DESCRIPTIONS

LEVEL 100

EASC 101: Physical Geology

Physical Geology is the science of the earth and the processes that are acting upon it. The course cover the following topics: minerals; volcanism and extrusive rocks; intrusive activities and origin of igneous rocks; weathering and soil; sediments, sedimentary rocks and structures; metamorphism, metamorphic rocks and hydrothermal rocks; the rock cycle; mass wasting; streams and landscape; groundwater; glaciers and glaciation; deserts and wind action; shorelines and coastal processes; crustal deformation and folds; faults; earthquakes; the Earth's interior; the ocean floor; plate tectonics; mountain building. The course may include trips to the field to reinforce geological concepts learned in class and laboratory.

EASC 102: Geological Map Work

This course is mainly concerned with the interpretation of geological maps and the relationship between the landscape and underlying rocks. It covers the recognition and interpretation of geological structures from maps.

EASC 104: Historical Geology

Historical Geology deals with the events that took place all over the world, throughout time. The syllabus covers the following topics: the structure of the Earth, the origin of the Universe, the origin of the Earth, and origin of the elements; the tempo of Earth history: catastrophic and/or uniformitarian; age of the Earth; time, including the vastness of geologic time, relative dating, radioactivity and isotopic dating; Geological Time Scale; fossils and fossilization; recognition, correlation, and interpretation of strata; origin and evolution of life; changes in sea level and climate; the evolution of continents; the geological record: events in Precambrian, Palaeozoic, Mesozoic and Cenozoic eras.

LEVEL 200

EASC 210: Geological Field Methods I

This is a practical field-based course consisting of: (i) Lecture/practical sessions on geological mapping techniques, construction and interpretation of geological maps and cross-sections, field safety and welfare, and field trip planning and organisation. (ii) ‘live-in’ field geological mapping providing 'hands-on' instruction in geological mapping techniques and data collection for preparation of geological maps and cross sections.

Details of the course content are as follows:

Semester I: Introduction to geological mapping; geological compass and field navigation; field use of compass to plot data; GPS in geological mapping; field mapping techniques; recording of field data; identification and description of sedimentary rocks in the field; identification and description of sedimentary structures; collection and measurement of paleocurrent data; excursion

briefing and organisation. *Hands-on Exercises*: scale calculation & conversion; measurement of a pace; plotting a grid from GPS coordinates; pace and compass closed traverse.
Inter-Semester Break: Field mapping, with supervision, in a sedimentary terrain (e.g., the Sekondian Group in the Sekondi/Takoradi area).
Semester II: Analysis and interpretation of data collected from the field. Preparation of geological maps and sections, and submission of Field Notebook. *Hands-on Exercises*: Analysis of structural and lithological data collected from the field. Preparation and digitization of geological maps and submission of Field Notebook. Preparation of a short report on the sedimentology of the studied formation.

EASC 219: Practical Crystallography
This is a practical course involving the essentials of geometrical crystallography and internal order of crystals. The detail syllabus is as follows: *Essentials of geometrical crystallography*: Crystal description, symmetry elements, crystal symmetry, crystallographic axes. Parameters, indices, crystallographic notation, principal laws geometric crystallographhy. Faces, forms, zones, crystal habit, measurement of crystal angles. Law of rational indices, classification of crystals, crystal systems, thirty-two crystal classes, spherical projection, stereographic projection, intergrowth of crystals. *Essentials of Internal Order of crystals*: Symmetry elements, space lattice, unit cell, space groups.

EASC 222: Petrography
This practical course covers the study of igneous, sedimentary and metamorphic rocks in hand specimen and thin sections. Concepts are illustrated by rock suites from Ghana and elsewhere.

EASC 213: Geological Structures
Definitions, types, elements, scales and classification of structures. Primary and secondary structures. Fundamental principles of structural geology; petrofabrics; structural analyses; significance of structural geology in geological mapping and mining.

EASC 214: Principles of Geochemistry
This course intends to familiarize students with the tools of geochemistry. These include the tools of thermodynamics, kinetics, aquatic chemistry, and trace element geochemistry. The course is divided into two parts. Part I covers the theory and application of thermodynamics and kinetics to processes controlling the composition of natural waters, and basic mineral-water-atmospheric gas interactions. Part II covers trace elements in igneous processes, including Goldschmidt's classification of the elements and the geochemical periodic table, element partitioning between coexisting minerals, and trace element distribution during partial melting and crystallization.

EASC 215: Stratigraphy and Sedimentation
The course is divided up into three parts. The first part deals with the basic aspects of sedimentation and the formation of sedimentary rocks. This will provide the framework to interpret the processes of sedimentation responsible for forming different types of sedimentary rocks. The second part will look at the dominant types of environments where sediments are deposited to furnish the actualistic background to interpret ancient environments. The third part entails synthesizing sedimentologic and stratigraphic data to permit interpretations of Earth history.
Course outline: Sedimentary processes, environments and facies; properties and classification of sediments and sedimentary rocks; sedimentary textures and structures; stratigraphic nomenclature and the stratigraphic column; principles of stratigraphy. Laboratory work emphasizes the description and analysis of sedimentary rock bodies.

EASC 216: Fundamentals of Geophysics
This course is an introduction to basic principles of geophysics as applicable to exploration and environmental problems, and solid earth. Topics covered include general earth properties (size, mass, and moment of inertia), seismology (wave equation, P, S, and surface waves, seismic reflection and refraction), gravity (gravity anomalies, rheology, flexure, geodesy, and geoid), magnetics (dipole field, paleomagnetics, and seafloor spreading), electrical, geophysical well logging, radioactivity and geochronology, and heat flow.

EASC 217: Optical Mineralogy
This course is designed to prepare students for the study of rocks in thin section (i.e. petrography). Topics to be covered include the elementary principles of crystal optics, familiarization with the microscope, the immersion method, isotropic, uniaxial, and biaxial optics, and the detailed study of rock-forming minerals in thin section. By the end of the course students should be able to readily identify the major rock-forming minerals in thin section. In addition students will learn how to find the necessary information to identify an unknown and perhaps never studied mineral. In order to accomplish the first two objectives, students will learn about the underlying concepts related to mineral behaviour in transmitted/polarized light and the use of the petrographic microscope.

EASC 209: Earth's Materials and Resources
The course is made up of two parts. The first part concerns Earth's materials, including the atom, elements, compounds and minerals, crystallinity, the importance of silicate minerals, physical properties of minerals, and formation, identification and description of minerals and rocks. Earth Materials is a laboratory based, however, instead of dedicating a specific day of the week to laboratory work, the lecture and laboratory elements will be integrated. Everyday life and the fabric of modern civilization depend on using the Earth's physical resources: water to drink; fuel to burn; rocks and minerals to build roads and houses; metals for machinery, electronics, and communications. The second part of the course is about the occurrence, availability, exploitation and sustainability of these essential resources. It also consider their origins, how to find and extract them, and the environmental consequences of exploitation. The course may include several one-day long trips to the field to reinforce geological and environmental concepts learned in class and laboratory.

EASC 211: Natural Hazards and Disasters
The course is divided into two parts. Part I involves natural disasters and their environmental impact and covers earthquakes, volcanoes, tsunamis, mass wasting, slope stability, floods, river management and human impact, subsidence, the greenhouse effect and ozone depletion. Part II provides an introduction to natural hazards. The lectures cover the following topics: hazards concept and context; spatial variability and human persistence; hazard forecasting and risk assessment; the perception of hazards and extreme events; experiencing hazards; adjustment to hazards; the human impact; and hazards: present and future prospect; disaster management in Ghana.

EASC 218: Introduction to Palaeontology
Brief introduction study of foraminefera, diatoms, cocoliths etc. Nature of the organism and geologic importance. Important index fossils, Environmental stratigraphy, environmental reconstruction and the earth science. Identification and sketching of some specimens of the phyla of organisms indicated above.

EASC 280: Internship in Earth Science I
Long vacation industrial attachment to a governmental or private sector geoscience institution/ company. Credit is contingent on submission of a final report by student and an assessment report by industry.

LEVEL 300
EASC 310: Geological Field Methods II
This is a practical field-based course consisting of: (i) Lecture/practical sessions on geological mapping techniques, and construction and interpretation of geological maps and cross-sections. (ii) 'live-in' field geological mapping providing 'hands-on' instruction in geological mapping techniques and data collection for preparation of geological maps and cross sections.
Details of the course content are as follows:
Semester I: GIS: geoid, latitude/longitude, UTM, national map grids. GPS: theory, satellites, GPS time. Cross-sections: selection, orientation, layout, construction; igneous & metamorphic rocks in the field; Geological structures in the field; Excursion briefing and organisation.
Inter-Semester Break: Field mapping, with supervision, in an igneous/metamorphic terrain (e.g., the Dahomeyan/Togo/Buem Structural Units in the Tsito – Peki – Ho areas)
Semester II: Interpreting field data:- Geological history & compilation of a (schematic) rock relation diagram. *Hands-on Exercises*: Cross-section of field traverse. Analysis of structural data collected from the field. Preparation and digitization of geological maps and submission of Field Notebook and report.

EASC 321: Igneous and Metamorphic Petrology
This course covers the introduction to the origin and evolution of magmatic systems, and metamorphic systems and processes. Concepts are illustrated by rock suites from Ghana and elsewhere.

EASC 342: Geology of Ghana
This course covers the following: Introduction to the geology of the various geological units of Ghana: i.e., Birimian, Tarkwaian, Voltaian, coastal sedimentary basins (Sekondian, Tano basin, Keta basin), Togo, Buem, and the Dahomeyan. Lithotectonic evolution of the geological units of Ghana; Metallogenesis; Theories on the evolution of the geology of Ghana.

EASC 323: Soil Mechanics
Soil classification; Practical importance of index properties; Principal types of soils; Size and shape of soil particles; Properties of very fine soil fractions; Mechanical analysis of soils: Bulk density; Unit weight; Atterberg limits:-Liquid limit; Plastic limit; Plasticity index; Liquidity index; Shrinkage limit; Sensitivity; Phase relationships. Clay-Silt-Sand-Gravel-Loess- Peat-Fills-Soil Admixtures. Total and effective stresses; Mohr-Coulomb failure criterion; Shear strength tests; Shear strength of sands; Shear strength of saturated clays; Shear strength of partially-saturated soils; Residual strength. Laboratory Work.

EASC 324: Economic Geology
The course covers the study of economic mineral deposits including industrial minerals and fossil fuels. Topics covered include: Ore bearing fluids; Classification of ore deposits; Primary sources of diamond; Hydrothermal precious metal deposits; Sedimentary ore deposits; Industrial minerals. May include field visits to selected ore and industrial mineral deposits in Ghana.

EASC 325: Fundamentals of Hydrogeology and Hydrology
This course provides an overview of water on the planet and its interaction with geologic materials. The

first part of the course describes surface water processes, including precipitation, evaporation, snow hydrology, and runoff processes. The second part of the course follows water as it moves to the subsurface as soil water and ground water. Lecture topics include properties of aquifers, principals of groundwater flow, regional groundwater flow, wells, basin development, and water quality management.

EASC 326: Aerial Photo Interpretation
Introduction, historical, photogeology, types of airphotos, problems of photographing, scale, three-dimensional vision, parallax- photogrametry, uses of aerial photos. Principles of aerial photo interpretation, colour & tune, texture, shapes & pattern, topography and man-made features. Drainage wadis. Photo interpretation of rocks, Quaternary deposits, geological structures, and geomorphological features. Morphometric analysis of drainage basins, drainage networks, order and pattern.

EASC 317: Environmental Geochemistry
The fundamental geochemical principles studied in EAES 204 are applied to the understanding of specific types of contaminants and contaminated environments: heavy metal contamination; landfills; pollutant transport in groundwater, environmental geochemistry of mineral deposits; acid rock and acid mine drainage processes; geochemistry of radioactive waste disposal; and geochemistry of organic compound contamination.
EASC 328: Structural Geology and Tectonics
Descriptive, kinematic, and dynamic analysis of geologic structures; field identification of geological structures; types of deformation and related structures. Plate tectonics and relationship to the tectonic stresses affecting the earth. Detailed description of thrusts systems and associated structures. Strike-slip faults and second order wrench structures. Extensional tectonics and continental rifts. Structural characteristics of continental rifts and the relationship between individual normal faults. Transfer zones between individual normal faults and between half grabens. Structural inversion.

EASC 331: Computer Applications in the Earth Sciences
Introduction to the basics of computer applications in the earth sciences. Introduction and use of various earth science related modeling and analytical programmes.

EASC 332: Introduction to Petroleum Geology
This course provides an overview of the importance of energy in our lives, the very significant role that fossil fuels like petroleum and coal have in supplying this energy, the environmental effects of producing, transporting, refining, using and burning these fuels, how petroleum is found and how wells are drilled to produce it, the conditions in nature required for petroleum formation and trapping, and the role that geologists and geophysicists have in petroleum exploration and production. *Course details*: concepts, terms, and history of petroleum and energy use in Ghana and the world; reservoir rocks and their fluids; drilling and logging of a well; the subsurface environment of sedimentary basins; generation and migration of petroleum; traps and seals.

EASC 333: Environmental Impact Assessment
Evolution of Environmental Impact Assessment (EIA) processes, the concept of sustainable development, national legislation on the environment and the EIA process. Identification and assessment of environmental impacts of development and their implication on overall decision-making process. Tools of impact assessment and mitigation: scooping studies, demographic, climatic, health, and ecological, social, economic impact assessment. Environmental management systems: environmental auditing and reporting. Land disturbance and reclamation, project decommissioning and. Case studies in mining and other geology environmental management.

EASC 334: Organic Geochemistry
This course focuses on organic carbon geochemistry and its use to solve problems of geological and environmental relevance. The subjects treated include organic carbon in space, the global carbon cycle, chemical composition of biogenic matter, sedimentology of organic matter, organic matter diagenesis, molecular fossils, geopolymers, generation and composition of fossil fuels, environmental organic geochemistry, and carbon stable isotope geochemistry.

EASC 335: Applied Geophysics
This course is a study of geophysical techniques applied to solving geoscience problems in resource exploration and development, natural hazards, and pollution control. The course is intended to be a practical, hands-on, field-oriented course on the applications of geophysics to these problems. For each topic, the development will proceed from basic principles (theory) through methodology and applications, to case studies. Applications will be emphasized; theory will be kept to essentials. The basic principles and operational procedures of each method will be presented, along with discussions of where the method is and is not applicable. Case studies will be included to illustrate applications.

EASC 336: Mineral Economics
This course provides an understanding of the broad aspects of the mineral industry, ore reserve classification and estimation, and project evaluation criteria. The course covers the following: uniqueness of the mining sector investment, mine taxation, ore reserve estimation, valuation, mineral projects evaluation and selection criteria, introduction to Ghana's mineral policy, and environmental considerations in mining sector management.

EASC 338: Earthquake Seismology and Disaster Risk Reduction
Lectures covers the following: earthquake seismology, earthquake mechanics, wave propagation, earth structure, instrumentation, interpretation of seismograms, focal mechanisms, faults, paleoseismology, seismotectonics, earthquake locations and magnitudes, etc. Earthquake hazard assessment including use of fault and earthquake history, strong ground motion, attenuation, and related information. Laboratory work will focus on the interpretation and analyses of digital earthquake data using digital and analog seismograms, analyses of local earthquake data on a workstation, plotting and interpretation of earthquake record sections, interpretation of paper record seismograms, and spectral analyses of strong ground motion records and probabilistic risk assessment.

EASC 321: Environmental Pollution
Definition of pollution; major categories and sources of air pollution; anthropogenic impacts. Dangers of some air and water pollutants, dangers of stratospheric ozone depletion and radon in indoor air; Types and effects of water pollution; Detecting pollution; Thermal pollution and thermal shocks; Damages of air pollution on human health, vegetation and building materials, control and monitoring of pollution; Acid rain and deposition; Air pollution control; Measurement of Air and Water pollution; Air and Water pollutant standards index from EPA and WHO. Status of water quality in developed and developing countries; Groundwater problems and ways to protect this resource; Human waste disposal.

EASC 380: Internship in Earth Science II
Long vacation industrial attachment to a governmental or private sector institution/company. Credit is contingent on submission of a final report by student and an assessment report by industry.

LEVEL 400

EASC 400: Project in Earth Science

Students do individual research work in their respective fields under the supervision of faculty members and present a report at the end of the academic year.

EASC 402: Statistical Methods in Earth Science

Techniques of probability and data analysis as applied to problems in the earth and environmental sciences. Topics include probability, data description, hypothesis testing, time series analysis, correlation and regression analyses, and multivariate methods. Laboratory work focuses on the use of statistical software packages for data analysis.

EASC 403: Remote Sensing and Geographic Information Systems

This course is of two parts. Part I introduces the principles and concepts of Remote Sensing (RS): a sophisticated technology of earth observation, which provides fundamental data for global environment investigation. In this part, students are introduced to environmental issues of Earth, principles of RS, satellites and sensors, RS imagery, data acquisition systems, digital image processing for RS imagery, and applications. Part II introduces the principles, concepts and applications of Geographic Information Systems (GIS): a decision support tool for planners and managers of spatial information. Database development, manipulation and spatial analysis techniques for information generation will be taught. Application of GIS in natural resource management, environment, civil engineering, etc, will be discussed through mini project and laboratory exercises.

EASC 410: Project in Geological Field Mapping

Integrated approach to examining geologic relationships in the field; deciphering geologic evolution of map regions through the collection and interpretation of geologic data. Students spend 3-4 weeks in the field to collect geological data for laboratory analysis, preparation of geological maps, cross sections and report writing.

EASC 411: Mineralogy

The course is divided into two parts. Part 1 comprises crystal chemistry, crystal growth, relationship between crystal structure and temperature, pressure, and composition (phase equilibria), x-ray crystallography and chemical analysis of minerals. Part 2 concerns detailed study of selected phase systems, systematic and determinative mineralogy and analysis of some selected minerals.

EASC 413: Igneous and Metamorphic Petrology

Advanced concepts in the origin and evolution of magmatic and metamorphic systems. Magma genesis and dynamics. Concept illustrated by rocks from Ghana and elsewhere.

EASC 414: Sedimentary Petrology

The purpose of this course is to give students a broad understanding of how sedimentary rocks form and how they evolve as they undergo burial. The course covers the following: origin, mineralogy and diagenesis of clastic and carbonate sedimentary rocks; quantitative analysis of sedimentary rocks; chemical and biochemical sedimentary rocks; interpretation of siliciclastic and carbonate sedimentary rocks.

EASC 415: Geochemistry and Cosmochemistry
This course discusses the Earth from geochemical perspective using the fundamental geochemical tools studied in *EAES 206*. It covers the following: Chosmochemistry: nucleosynthesis, meteorites, formation of the solar system and the planets; The Mantle and Core: composition of the earth's mantle and core, the "primitive mantle", magma ocean and mantle differentiation, mantle geochemical reservoirs; The crust: oceanic crust; crust-mantle interaction, continental crust, growth of the continental crust; Reactions at the earth's surface: weathering, soils, and stream chemistry; The oceans as a chemical system.

EASC 416: Geology of Africa
The course covers the following topics: Precambrian of Africa, Proterozoic cratonic basins and mobile belts, Palaeozoic Sedimentary Basins in Africa, Mesozoic – Cenozoic basins in Africa, the Atlas Belt.

EASC 418: Geochronology
The primary objective of this course is to provide a practical overview of principles and techniques used in geochronology. The theory, methodology and interpretation of the following dating techniques will be discussed: U-Th-Pb, Rb-Sr, Sm-Nd, Pb-Pb, K-Ar, Ar-Ar, and Fission track dating. Cosmogenic and fossil isotopes. The dating of Ghanaian rocks will also be discussed.

EASC 421: Hydrology
The course covers the following: the hydrological cycle, hydrometeorology and climate, hydrometric networks and catchment morphometry, precipitation measurements and analysis, evaporation measurements and analysis, soil moisture, river flow measurements and analysis, rainfall-runoff analysis, hydrographs. Hydrological instruments are introduced; students employ the instruments to make field measurements and perform a range of data analysis and exercises.

EASC 422: Rural Water Supply
The course is designed to incorporate various areas in water resources management including water as a resource, water resources of Ghana, Ghana's water policy, water supply options in Ghana; management, planning and implementation of rural water schemes. Basic principles and concepts in rural water supply, community interactions, developing a project strategy; Community Water supply policy of Ghana will also be taught. Topics such as finding, design, constructing and assessing groundwater, water quality aspects of rural water supply; rural water infrastructure, capacity building, community water supply options and innovations will also be taught. Case histories will be an integral part of the programme.

EASC 423: Hydrogeology
Groundwater and the hydrologic cycle, Groundwater resource evaluation, Well drilling methods, Well screens and methods of sediment size analysis, Water well design, Installation and removal of screens, Water well development, Well and pump maintenance and rehabilitation.

EASC 424: Water Quality and Hydrochemistry
Water quality standards. Hydrochemical behaviour of contaminants. Measurement of parameters. Hydrochemical sequences. Graphical methods and hydrochemical facies. Sources of contaminants. Contaminant transport. Hydrochemical behaviour of contaminants. Case study: Groundwater chemistry in crystalline terrain.

EASC 427: Integrated Water Resources Management
The course develops knowledge in climate dynamics, hydrology and surface water resources which actually link hydro-meteorological and hydrological processes together with the relationship between rainfall and hydrological measurements, the important of groundwater resources in water resources management. Integrated water resources management designed to provide basic understanding of the principles, paradigms and methodologies in IWRM shall be treated along with water management and the environment and water quality management and the impacts of human activities on the ecosystem. Case studies involving the major river catchments shall be carried out.

EASC 428: Exploration Geophysics
Theory: Instrumentation, Survey procedures, data processing and interpretation. Methods: Seismic, Electrical (Resistivity, S.P. & I.P.), Electro-Magnetics, Gravity, Magnetics.

EASC 430: Field Exercises in Earth Science
The course includes several one-day long and one one-week field trips to landfill and mine sites. It introduces practical skills appropriate to the study of earth and environmental science. The course concentrates on interactions and feedbacks in the environment, including geology, landforms, soil types and water quality. These field studies are supported by laboratory sessions in which students analyze their observations and the data they have gathered from the field.

EASC 431: Exploration Methods, Planning and Management
The course covers: exploration programme design, reconnaissance exploration, detailed or follow-up exploration, sampling and assaying techniques, drilling techniques, project evaluation.

EASC 432: Exploration Geochemistry
The course covers the following: Geochemistry of the supergene environment; Supergene mineralization; Regolith geochemistry; Geochemical exploration: basic principles, drainage, soil and vegetation surveys Statistical treatment of geochemical data; Analytical methods.

EASC 433: Mineral Projects Feasibility Studies
The role of the feasibility study in the mine development decision process, organisation of the preliminary feasibility study, presentation of project material, mining methods, geological data, mineral processing, surface facilities/ infrastructure/environmental requirements, capital and operating cost, revenue estimation, mineral taxation and financial evaluation, sensitivity and risk analysis.

EASC 434: Mining and the Environment
Acid Mine Drainage; mineral resources in relation to renewable resources; environmental and health impacts of mineral extraction and processing; land degradation in relation to mining especially surface mining operations. Visits to mine sites to observe environmental issues associated with mining.

EASC 435: Geostatistical Ore Reserve Estimation
Review of statistical measures, outliers, and the desirable properties of an estimator. Basic concepts: regionalised variables, stationarity and intrinsic hypothesis. Variograms and structural analysis: calculation and interpretation experimental variograms and fitting theoretical models. Use of volume variance relationships. Estimation variance: sampling programs, optimal drill hole positions. Theory and practice of kriging: estimation at grid node and over block, total, and average grade. Recoverable reserves.

EASC 440: Communication and Entrepreneurship in the Earth Sciences
The course is divided into two parts. The purpose of Part I is to help students to communicate ideas better and to learn the skills of communicating geology. Topics include discussion and review of different kinds of geological publications such as theses, articles, survey articles, books, abstracts, etc. Writing exercises (dealing with content as well as language) will include the students' own CV's, abstracts, extended abstracts, and papers. Also included are oral presentation delivery, proposal development, content organization and audience perspective. The course consists of lectures, student presentations and constructive critiques that take place intensively over the 13-week course period. Part II teaches students the basic and foundational skills needed to start their own business in the geosciences. Using the fundamentals of economics, marketing, accounting and business organizations, students will develop a comprehensive business plan that includes sales, financial, and legal considerations for starting and operating a small business.

EASC 441: Basin Analysis
Introduction - scope, purpose and developments. Sedimentary basins. Regional and global stratigraphic cycles. Depositional systems and facies analysis. Data acquisition - measuring and recording surface and subsurface data. Data manipulation. Burial history. Selected case histories of sedimentary basins. Recognition of ancient sedimentary environments using a combination of wireline log responses, sedimentary structures and mineralogy. The construction of subsurface contour and facies maps, and isopach maps using borehole data.

EASC 442: Petroleum Reservoir Geophysics
The applications of geophysics in 2D and 3D mapping of geological structures. Reflection seismic acquisition. Seismic processing fundamentals and digital filtering. Interpretation of 2D and 3D seismic reflection data, including horizontal and vertical slices, presentation parameters, horizon autotracking, fault mapping, stratigraphic and structural interpretation, and reservoir evaluation. Reservoir aspects of seismic interpretation. Seismic stratigraphy.

EASC 443: Basin Tectonics
Basins in their plate-tectonic setting. Lithosphere behaviour and the mechanisms of basin formation. Key features of extensional, compressional and strike-slip basins. Testing tectonic models by stratigraphic analysis. Facies architecture of basins including: (i) tectonics and sedimentation (ii) sequence stratigraphy. The interaction between sea-level change, tectonics, climate and sediment supply in the final development of a basin-fill.

EASC 444: Reservoir Engineering
Basic petrophysical properties of reservoir rocks including porosity, permeability, fluid saturation, electrical conductivity, capillary pressure, and relative permeability; classification of oil and natural gas reservoirs; introduction to reserve estimation principles. Laboratory measurement of the reservoir rock characteristics mentioned above. Derivation of the general material balance equation. Application of the general material balance equation for determining initial oil in place and gas cap size and water influx constant under different drive mechanisms. Application of the general material balance equation for determining the initial gas in place for conventional gas reservoir.

EASC 445: Micropalaeontology/Palynology
Foraminifera; Ostracods; Conodonts; Diatoms; Palynology: Definition of palynology. Some application of palynology. Pollen & Spore; Dinoflagellates; Acritarchs; Practicals: Method of preparation of microfossil.

EASC 451: Rock Mechanics
Index properties of rocks; engineering characteristics of sedimentary, igneous and metamorphic rocks. Shear strength of planar discontinuities; Shearing on an inclined plane; Surface roughness; Shear testing on discontinuities in rock; Estimating joint compressive strength and friction angle; Shear strength of filled discontinuities and closely jointed rock masses; Testing closely jointed rock masses; Residual Strength; Schmidt Hammer Test. Rock Mass Classification and their importance in engineering works; Rock Quality Designation (RQD); Influence of clay seams and fault gouge; CSIR classification of jointed rock masses; NGI Tunneling Quality Index. Types of earth-moving Equipment; Borrow materials; Cuts in rocks and soils; cuts; Shallow Foundations; Foundations of alternate hard and soft strata; Free-draining materials; Roads and Highways; Earth dams; Canal works. Laboratory work.

EASC 452: Site Investigations
Site mapping; Test pit excavations and Logs; Borehole layout; Drilling methods and equipment: Wash borings; Rotary and percussion drilling in Soils; Auger Borings; Disturbed and Undisturbed sampling; In-situ tests: Shear vane tests; Standard Penetration Tests (SPT); Dynamic Cone Penetration Tests (DCPT); Static Cone Penetration Tests (STPT); Plate Loading Tests; Exploratory drifts and tunnels; Logs of Core Borings; Water sampling: Installation of piezometers. Application of geophysical surveys in site investigations. Interpretation of geophysical survey results and implications on engineering geological problems. Site investigation reports. Case studies; Field work (8 days)

EASC 453: Bearing Capacity and Slope Stability Analysis
Theory of bearing capacity cohesive and cohesionless soils and clays; Bearing capacity estimation from in situ tests; Estimation of bearing pressures by empirical methods, Foundation Types; Protection of foundations against attack by soils and groundwater. Slope failure types in soils, General methods of analysis in cohesive and cohesionless soils, End-of-construction and long-term stability. Plane failures; Wedge failure; Circular failure; Toppling failure; Application of Hemispherical Projections to Determine Failure Modes; Influence of a slope curvature upon stability; Surface protection of slopes; Control of rock falls; Monitoring and interpretation of slope displacements. Field Visits (3 days).

EASC 455: Geology of Civil Engineering Projects
Urban geology, engineering geology of dams and tunnels, building cracking evaluation, ground treatment: stabilization, dewatering, grouting and rock bolting. Role of engineering geologist during construction of roads, houses, dams, tunnels, etc. In depth study using case studies of major civil engineering projects such as tunnels, motorways, dams, etc. Visit to a Mine (2 days).

EASC 456: Rock as a Construction Material
Explorations for quarries and aggregates for concrete, roads and highways, runways and railways; Explosives and blasting; Physical properties and Chemical reaction on aggregates in Concrete mixes; Sulphides and Organic Substances in Concrete; Pozzolanic Materials; Sampling; Laboratory Work; Field Visits (4 days).

DEPARTMENT OF MATHEMATICS

INTRODUCTION

Mathematics is a critical skill which enables scientific and technological innovation and is elemental to all forms of commerce. Over the past two centuries, most of the great innovations that have changed the way people live were enabled by Mathematics and our dependence on Mathematics continues to increase. The wide range of courses offered in the undergraduate programme and the logical, analytic, and computational skills acquired, enable the Mathematics graduate to pursue careers in diverse fields such as Education (secondary and tertiary levels), the Military and Police Services, Business, Finance, Industry and the Civil / Public Service.

The Department runs Single Major (3:2:1:1), Major-Minor (3:2:2:1) and Combined (3:2:2:2) programmes in Mathematics**.** At 100 Level there are two 3 credit courses, MATH 121 Algebra and Trigonometry and MATH 122 Calculus I. To progress to Level 200 Mathematics, candidates are required to pass these Level 100 courses.

FACULTY

Margaret L. McIntyre *BSc PhD (Latrobe)*	-	Senior lecturer/**Head of Dept**
D. Adu-Gyamfi *BSc (Ghana) PhD (London)*	-	Senior lecturer
J. De-Graft Mensah *BSc (UCC) MSc (Trondheim)*	-	Lecturer
P. Acquaah *BA MPhil (Ghana)*	-	Lecturer
P.K. Osei *BSc MPhil (Ghana)*	-	Lecturer
T. Katsekpor *BA MPhil (Ghana)*	-	Lecturer
E.K.A.Schwinger *BA (Ghana) MSc (Bergen)*	-	Lecturer
Peace Chisara.N.Ogbogbo *B.Sc (Imo State), M.Sc, MPhil (Ibadan)*	-	Lecturer
B.V.Normenyo, *B.Sc. MPhil (Ghana)*	-	Lecturer
Seth Kwame Kermausuor *BA (Ghana), MSc (African Univ.), Msc (Auburn Univ.)*	-	Assistant Lecturer
Anton Asare-Tuah *BA, MPhil (Ghana)*	-	Assistant Lecturer
D.A.Akyeampong *BSc (Ghana) DIC PhD (London)*	-	Professor/Part-time
J.S.G.Jackson *BSc (London) MA (Cambridge)*	-	Senior Lecturer/Part-time

PROGRAMME STRUCTURE

FIRST SEMESTER
LEVEL 100

Course Code	Course Title	Credits
*UGRC 110	Academic Writing 1	3
* UGRC 130	Science and Technology in our Lives	3
* UGRC 150	Critical Thinking and Practical Reasoning	3
*UGRC 160	Introduction to Literature	3
MATH 121	Algebra and Trigonometry	3
	2 Courses from 2 other assigned Departments	6
	MINIMUM CREDITS REQUIRED	**15**

Note: Students to choose any 2 courses (6 credits) of the UGRC

SECOND SEMESTER

Course Code	Course Title	Credits
*UGRC 110	Academic Writing 1	3
* UGRC 130	Science and Technology in our Lives	3
* UGRC 150	Critical Thinking and Practical Reasoning	3
* UGRC 160	Introduction to Literature	3
MATH 122 :	Calculus I	3
	2 Courses from 2 other assigned Departments	6
	MINIMUM CREDITS REQUIRED	**15**

*Note: Students to choose any 2 courses (6 credits) of the UGRC

SINGLE MAJOR IN MATHEMATICS

LEVEL 200
FIRST SEMESTER
Core

Code	Title	Credits
UGRC 210/220	Academic Writing II/Introduction to African Studies	3
MATH 221	Algebra	3
MATH 223	Calculus II	3
STAT 201	Introductory Probability I	3
Total		**12**

*Note: Students to choose 1 UGRC course

LEVEL 200
SECOND SEMESTER
Core

Code	Title	Credits
UGRC 220	Academic Writing II/Introduction to African Studies	3
MATH 224	Introductory Abstract Algebra	3
Total		**6**
Electives(Select a minimum of 6 credits)		
MATH 226	Introductory Computational Mathematics	3
MATH 222	Vector Mechanics	3
STAT 204	Introductory Probability II	3

In each semester, students may select 3 credits from another of their 200 level departments.

*Note: Students to choose 1 UGRC course

LEVEL 300
FIRST SEMESTER
Core

Code	Title	Credits
MATH 351	Linear Algebra	3
MATH 353	Analysis I	3
MATH 355	Calculus of Several Variables	3
*MATH 350	Differential Equations I	3
Total		**9-12**
Electives (Select 3-9 credits)		
MATH 361	Classical Mechanics	3
MATH 359	Discrete Mathematics	3
MATH 357	Computational Mathematics I	3

SECOND SEMESTER
Core

Code	Title	Credits
MATH 354	Abstract Algebra I	3
MATH 356	Analysis II	3
*MATH 350	Differential Equations I	3
Total		**9**
Electives (Select 6-9 credits)		
MATH 366	Electromagnetic Theory I	3
MATH 362	Analytical Mechanics	3
MATH 368	Introductory concepts of Financial Mathematics	3
MATH 358	Computational Mathematics II	3

* Please note MATH 350 may be taken in either first or second semester.

LEVEL 400
FIRST SEMESTER
Core

Code	Title	Credits
MATH 400	Project	3
MATH 421	Advanced Calculus	3
MATH 420	Abstract Algebra II	3
MATH 427	Complex Analysis	3
Total		**12**
Electives (Select a minimum of 3 credits)		
MATH 431	Differential Geometry	3
MATH 433	Introduction to Quantum Mechanics	3
MATH 429	Topology II	3
MATH 423	Methods of Math Physics	3

SECOND SEMESTER

Core

Code	Title	Credits
MATH 400	Project	3
MATH 422	Integration theory and Measure	3
Total		**6**
Electives (Select a minimum of 12 credits)		
MATH 352	Introduction to Field Theory	3
MATH 428	Boundary Value Problems	3
MATH 424	Calculus on Manifolds	3
MATH 426	Module Theory	3
MATH 434	Special Relativity	3
MATH 432	Introduction to Functional Analysis	3

MAJOR – MINOR IN MATHEMATICS

LEVEL 200

FIRST SEMESTER

Core

Code	Title	Credits
UGRC 210/220	Academic Writing II/Introduction to African Studies	3
MATH 221	Algebra	3
MATH 223	Calculus II	3
Total		**9**

*Note: Students to choose 1 UGRC course

SECOND SEMESTER

Core

Code	Title	Credits
UGRC 210/220	Academic Writing II/ Introduction to African Studies	3
MATH 224	Introductory Abstract Algebra	3
Total		**6**
Electives(Select 3 credits)		
MATH 222	Vector Mechanics	3
MATH 226	Introductory Computational Mathematics	3

*Note: Students to choose 1 UGRC course

LEVEL 300-Major

FIRST SEMESTER

Core

Code	Title	Credits
MATH 351	Linear Algebra	3
MATH 353	Analysis I	3
MATH 355	Calculus of Several Variables	3
Total		**9**

SECOND SEMESTER

Core

Code	Title	Credits
MATH 354	Abstract Algebra I	3
MATH 356	Analysis II	3
MATH 350	Differential Equations I	3
Total		**9**

In the Major-minor programme a major student will do 6 credits from the minor department. Major students may choose to add 3 credits from the Mathematics electives offered.

LEVEL 400-Major

FIRST SEMESTER

Core

Code	Title	Credits
MATH 421	Advanced Calculus	3
MATH 420	Abstract Algebra II	3
MATH 427	Complex Analysis	3
Total		**9**
Electives (Select a minimum of 9 credits)		
MATH 400	Project	3
MATH 431	Differential Geometry	3
MATH 433	Introduction to Quantum Mechanics	3
MATH 423	Methods of Mathematical Physics	3
MATH 429	Topology II	3

SECOND SEMESTER

Core

Code	Title	Credits
MATH 422	Integration Theory and Measure	3
Total		**3**
Electives (Select a minimum of 12 credits)		
MATH 352	Introduction to Field Theory	3
MATH 424	Calculus on Manifolds	3
MATH 426	Module Theory	3
MATH 434	Special Relativity	3
MATH 432	Introductory Functional Analysis	3
MATH 400	Project	3

A minor in the Major-Minor programme completes the same programme at 200 level as the major student and at 300 level the minor does 6 credits of Mathematics courses in each semester. There are no 400 level courses in the minor programme.

COURSE DESCRIPTIONS AND PREREQUISITES

Prerequisite for 100 LEVEL: SHS (or equivalent) grade B in elective mathematics.

LEVEL 100

MATH 101: General Mathematics I (Non-Mathematics students)

Indices and Logarithms. Equations and inequalities. Functions and graphs. Arrangements and selections. Binomial theorem. Limits, differentiation and integration.

MATH 121: Algebra and Trigonometry

Logic and concept of mathematical proof. Sequences and series. Set theory. Indices, logarithms and the algebra of surds. Concept of a function.Trigonometric functions, their inverses, their graphs, circular measure and trigonometric identities. Vector algebra. Coordinate geometry in the plane.

MATH 122 : Calculus I

Elementary idea of limit, continuity and derivative of a function. Rules of differentiation. Applications of differentiation. Derivative of the elementary and transcendental functions. Methods of integration. Improper integrals.

Applications of integration. Formation of differential equations and solution of first order differential equations.

LEVEL 200

Prequisite for 200 LEVEL MATH courses- Passes in MATH 121 and MATH 122.

MATH 221 Algebra

Polar coordinates; conic sections. Complex numbers: algebra, Argand diagram, roots of unity. Algebra of matrices and determinants, linear transformations. Transformations of the complex plane. Coordinate geometry in 3 dimensions. Vector product and triple products. Geometry of the sphere.

MATH 222 Vector Mechanics

1-dimensional kinematics. Forces acting on a particle. 1-dimensional dynamics. Newton's laws of motion; motion under constant acceleration, resisted motion, simple harmonic motion. 3-dimensional kinematics. Relative motion. 2-dimensional motion under constant acceleration. Work, energy and power. Impulse and linear momentum.

MATH 223 Calculus II

Second derivative of a function of a single variable. Applications of first and second derivatives. Hyperbolic and inverse hyperbolic functions. Methods of integration. Applications of the definite integral. Ordinary differential equations, first order and second order (with constant coefficients). Higher derivatives, Taylor(Maclaurin) series expansion of elementary functions.

MATH 224 Introductory Abstract Algebra

Equivalences, partial order. Construction of **R** from **Z**. Elementary number theory. Axiomatically defined systems; groups, rings and fields. Morphisms of algebraic structures. Vector spaces. Homomorphism of vector spaces.

MATH 226 Introductory Programming for Computational Mathematics

Variables, functions, arrays and matrices, classes, introduction to Graphical User Interfaces (GUI's). Introduction to symbolic computing. Visualization in mathematics.

LEVEL 300

MATH 351 Linear Algebra-prerequisite MATH 221 or MATH 224

Spanning sets. Subspaces, solution spaces. Bases. Linear maps and their matrices. Inverse maps. Range space, rank and kernel. Eigenvalues and eigenvectors. Diagonalization of a linear operator. Change of basis. Diagonalizing matrices.
Diagonalization theorem. Bases of eigenvectors. Symmetric maps, matrices and quadratic forms.

MATH 354 Abstract Algebra I-prerequisite MATH 224

Subgroups, cyclic groups.The Stabilizer-Orbit theorem.Lagrange's theorem. Classifying groups. Structural properties of a group. Cayley's theorem. Generating sets. Direct products. Finite abelian groups. Cosets and the proof of Lagrange's theorem. Proof of the Stabilizer-Orbit theorem.

MATH 353 Analysis I-prerequisite MATH 223

Normed vector spaces. Limits and continuity of maps between normed vector spaces.
The algebra of continuous functions. Bounded sets of real numbers. Limit of a sequence. Subsequences. Series with positive terms.Convergence tests. Absolute convergence. Alternating series. Cauchy sequences and complete spaces.

MATH 356 Analysis II-prerequisite MATH 223

Sequences of functions. Pointwise and uniform convergence. Power series. The contraction mapping theorem and application. Real analysis. Definition of integral and condition for integrability. Proof of the fundamental theorem of calculus and major
basic results involved in its proof

MATH 361 Classical Mechanics -prerequisite MATH 222

1-dimensional dynamics: damped and forced oscillations. Motion in a plane: projectiles, circular motion, use of polar coordinates and intrinsic coordinates. Two-body problems, variable mass. Motion under a central, non-inertial frame. Dynamics of a system of particles

MATH 366 Electromagnetic Theory I

Scalar and vector fields, grad, div and curl operators. Orthogonal curvilinear coordinates. Electrostatics: charge, Coulomb's law, the electric field and electrostatic potential, Gauss's law, Laplace's and Poisson's equations. Conductors in the electrostatic field. Potential theory

MATH 362 Analytical Mechanics- prerequisite MATH 222

Rigid body motion, rotation about a fixed axis. General motion in a plane, rigid bodies in contact, impulse. General motion of a rigid body. Euler-Lagrange equations of motion.

MATH 364 Introductory concepts in Financial Mathematics

Probability functions, random variables and their distributions, functions of random variables; basic theorems for functions of independent random variables, characteristic function of a random variable; central limit theorem, random walks and martingales; Markov chain, Markov process, queuing theory.

MATH 350 Differential Equations I-prerequisite MATH 223

Differential forms of 2 and 3 variables. Exactness and integrability conditions. Existence and uniqueness of solution. Second order differential equations with variable coefficients. Reduction of order, variation of parameters. Series solution. Ordinary and regular singular points. Orthogonal sets of functions. Partial differential equations.

MATH 352 Introduction to Algebraic Field Theory-prerequisite MATH 224
Algebraic numbers. Extending fields. Towers of fields. Irreducible polynomials. Constructible numbers and fields. Transcendence of π and ϵ. Residue rings and fields

MATH 355 Calculus of Several Variables-prerequisite MATH 223
Functions of several variables, partial derivative. Directional derivative, gradient. Local extema, constrained extrema. Lagrange multipliers. The gradient, divergence and curl operators. Line, surface and volume integrals. Green's theorem, divergence theorem, Stokes' theorem.

MATH 359 Discrete Mathematics-prerequisite MATH 224
Boolean algebra. Combinatorics languages and grammars. Recurrence relations, generating functions and applications. Problems of definition by induction: no closed form, infinite loops and the halting problem. Algorithms: correctness, complexity, efficiency. Graph theory: planarity, Euler circuits, shortest-path algorithm. Network flows. Modelling computation:languages and grammars, models, finite state machines, Turing machines

MATH 357 Computational Mathematics I
Error analysis. Rootfinding; 1 and 2 point methods. Linear systems of equations, matrix algebra, pivoting. Analysis of algorithms. Iterative methods. Interpolation,polynomial approximation, divided differences. Initial value problems, single and multistep methods. Numerical integration

MATH 358 Computational Mathematics II
Multi-dimensional root-finding. Optimization. Non-linear systems of equations. Eigenvalues. Numerical methods for ordinary differential equations and for partial differential equations

MATH 421 Advanced Calculus
Linear and affine maps between normed vector spaces. Limits, continuity, tangency of maps and the derivative as a linear map. Component-wise differentiation, partial derivatives, the Jacobian as the matrix of the linear map. Generalized mean value theorem. Inverse map theorem. Implicit function theorem.

MATH 422 Integration theory and Measure
Generalisation of the Riemann (*R*) integral (eg Kurzweil-Henstock (*KH*) integral). Lebesgue *(L*) integral. Relationship between the *KH*-integrable, *L*-integrable and *R*-integrable functions. Convergence theorems. Measurability. Measure

MATH 423 Methods of Mathematical Physics
Calculus of variation. Special functions, gamma and beta functions,Legendre polynomials, Bessel functions, hypergeometric functions. Generalised functions, the Dirac delta function. Sturm-Liouville equation, eigenvalues and eigenfunctions, Green's functions. Integral equations.

MATH 424 Calculus on Manifolds
Manifold, submanifold, differentiability of maps between manifolds, the tangent space, the tangent bundle and the tangent functor. Vector bundle. The exterior algebra, the notion of a differentiable form on a manifold, singular *n*-chains and integration of a form over a chain. Partition of unity. Application to Stokes' theorem.

MATH 420 Abstract Algebra II
Finite groups. Sylow theorems and simple groups. Composition series and Jordan-Holder theorem. Direct and semi-direct products. Abelian groups, torsion, torsion-free and mixed abelian groups.

Finitely generated group and subgroups. P-groups, nilpotent groups and solvable groups. Introduction to module theory.

MATH 426 Module Theory
Modules, submodules, homomorphism of modules. Quotient modules, free (finitely generated) modules. Exact sequences of modules. Direct sum and product of modules.
Chain conditions, Noetherian and Artinian modules. Projective and injective modules. Tensor product, categories and functors. Hom and duality of modules.

MATH 427 Complex Analysis
Elementary topology of the complex plane. Complex functions and mappings. The derivative. Differentiability and analyticity. Harmonic functions. Integrals. Maximum modulus, Cauchy-Gorsat, Cauchy theorems. Applications. Taylor and Laurent series, zeros and poles of a complex function. Residue theorem and consequences. Conformal mapping, analytic continuation.

MATH 428 Boundary Value Problems
Elements of Hilbert Space, distribution and Sobolev spaces: forms, operators and Green's formula, abstract boundary problems, coercivity; elliptic forms, Dirichlet-Neumann and mixed Dirichlet-Neumann problems; boundary value problems of the 3rd and 4th types.

MATH 429 Topology II
Product spaces, finite, countable, arbitrary. Tychonoff's theorem. Generalised Heine-Borel theorem.
Cantor spaces. Countability and separation properties in metrization theorems.

MATH 431 Differential Geometry
Arclength, curvature and torsion of a curve. Geometry of surfaces. Curvature, first and second fundamental form, Christofel symbols. Geodesics. Parallel vector fields. Surfaces of constant curvature. Introduction to manifolds, tangent space, tangent bundle. Vector fields and Lie brackets. Parallel vector fields on manifolds. Riemannian manifold.

MATH 433 Introduction to Quantum Mechanics
(Principle of least action, Hamilton's equation, Poisson brackets. Liouville's equation.) Canonical transformations. Symmetry and conservation laws. Postulates of quantum mechanics, the wave formalism. Dynamical variables. The Schrodinger equation in one-dimension; free particles in a box, single step and square well potentials. Orbital angular momentum. The 3-dimensional Schrodinger equation; motion in a central force field, the 3-d square well potential, the hydrogenic atom. Heisenberg's equation of motion, harmonic oscillator and angular momentum.

MATH 434 Special Relativity
Galilean relativity, postulates of special relativity; Lorentz transformations. Lorentz-Fitzgerald contraction, time dilation. 4-vectors, relativistic mechanics, kinematics and force, conservation laws; decay of particles; collision problems, covariant formulation of electrodynamics.

MATH 432 Introductory Functional Analysis
Finite dimensional normed vector spaces. Equivalent norms. Banach spaces.Infinite-dimensional normed vector spaces--Hamel and Schauder bases; separability. Compact linear operators on a Banach space. Complementary subspaces and the open-mapping theorem. Closed Graph theorem.

Hilbert spaces. Special subspaces of $l_{¥}$ and l_1 and the dual space. The completion of a normed vector space. Reflexive Banach spaces

DEPARTMENT OF NUTRITION AND FOOD SCIENCE

INTRODUCTION

Students are admitted into the Department at Level 200 after the General Biological Science programme at Level 100.

Two distinct programmes (subjects) are offered in the Department of Nutrition and Food Science. Students therefore have a choice of graduating with a combined major in Nutrition and Food Science or a Single major in either Food Science or Nutrition.

To graduate with a B.Sc. degree in **Nutrition and/or Food Science,** students must ensure that they take all core courses and enough electives to make up the required course load that would include all the required Departmental credits. Students are also to fulfill all University course requirements for each semester.

The total number of course credits to be taken must be between **15–18** credits per semester except in the second semester of Level 400 where students are to take **15** credits.

Programme structures for the three options (Double Major Nutrition and Food Science, Single Major Food Science, and Single Major Nutrition) are provided.

FACULTY

KwakuTano-Debrah *BSc MPhil (Ghana) PhD (Hiroshima)*	-	Associate Professor/ **Head of Department**
Samuel Sefa-Dedeh *BSc (Ghana) MSc PhD (Guelph)*	-	Professor
Ebenezer Asibey-Berko *BSc (Ghana PhD (lowa State)*	-	Professor
George S. Ayernor *BSc (Ghana) PhD (Reading)*	-	Professor
Anna Lartey *BSc (Ottawa) MSc (Guelph) PhD (Davis)*	-	Associate Professor
Esther O. Sakyi-Dawson *BSc MPhil (Ghana) PhD (Cornell*	-	Associate Professor
William B. Owusu *BSc MPhil (Ghana) MSc (Queen's)ScD (Harvard)*	-	Senior Lecturer
Agnes S. Budu *BSc MPhil (Ghana) PhD (Cranfield)*	-	Senior Lecturer
Matilda Steiner-Asiedu *BSc (Ghana) MPhil PhD (Bergen) MPH (Brown)*	-	Senior Lecturer
Emmanuel O. Afoakwa *BSc MPhil (Ghana) PhD (Strathclyde)*	-	Associate Professor
Firibu K. Saalia *BSc MPhil (Ghana) PhD (Georgia)*	-	Lecturer
Frederick Vuvor *BSc MPhil (Ghana)*	-	Lecturer
Esi K. Colecraft *BSc (Cornell) MPhil (Penn State) Dr PH (Alabama)*	-	Lecturer

Gloria Ethel Otoo *BSc (Ghana) PhD (Connecticut)*	-	Lecturer
George Amponsah Annor *BSc MPhil (Ghana)*	-	Lecturer
Betty Bediako-Amoa *Bsc (Ghana) PhD (Leeds)*	-	Senior Lecturer
***W.A. Plahar** *BSc MPhil (Ghana) PhD (Wash State)*	-	Part-time Lecturer
Wisdom K. Amoa Awua *BSc PhD (Ghana) MAppS (Australia)*	-	Part-time Lecturer
Paa Nii T. Johnson *BSc (Kumasi) PhD (Reading)*	-	Part-time Lecturer
Kwabena Frempong *BSc MPhil (Ghana) EMBA (GIMPA)*	-	Part-time Lecturer
Isabella Mansah Agra *BSc (Kumasi) MPhil (Ghana)*	-	Part-time Lecturer

BSC FOOD SCIENCE (SINGLE MAJOR)

LEVEL 200
First Semester

Course Code	Course Title	Credits
Core		
UGRC 210	Academic Writing II	3
FOSC 201	Fundamentals of Food Science and Technology	2
NUTN201	Introductory Human Nutrition	2
BCMB 201	Structure and Function of Biomolecules	3
CHEM 213	Physical Chemistry I	2
CHEM 233	Organic Chemistry I	2
CHEM 271	Analytical Chemistry I	2
TOTAL		**16**

Second Semester

Course Code	Course Title	Credits
Core		
UGRC 220	Introduction to African Studies	3
FOSC 202	General Microbiology (Theory & Lab)	3
FOSC 204	Unit Operations in Food Processing I	3
NUTN202	History of Nutrition and Concepts in Nutrition	2
CHEM 234	Organic Chemistry II	2
TOTAL		13
Electives		
BCMB 202	Cell Biology I	2
BCMB 204	Enzymology	2

LEVEL 300
First Semester

Course Code	Course Title	Credits
Core		
FOSC 301	Food Chemistry I	2
FOSC 303	Food Microbiology and Safety (Theory & Lab)	3
FOSC 305	Biometry	2
FOSC 307	Beverage and Sugar Processing Technology	2
NUTN 301	Nutrients and their Metabolism I	2
BCMB 301	Intermediary Metabolism	3
Total		14
Electives		
NUTN 303	Nutritional Physiology (Theory and Practical)	3
NUTN 305	Nutrition, Sustainable Livelihoods and Extension	2

Second Semester

Course Code	Course Title	Credits
Core		
FOSC 302	Food Chemistry II	2
FOSC 304	Unit Operations in Food Processing II	3
FOSC 306	Thermal Processing of Foods (Theory and Laboratory)	3
FOSC 308	Post-harvest Science and Technology	2
NUTN 304	Food Analysis	1
TOTAL		11
Electives		
*FOSC 300	Internship	1
*FOSC 310	Professional Development Seminar I	1
NUTN 302	Nutrients and their Metabolism II	2
NUTN 306	Methods in Nutrition Research I	2
NUTN 308	Animal Experimentation	2
NUTN 312	Foods and Social Factors in Nutrition	2

* Students are to select either FOSC 300 or FOSC 310 in addition to any of the other electives to make up 15 to 18 credits. These two courses cannot be taken together.
Internship will be done during the vacation of Level 300 but the report will be presented in the first semester of Level 400.

LEVEL 400

First Semester

Course Code	Course Title	Credits
Core		
FOSC 401	Food Chemistry and Analysis Laboratory	3
FOSC 403	Food Packaging	2
FOSC 405	Sensory Analysis of Foods	2
FOSC 407	Plant Products Processing Technology	3
FOSC 409	Animal Products Processing Technology	2
FOSC 411	Food Commodity Processing Technology Laboratory	1
TOTAL		13
Electives		
FOSC 413	Food Additives and Chemical Toxicology	2
FOSC 410	Special Topics in Food Science	1
NUTN 401	Assessment of Nutrition Status I	2
NUTN 405	Nutrients Interrelationships and Needs	2
NUTN 411	Human Growth and Development	2

SECOND SEMESTER

Course Code	Course Title	Credits
Core		
FOSC 400	Food Science Project	6
FOSC 402	Food Processing Plant Operations and Sanitation	2
FOSC 404	Food Quality Assurance, Laws and Regulations	3
FOSC 412	Professional Development Seminar II	1
	Total Credits	12
Electives		
FOSC 406	Principles of Food Product Development	2
FOSC 408	Industrial Microbiology and Food Biotechnology	2
NUTN 406	Diet and Disease	2
NUTN 402	Applied Nutrition and Food Policies	2

BSC PROGRAMME
SINGLE MAJOR IN NUTRITION

LEVEL 200
First semester
Core

Course Code	Course Title	Credits
UGRC 210	Academic Writing II	3
FOSC 201	Fundamentals of Food Science and Technology	2
NUTN 201	Introductory Human Nutrition	2
BCMB 201	Structure and Function of Biomolecules	3
CHEM 213	Physical Chemistry I	2
CHEM 233	Organic Chemistry I	2
CHEM 271	Analytical Chemistry I	2
TOTAL		**16**

Second semester
Core

Course Code	Course Title	Credits
UGRC 220	Introduction to African Studies	3
FOSC 202	General Microbiology (Theory & Practical)	3
FOSC 204	Unit Operations in Food Processing I	3
NUTN 202	History of Nutrition and Concepts in Nutrition	2
CHEM 234	Organic Chemistry II	2
TOTAL		13
Electives		
BCMB 202	Cell Biology I	2
BCMB 204	Enzymology	2

LEVEL 300
First semester
Core

Course Code	Course Title	Credits
NUTN 301	Nutrients and their Metabolism I	2
NUTN 303	Nutritional Physiology (Theory and Practical)	3
FOSC 301	Food Chemistry I	2
FOSC 303	Food Microbiology and Safety (Theory and Lab) Food Microbiology and Food Safety (Theory and	3
FOSC 305	Biometry	2
BCMB 301	Intermediary Metabolism	3
TOTAL		**14**

Electives		
NUTN 305	Nutrition, Sustainable Livelihoods and Extension	2
PSYC 307	Developmental Psychology	3
FCOS 301	Consumer Behaviour & Education	2
FCOS 309	Dynamics of Family Relations	2

Second semester

Core

Course Code	**Course Title**	**Credits**
NUTN 302	Nutrients and their Metabolism II	2
NUTN 304	Food Analysis	1
NUTN 306	Methods in Nutrition Research I	2
FOSC 302	Food Chemistry II	2
BCMB 306	Integration and Control of Metabolism	3
TOTAL		**10**
Electives		
NUTN 300	Nutrition Internship	1
NUTN 310	Professional Development Seminar I	1
NUTN 308	Animal Experimentation	2
NUTN 312	Foods and Social Factors in Nutrition	2
FOSC 308	Post Harvest Science & Technology	2

* Students are to select either NUTN 300 or NUTN 310 in addition to any of the other electives to make up 15 to 18 credits. These two courses cannot be taken together.
Internship will be done during the vacation of Level 300 but the report will be presented in the first semester of Level 400.

LEVEL 400

First semester

Core

Course Code	Course Title	Credits
NUTN 401	Assessment of Nutrition Status I	2
NUTN 403	Assessment of Nutrition Status II	2
NUTN 405	Nutrients Interrelationships and Needs (Theory and Practicals)	3
NUTN 407	Community Assessment I: Field Data Collection	2
NUTN 409	Methods in Nutrition Research II	2
NUTN 411	Human Growth and Development	2
TOTAL		13

Electives		
NUTN 413	Food and Nutrition Advocacy	2
BCMB 411	Clinical Biochemistry	2
FOSC 407	Food Additives and Chemical Toxicology	2

Second semester

Core

Course Code	Course Title	Credits
NUTN 400	Nutrition Proiect	6
NUTN 402	Applied Nutrition and Food Policies	2
NUTN 404	Community Assessment II: Field Data Analysis and Report Writing	2
NUTN 408	Nutrition of Vulnerable Groups and in Emergency Situations	2
NUTN 412	Professional Development Seminar II .	1
TOTAL		13
Electives		
NUTN 406	Diet and Disease	2
FOSC 404	Food Quality Management, Laws and Regulations	3
FOSC 408	Principles of Food Product Development	2

BSC PROGRAMME

COMBINED MAJOR IN FOOD SCIENCE AND NUTRITION

Level 200

First semester

Core

Course Code	Course Title	Credits
UGRC 210	Academic Writing II	3
FOSC 201	Fundamentals of Food Science and Technology	2
NUTN 201	Introductory Human Nutrition	2
BCMB 201	Structure and Function of Biomolecules	3
CHEM 213	Physical Chemistry I	2
CHEM 233	Organic Chemistry I	2
CHEM 271	Analytical Chemistry I	2
TOTAL		**16**

Second semester

Core

Course Code	Course Title	Credits
UGRC 220	Introduction to African Studies	3
FOSC 202	General Microbiology (Theory and Lab)	3
FOSC 206	Physic Unit Operations in Food Processing I	3
NUTN 202	History of Nutrition and Concepts in Nutrition	2
CHEM 234	Organic Chemistry II	2
TOTAL		13
Electives		
BCMB 202	Cell Biology	2
BCMB 204	Enzymology	2

LEVEL 300

First semester

Core

Course Code	Course Title	Credits
NUTN 301	Nutrients and their Metabolism I	2
NUTN 303	Nutritional Physiology (Theory and Practicals)	3
FOSC 301	Food Chemistry I	2
FOSC 303	Food Microbiology and Safety (Theory and Lab)	3
FOSC 305	Biometry	2
BCMB 301	Intermediary Metabolism	3
TOTAL		**15**
Electives	~	
NUTN 305	Nutrition, Sustainable Livelihoods and Extension	2
FOSC 307	Beverage and Sugar Processing Technology	2

Second semester

Core

Course Code	Course Title	Credits
NUTN 302	Nutrients and their Metabolism II	2
NUTN 304	Food Analysis	1
FOSC 302	Food Chemistry II	2
FOSC 304	Unit Operations in Food Processing II	3
FOSC 306	Thermal Processing of Foods (Theory and Lab)	3
TOTAL		**11**
Electives		
FOSC/NUTN 300	Internship	1
NUTN/FOSC 310	Professional Development Seminar I	1
FOSC 308	Post-harvest Science and Technology	2
NUTN 308	Animal Experimentation	2
NUTN 306	Methods in Nutrition Research I	2
NUTN 312	Foods and Social Factors in Nutrition	2
BCMB 306	Integration and Control of Metabolism	3

Students are to select either FOSC/NUTN 300 or FOSC/NUTN 310 in addition to any of the other electives to make up 15 to 18 credits. These two courses cannot be taken together.
*Internship will be done during the vacations (Level 300) but the report will be presented in the first semester of Level 400.

LEVEL400
FIRSTSEMESTER

Core

Course Code	Course Title	Credits
NUTN 401	Assessment of Nutrition Status I	2
NUTN 403	Assessment of Nutrition Status II	2
NUTN 407	Community Assessment I: Field Data Collection	2
FOSC 401	Food Chemistry and Analysis Laboratory	3
FOSC 405	Sensory Analysis of Foods	2
FOSC 407	Food Additives and Chemical Toxicology	2
TOTAL		**13**
Electives		
FOSC 403	Food packaging	2
FOSC 409	Plant Products Processing Technology	3
FOSC 411	Animal products Processing Technology	2
FOSC 413	Food commodity Processing Laboratory	1

NUTN 405	Nutrient Interrelationships and Needs (Theory and Practicals)	3
NUTN 409	Methods in Nutrition Research II	2
NUTN 411	Human Growth and Development	2

Second semester
Core

Course Code	Course Title	Credits
FOSC/NUTN 410	Project Work	6
FOSC 402	Food Processing Plant Operations and Sanitation	2
FOSC 404	Food Quality Management, Laws and Regulations	3
NUTN 404	Community Nutrition II: Field Data Analysis and Report	2
NUTN 402	Applied Nutrition and Food Policies	2
TOTAL		15
Electives		
FOSC/NUTN 412	Professional Development Seminar II	1
FOSC 406	Principles of Food Product Development	2
FOSC 408	Industrial Microbiology and Food Biotechnology	2
NUTN 406	Diet and Disease	2
NUTN 404	Nutrition of Vulnerable groups and in Emergency Situations	2

BSC PROGRAMME
COMBINED MAJOR IN NUTRITION AND BIOCHEMISTRY

LEVEL 200
FIRST SEMESTER
Core

Course code	Course Title	Credits
UGRC 210	Academic Writing	3
NUTN 201	Introductory Nutrition	2
BCMB 201	Structure and Functions of Biomolecules	3
BCMB 203	Principles of Biochemical Techniques	2
CHEM 213	Physical Chemistry I	2
CHEM 233	Organic Chemistry I	2
CHEM 271	Analytical Chemistry I	2
Total		**16**

SECOND SEMSTER
Core

Course code	Course Title	Credits
UGRC 220	Introduction To African Studies	3
NUTN 202	History And Concepts In Nutrition	2
BCMB 200	Practical Biochemistry I	3
BCMB 204	Enzymology	2
BCMB 206	Spectroscopic And Radioisotopic Techniques	1
CHEM 234	Organic Chemistry II	2
FOSC 202	General Microbiology (Theory And Practical)	3
Total		**16**

***LEVEL 300**
FIRST SEMESTER
Core

Course code	Course Title	Credits
NUTN 301	Nutrients And Their Metabolism I	2
NUTN 303	Nutritional Physiology (Theory And Practical)	3
BCMB 301	Intermediary Metabolism	3
BCMB 303	Molecular Biology I	2
BCMB 305	Biochemistry Of Hormones	2
BCMB 311	Practical Biochemistry II	3
FOSC 305	Biometry	2
Total		**17**

SECOND SEMESTER
Core

Course code	Course Title	Credits
NUTN 302	Nutrients And Their Metabolism II	2
NUTN 304	Food Analysis	1
BCMB 304	Molecular Biology II	2
BCMB 306	Integration And Control Of Metabolism	3
BCMB 308	Bioenergetics	2
BCMB 314	Membrane Biochemistry	2
Total		**12**

***Students are to talk to their advisors to select electives to make the total credits.**

***LEVEL 400**
FIRST SEMESTER
Core

Course code	Course Title	Credits
NUTN 401	Assessment of Nutritional Status I	2
NUTN 403	Assessment of Nutritional Status II	2
NUTN 407	Community Assessment I: Field Data Collection	2
BCMB 401	Protein Chemistry I	2
BCMB 403	Molecular Biotechnology and Applications	2
BCMB 405	Cell Signaling	2
BCMB 410	Seminar Presentation and Scientific Writing	1
Total		**13**

SECOND SEMESTER
Core

Course code	Course Title	Credits
NUTN 400	Project	6
NUTN 402	Applied Nutrition and Food Policies	2
NUTN 404	Community Nutrition II: Field Data Analysis and Report Writing	2
BCMB 402	Protein Chemistry II	2
BCMB 404	Immunology and Immunochemistry	2
BCMB 408	Entrepreneurship for Innovation In Biosciences	2
Total		**16**

***Students are to talk to their advisors to select electives to make the total credits.**

DESCRIPTION OF FOOD SCIENCE COURSES

FOSC 201: Fundamentals of Food Science and Technology (2 Credits)
Historical development of food science. An introduction to the multidisciplinary nature of Food Science, showing how the integration of knowledge from several traditional disciplines such as chemistry, physics, biology microbiology, and engineering can be applied to solving today's food problems. The course will provide an understanding of the basic principles and practice of Food Science and Technology in converting raw agricultural commodities into nutritious, safe, and economical food. products. Overview of food constituents, food deterioration and spoilage, food laws and regulations. Food Science and technology in relation to food security, and national development. Food control in World trade

FOSC 202: General Microbiology (Theory & Lab) (3 Credits)
An understanding of the basic principles of microbiology as well as the medical, agricultural, and other applied aspects of the field of microbiology. The structure, growth, nutrition, metabolism, genetics and diversity of microorganisms and methods used to study microorganisms, including safe handling, cultivation techniques, microscopy and other microbial identification methods.
The laboratory will provide students with the basic laboratory skills of microbiology including techniques of sampling and isolation of bacteria from natural environments, safe handling and growing pure cultures of microorganisms, diluting, pipetting and enumerating microorganisms, microscopic techniques for identification of microbes. Recording, interpretation and reporting of microbiological data.

FOSC 204: Unit Operations in Food Processing I (3 credits) [Prerequisite CHEM 213, FOSC 201]

Overview of the laws of conservation of mass and energy and concepts of materials and energy balance in food processing. Transport phenomena - Theory and applications of fluid flow; Heat transfer theory and applications and equipment. Mechanical operations - Size reduction of solid and liquid foods, theory, applications and equipment; effects on physicochemical properties foods. Mechanical separation - centrifugation, filtration, expression, sieving; Mixing - mixing of liquids and solids, effect of mixing on functionality of foods.

FOSC 300: Internship

A supervised 6-week (minimum) attachment to a food processing industry, food related research or regulatory organization or projects. A written report must be submitted for assessment.

FOSC 301: Food Chemistry I (2 credits) [Prerequisite CHEM 213, 233, 234]

The chemistry of water. Freezing and its effects on food quality. Water activity, sorption isotherms, and food storage and stability. Chemistry and application of food pigments and flavour components.

FOSC 302: Food Chemistry II (2 credits) [Prerequisite CHEM 213, 233, 234]

Chemistry and functionality of food carbohydrates, proteins and lipids and the effect of processing on these. Enzymes in food processing.

FOSC 303: Food Microbiology and Safety (Theory and Lab) (3 credits) [Prerequisite FOSC 202]

Cultural and morphological characteristics of microorganisms in food and water. Food ecosystem. Microbiological standards and control. Control of microorganisms in food. Microorganisms in food production, spoilage and safety. Food and water-borne diseases, Food infections and intoxications. The laboratory will provide hands-on knowledge of the techniques for the isolation, enumeration and identification, of microorganisms involved in food spoilage, food borne diseases and food fermentations.

FOSC 304: Unit Operations in Food Processing II (3 credits) [Prerequisite FOSC 204]

Physical phenomena: Dehydration - introduction, drying rate theory, equipment; Chilling and freezing - theory and applications, Equipment; Evaporation - theory and applications, equipment, industrial applications; Theory and application of Reverse osmosis. Extrusion - theory, equipment and operation, applications in food processing; Irradiation - theory, equipment and operation, applications in food processing; Traditional and modern applications of unit operations in food processing.

FOSC 305: Biometry (2 credits)

Statistical Applications for Nutrition and Food Science data analysis. Students t-test, Chi-square, Analysis of variance, regression and correction. Non-parametric statistics. Introduction to the use of computer statistical packages

FOSC 306: Thermal Processing of Foods (Theory and Lab) (3 Credits) [Prerequisite FOSC 202, 304]

Overview of the History of Canning Technology, Basis of the canning process and principles of canning technology. Sterilization systems and Heat transfer problems; Equipment and containers for thermal processing of foods. Heat Penetration determination and Thermal Process Calculations. Aseptic Processing - Principles and applications. Microwave Heating of Foods -

Principles, Operations, and Industrial applications. Manufacturing Operations - Raw material preparation to warehousing,
Practicals - Thermal processing equipment, design operations and safety factors; Laboratory exercises in canning, pasteurization and aseptic processes; Evaluation of the quality of thermal processed foods; Seam analysis; Application of thermal processing to selected food commodities; Industrial visits.

FOSC 307: Beverage and Sugar Processing Technology (2 credits)
Principles of beverage processing. Raw materials for beverage production. The chemistry and processing technologies of cocoa, tea, coffee and other beverages. Chocolate processing technology. Raw materials for sugar processing. Sugar processing technology - raw sugar manufacture, cane sugar refining.

FOSC 308: Post-Harvest Science and Technology (2 credits)
Understanding the post-harvest system. The handling of food from harvest to consumption. The physiology and biochemistry of harvested produce. Harvesting, packing, haulage and transportation of fresh produce. Causes of deterioration in perishables and durables and factors that promote these deteriorations and their control. Handling, storage and conservation processes to manage harvested produce. Food loss vectors and their control. Field visits and evaluations.

FOSC 310: Professional Development Seminar (1 credit)
Attachment to a Senior Member for supervised independent study. Training in literature search, and information gathering, writing and speaking skills. Presentation of a literature review on a given topic at a seminar. A term paper and regular attendance at department seminars are required.

FOSC 400: Food Science Project (6 credits)
Individual research on relevant topics of interest in Food Science conducted under the supervision of an academic staff member. A written project report in the form of a dissertation would be required.

FOSC 401: Food Chemistry and Analysis Laboratory (3 credits) [Prerequisite: FOSC 301, 302, NUTN 304]
Food Analysis laboratory practice. Chemical, physical and microscopy techniques for the analysis of food products. Sampling methods. Reporting of analytical data. Official methods of food analysis. Appreciation of the principles of analytical techniques for Moisture, Proteins, lipids, carbohydrates and colour analysis of foods. Chemical analysis of water quality. Instrumental methods of food analysis. Applications of spectroscopy.
Laboratory experience in Food Chemistry. Protein, carbohydrate, lipids properties, colour and flavour measurement of selected processed foods. Analysis of browning systems.

FOSC 402: Food Processing Plant Operations and Sanitation (2 Credits)
Principles and practices of the organisation and management of plant operations. Plant lay-out and flow patterns. Plant and warehouse siting and design. Pilot operations and optimization.
Cleaning operations; use of detergents and sanitizers, water use, waste disposal and pollution control; Public Health Acts and Regulations. Environment issues in food processing. Industrial visits.

FOSC 403: Food Packaging (2 Credits)
Forms and levels of packaging. Food packaging materials,- their structure, properties,functionality and uses and conversion processes. Interactions between packaging materials and food. Relation of packaging to preservation and shelf life of foods. Food labeling. Packaging applications for specific food commodities. Safety, environmental and legal issues related to food packaging.

FOSC 404: Food Quality Assurance, Laws and Regulations (3 Credits)
Principles of quality control, quality assurance and introduction to total quality management Food quality and food safety management systems. Organization of food industry quality programmes. Quality characteristics of foods and their measurements. Sampling and sampling plans for quality control. Statistical quality control processes and procedures including reporting and recording. Food Standards and specifications Codex Alimentarius.; procedures for elaboration of food standards. Food legislation and regulatory agencies; Legal issues in food science and technology.

FOSC 405: Sensory Analysis of Foods [Prerequisite FOSC 305], (2 Credits)
Food Quality assessment using sensory responses. Principles of sensory analysis as a scientific method. The senses and basic sensory characteristics (aroma, taste and texture) of food. Organisation of sensory evaluation facilities, sensory test methods and their applications in testing various attributes of foods. Consumer testing for product acceptability. Analysis of sensory data. Application of sensory evaluation in the food industry.

FOSC 406: Principles of Food Product Development (2 credits)
An introduction to the sequence of events leading to Food product development from concept to product launch. Prototype development, product optimization and testing. Logistics for product development. Economics of product development and marketing issues. The course involves the integration and application of the basic concepts and principles of food science and will allow students to bring their knowledge of these to bear in the conceptualization of new food products. As part of the course students will be required to submit a written report on a new food product.

FOSC 407: Plant Products Processing Technology (2 credits) [Prerequisite FOSC 308]
The structure, chemical and nutritional composition, of plant food commodities. Preservation, processing and product characteristics of fruits and vegetables, roots and tubers, cereals, legumes, oil seeds and spices of importance in Ghana. Use of industrial as well as indigenous technologies and characteristics of traditional plant food products.

FOSC 408: Industrial Microbiology and Food Biotechnology (2 credits)
Industrial microbiology, Industrial microorganisms, Products of industrial interest, Principles of Industrial fermentation processes, Chemical and microbiological changes occurring during industrial fermentation, Typical processes of Industrial fermentation. Production of African fermented foods.

FOSC 409: Animal Products Processing Technology (2 credits)
The characteristics of conversion of muscle to meat; Characteristics of fish and fish products, milk and milk products; Industrial and traditional technologies for processing and preservation of fish and meat. Technologies for milk products processing and processing of eggs. Public health issues in relation to animal products.

FOSC 410: Special Topics in Food Science/Independent Study (1 credit)
Supervised independent study on new and emerging technologies/ processes and innovations in any area of Food Science and Technology. Students will be given selected readings each week to

guide their study. These reading may be given by one or more faculty members. A term paper will be required for assessment.

FOSC 411: Food Commodity Processing Technology Laboratory (1 credit)
(Prerequisites: FOSC 409,411)
Practical course on processing various food commodities.- cereals, legumes, roots and tubers, fruits and vegetables, oil seeds, fish, meat, dairy. The course involves practicals in the laboratory with an aim to understanding and improving traditional food processing technologies as well as industrial visits to small scale as well as multinational large scale food processing industries.

FOSC 412: Professional Development Seminar II (1 credit)
The course aims at improving the communication skills of students within the scientific context, Topics will include scientific report writing and presentation skills. Critiquing of published material and presentation of a researched topic at a seminar. Seminar attendance is required. Pass/Fail grade.

FOSC 413: Food Additives and Chemical Toxicology (2 Credits)
Classes of food additives including direct and indirect additives; Objectives of use of additives Principles guiding use and non-use of additives, regulation and control additives. Chemistry and properties, Modes of action; Fundamentals of toxicology, Current methodologies in toxicological studies and examination. Classification and sources of toxicants. Risk analysis and risk management of toxic substances in foods**.**

DESCRIPTION OF NUTRITION COURSES
BSC PROGRAMME

NUTN 201: Introductory Human Nutrition (2 credits)
Major nutrients in foods and their food values: Carbohydrate, Proteins, Lipids, Vitamins and minerals; Breastfeeding; Food sources of nutrients, Food habits; Nutrition and disease; Population growth, Food production and nutritional status.

NUTN 202: History of Nutrition and Concepts in Nutrition (2 credits)
Pre-scientific ideas about foods; investigation of carbohydrates, fats and albuminous substances; food utilization, experiments with gelatin; pioneers in nutrition; animal nutrition; respiration and calorimetry; chemical analysis of foods; The discovery of vitamins; inorganic elements; fatty acids. Definitions, Nutrition, Nutritional science, nutrition professionals (Nutritionists, Dieticians, Food Scientist etc), Nutrition and Health; foods and food values, levels of nutritional status, factors influencing food choices, under-nutrition, over nutrition, Double-burden of disease, Nutritional problems in Ghana, Assessing nutritional adequacy of diets, Nutrition in eating disorders, Nutrition for exercise and sports performance, Nutrition guidelines for health promotion; Plant based diets.

NUTN 300: Nutrition Internship (1 credits)
A 6-week practical attachment to an organization or projects that works on nutrition related issues. The chosen organization must be approved by the department. The student is visited at least once to aid in the evaluation. Report must be submitted for evaluation. This is done during the long vacation.

NUTN 301: Nutrients and their Metabolism I (2 credits)
Classification, metabolism and physiological functions, effects of deficiencies and trends in the

consumption of carbohydrate, protein, and fat. Food as a source of energy, energy expenditure, measurement and factors influencing energy expenditure. Carbohydrate, protein and fat inter-relationships in meeting energy requirements, and their implications for health.

NUTN 302: Nutrients and their Metabolism II (Prerequisite: NUTN 301) (2 credits)
Functions and distribution of minerals in the human body. Dietary sources, deficiency symptoms, human requirements for minerals. Role of trace elements in human nutrition and requirements. Landmarks in the discovery of vitamins, functions, metabolism, recommended intakes, dietary sources, effects of deficiencies of fat soluble and water soluble vitamins

NUTN 303: Nutritional Physiology: Theory and Practical (3 credits)
The study of body systems associated with the delivery of food to the body. The structure of the digestive system in relation to its functions in digestion and absorption. Blood physiology: blood and other fluid compartments of the body in relation to the transfer of nutrients and metabolites. Cellular components of blood. Excretion. Laboratory experiments to illustrate the principles and techniques used in nutritional physiology. Digestive system, blood physiology, normal and abnormal components of urine. The lab accompanies the lectures in Nutritional Physiology.

NUTN 304: Food Analysis I (Prerequisites: NUTN 301, 302) (1 credits)
Sampling and sample preparation, glassware for laboratory analysis. Precision and accuracy, data reporting, report write-up. Principles behind food analysis methods. Comparative moisture analysis, ash, crude fat, crude protein and crude fiber analysis. Calorific value of foods. Determination of phosphorus, iron, calcium and vitamin C in foods.

NUTN 305: Nutrition, Sustainable Livelihoods and Extension (2 credits)
An overview of the sustainable livelihoods framework with emphasis on the interrelations between food security and nutrition and how nutrition influences..-5pecific components of the framework. The UNICEF malnutrition framework within the context of the sustainable livelihoods framework. Principles of extension and qualitative processes and methodologies for community diagnosis of nutrition problems and planning of community nutrition interventions. Review of Case-studies.

NUTN 306: Methods in Nutrition Research I (2 credits)
Survey of physical, biochemical and physiological methods used in nutritional investigation, e.g. fluorometry, amino acid analysis, automated haematology. Questionnaire design, Qualitative and quantitative methods of data collection. Ethics in research as it applies to both human subjects and animals. Internaal review board (IRB) The principle of confidentiality and data handling protocols.

NUTN 308: Animal Experimentation (2 credits)
Problems with human experimentation; advantages of animal experimentation; concerned societies and standards for animal experimentation; species of experimental animals; the experimental rat and disease; physical facilities for rat experimentation in Nutrition; rat models for human nutrition studies; effect of feeding different levels of nutrients e.g, iron, protein; nitrogen balance; digestibility; effect of diet on body functions.

NUTN 310: Professional Development Seminar I (1 credit)
Attachment to a Senior Member for supervised independent study. Training in literature search, and information gathering, writing and speaking skills. Presentation of a literature review on a given topic at a seminar. A term paper and regular attendance at department seminars are

required.

NUTN 312: Foods and Social Factors in Nutrition (2 credits)

An overview of the socio-cultural factors that influence food acquisition, preparation and consumption across the world. Social and economic factors that determine food choices. Food classifications and food proscriptions and prohibitions within the context of their nutritional implications for different demographic groups, particularly women and children. Food fads and diets. The effect of globalization, westernization and urbanization on food choices and associated nutritional implications. Population growth and resources.

NUTN 400: Nutrition Project (6 credits)

A supervised individual investigation in any topical issue directly or indirectly impacts on nutrition. A written project report in the form of a dissertation would be required. A minimum of 13 hours contact with the supervisor is an essential part of this course.

NUTN 401: Assessment of Nutritional Status I (Prerequisites: NUTN 301-303) (2 credits)

Indices used in assessing nutritional status of individual and groups in health and disease: dietary intakes, anthropometric measurements, Nutritional surveillance and growth monitoring.

NUTN 402: Applied Nutrition and Food Policies

Applied Nutrition programs, their implementation and evaluation; Effects of socio-economic factors on nutrition. Urbanization and nutrition. Nutrition education and methods of delivery of nutrition information to the public. Role of national and International organizations in combating hunger and malnutrition. Nutrition in emergency situations. Types of Food and Nutrition policies (FNP); Food importation and prices, income and quality of life, economic factors; necessary infol111ation for formulating FNP, efforts towards developing FNP for Ghana. FNP of other countries; food security; right to food.

NUTN 403: Assessment of Nutritional Status II (Prerequisites: NUTN 301-303) (2 credits)

Indices used in assessing nutritional status of individual and groups in health and disease: biochemical assessment, clinical and functional appraisal of nutritional status, vital statistics.

NUTN 404: Community Assessment II (2 credits)

Analysis of data collected from field survey. Dietary, biochemical, clinical, socio-economic and anthropometric analysis using various computer software and laboratory techniques. Preparation and writing of report.

NUTN 405: Nutrient Inter-relationships and Needs (Prerequisite: NUTN 301,302) (2 credits)

Inter-relationships among the macro and micro-nutrients; anti-vitamins and anti-metabolites. Concept of nutritional adaptation. Principles and methods of determination of nutrient needs; Proteins, amino acids, macro-minerals, trace elements, vitamins, fatty acids and fats. Laboratory on the techniques of determining nutrient needs and diagnosing nutrient deficiencies. Balance studies.

NUTN 406: Diet and Disease (Prerequisite: NUTN 301. 302) (2 credits)

Global trends of diet related diseases. A study of nutrition in the treatment and prevention of disease: Diabetes mellitus, protein-energy malnutrition, obesity, peptic ulcers, gout, hypertension, renal, cardiovascular diseases, cancer; Nutrition and dental health. Diet and Stress. Interrelationship between diet, physical activity and non-communicable diseases.

NUTN 407: Community Assessment I (Prerequisite: NUTN 401,403) (2 credits)
Identification of a community for needs assessment. This field work will include community entry techniques, transient walk and the applications of rapid appraisal and observations in needs identification. Nutritional assessment protocol to collect information on dietary, biochemical, clinical, socio-economic and anthropometric measures will be carried out in a chosen community. Interviewing skills, inter- and- intra personal relationships and working with people from diverse backgrounds and settings are incorporated in this course.

NUTR 408: Nutrition of Vulnerable Groups and in Emergency Situation (Prerequisites: NUTN 401, NUTN 403) (2 credits)
Study of the nutritional requirements in pregnancy, lactation, infancy, childhood, adolescence and in the aged. Relationship between maternal diet and pregnancy outcome. Breast feeding, weaning, nutrition of premature infants Complementary feeding, Alternative feeding in special conditions. Nutrition in emergencies. This course will discuss emergency situations that threaten food security and nutrition. A historical perspective on where and when nutritional emergencies occur will with reflection on the most nutritionally vulnerable groups during emergencies. Types of responses to nutritional emergencies

NUTN 409: Methods in Nutrition Research II (2 credits)
Quality Control for laboratory and Field data collection: General principles, setting up a quality control chart for the laboratory. Using the chart to identify questionable data; monitoring field data quality. Data analysis using software (Access, Epi-Info, WHO Anthro, FPro, Etc.)

NUTN 411: Human Growth and Development (Prerequisite: NUTN 401. 403)
Effects of nutrition on growth and development, regulatory growth mechanisms, measurement of growth, reference standards in growth measurement. Influence of nutrition on body composition. Estimation of human energy requirements; concepts of energy balance, factors influencing energy balance in obesity. Adaptation to low energy intakes In man. Energy, work capacity and performance.

NUTN 412: Professional Development Seminar II (1 credit)
The course will include improving the communication skills of students within the scientific context and lay public on nutrition facts. Writing an educational feature and publishing in any of the local mass media for the general populace and writing scientific report for publication; Presentation skills; Critiquing of published material. Seminar attendance is required.
Pass/Fail grade.

NUTN 413: Food and Nutrition Advocacy (2 credits)
Definition of advocacy. Identifying policy issues; Selecting an advocacy objective; Researching audiences; Developing and delivering messages; Understanding the Decision-making process; Building alliances; making effective presentations; Funding for advocacy; Improving your advocacy; Profiles software**.**

DEPARTMENT OF MARINE AND FISHERIES SCIENCES

The Department of Marine and Fisheries Sciences runs the following programmes: B.Sc Marine Science (Single Major); B.Sc Fisheries Science (Single Major), BSc. Marine Science (Major-Minor), and BSc. Fisheries Science (Major-Minor). Candidates must have satisfied ALL required Faculty-wide Level 100 courses prescribed for the Marine and Fisheries Sciences. Only students who have taken Faculty wide programmes in the Biological or Biomathematical programmes will be admitted for **Fisheries Science**.

To graduate with BSc. degree in **Marine Science** OR **Fisheries Science**, the student must take the following:

- Core: ALL
- Prescribed Electives as indicated.

All Core courses are compulsory. Candidates in the Major-Minor programmes must take and pass all indicated core courses. The total number of course credits to be taken must be between **15–18** credits per semester.

Faculty Members

Elvis Nyarko - Senior Lecturer/ **Head of Dept**
BSc (Ghana) MSc MPhil (Newcastle) PhD (Japan)
Francis K. E. Nunoo - Senior Lecturer
BSc (Ghana) PGD (Bremen) MSc M.Phil. (Newcastle) PhD (Ghana)
Patrick K. Ofori-Danson - Associate Professor
BSc (Ed) MSc PhD (Ghana)
Ayaa K. Armah - Senior Lecturer
BSc (Ghana) PGD (Halifax) PGD (Bremen) MSc (Ghana) MSc (Newcastle)
George Wiafe - Senior Lecturer
BSc PhD (Ghana) PGD (Halifax) MPhil (Newcastle)
Adelina M. Mensah - Lecturer
BSc (Ghana) MSc MPhil (Newcastle) PhD (Bonn)
Samuel Addo - Lecturer
BSc MPhil (Ghana)
Selorm D. Ababio - Lecturer
BSc MPhil (Ghana)
Emmanuel Lamptey - Lecturer
BSc MPhil (Ghana)
Dzidzornnu K. Atsu - Lecturer
BSc MPhil (Ghana)
Benjamin O. Botwe - Assistant Lecturer
BSc MPhil (Ghana)
Eunice K. Asamoah - Assistant Lecturer
BSc MPhil (Ghana)

LEVEL 100

Select one Group

GROUP A

FIRST SEMESTER

Core

Code	**Title**	**Credits**
UGRC 150	Critical Thinking and Practical Reasoning	3
ABCS 101	Introductory Animal Biology	3
CHEM 111	General Chemistry I	3
CHEM 110	Practical Chemistry	1
PHYS 105	Practical Physics	1
PHYS 143	Mechanics and Thermal Physics	2
MATH 101	General Mathematics	3
Total		**16**

SECOND SEMESTER

Core

Code	**Title**	**Credits**
UGRC 110	Academic Writing I	3
UGRC 130	Understanding Human Society	3
BOTN 104	Growth of Flowering Plants	3
CHEM 112	General Chemistry II	3
CHEM 110	Practical Chemistry	1
PHYS 106	Practical Physics II	1
PHYS 144	Electricity and Magnetism	2
Total		**16**

GROUP B

FIRST SEMESTER

Core

Code		**Credits**
UGRC 150	Critical Thinking and Practical Reasoning	**3**
EASC 101	Physical Geology	**3**
CHEM 111	General Chemistry	**3**
CHEM 110	Practical Chemistry	**1**
PHYS 105	Practical Physics I	**1**
PHYS 143	Mechanics and Thermal Physics	**2**
Select 3 credits		
MATH 101	General Mathematics	3
MATH 121	Algebra and Trigonometry	3
Total		**16**

SECOND SEMESTER

Core

Code	Title	Credits
UGRC 110	Academic Writing I	3
UGRC 130	Understanding Human Society	3
EASC 102	Geological Map Work	1
EASC 104	Historical Geology	2
Select 6 – 7 credits		
CHEM 112	General Chemistry II	3
CHEM 110	Practical Chemistry	1
PHYS 106	Practical Physics II	1
PHYS 144	Electricity and Magnetism	2
MATH 122	Calculus I	3
Total		**15 - 16**

GROUP C

FIRST SEMESTER

Core

Code	Title	Credits
UGRC 150	Critical Thinking and Practical Reasoning	3
MATH 121	Algebra and Trigonometry	3
PHYS 105	Practical Physics I	1
PHYS 143	Mechanics and Thermal Physics	2
CHEM 111	General Chemistry I	3
CHEM 110	Practical Chemistry	1
Select 3 credits		
STAT 101	Introduction to Statistics	3
CSCD 110	Computer Applications	3
EASC 101	Physical Geology	3
Total		**16**

SECOND SEMESTER

Core

Code	Title	Credits
UGRC 110	Academic Writing I	3
UGRC 130	Understanding Human Society	3
CHEM 112	General Chemistry II	3
CHEM 110	Practical Chemistry	1
PHYS 106	Practical Physics II	1
PHYS 144	Electricity and Magnetism	2
MATH 122	Calculus I	3
Total		**16**

SINGLE MAJOR IN MARINE SCIENCE

LEVEL 200
FIRST SEMESTER
Core

Code	Title	Credits
UGRC 210	Academic Writing II	3
MASC 201	Introductory Oceanography	3
MASC 203	Aquatic Ecology	3
FISH 201	Introduction to Fisheries Science	3
FISH 203	Introduction to Limnology	3
Total		**15**

SECOND SEMESTER
Core

Code	Title	Credits
UGRC 220	Introduction to African Studies	**3**
MASC 202	Marine Resources and Man	2
MASC 204	Oceanography and Fisheries Practical I	2
FISH 202	Principles of Aquaculture	3
Total		**10**

LEVEL 300
FIRST SEMESTER
Core

Code	Title	Credits
MASC 311	Nautical Science	3
FISH 317	Introductory Research Methods	3
MASC 327	Oceanography Practical I	2
Total		**8**
Electives (Select 7-10 credits)		
MASC 313	Coastal Wetlands	2
MASC 315	Coastal Geomorphology	2
MASC 319	Marine Non-living Resources and Industry	2
MASC 321	Principles of Remote Sensing and Geographic Information System in Marine Science	3
MASC 323	Coastal Tenure and Ethnobiology	2
MASC 325	Aquatic Plants	2
MASC 329	Behaviour of Aquatic Animals	2

SECOND SEMESTER
Core

Code	Title	Credits
MASC 326	Oceanography Field Course	4
MASC 328	Oceanography Practical II	2
FISH 332	Industrial Internship	2
Total		**8**

Electives (Select 7-10 credits)		
MASC 312	Marine Ecology I	3
MASC 314	Coastal Hydrology	2
MASC 316	Marine Biogeochemistry	2
MASC 318	Marine Invertebrates and Tetrapods	3
MASC 324	Aquatic Biodiversity and Conservation	3

LEVEL 400
FIRST SEMESTER
Core

Code	**Title**	**Credits**
MASC 400	Project	3
MASC 417	Oceanographic Data Management	2
MASC 423	Coastal Management	3
MASC 427	Oceanography Practical III	2
Total		**10**
Electives (Select 5-8 credits)		
MASC 419	Marine Affairs	2
MASC 421	Marine Hydrography and Cartography	3
MASC 425	Marine Sedimentology	3
MASC 429	Marine Natural Products and Biotechnology	2
MASC 431	Marine Turtle Ecology and Conservation	3
MASC 433	Application of Remote Sensing and Geographic Information System in Marine Science	3
MASC 435	Waterbird Ecology and Conservation	2
MASC 437	Introductory Coastal Engineering	2
MASC 439	Marine Geochemistry	2
MASC 441	Global Climate Change and the Marine and Coastal Environment	2

SECOND SEMESTER
Core

Code	**Title**	**Credits**
MASC 400	Project	3
MASC 428	Oceanography Practical IV	2
Total		**5**
Electives (Select 10 credits)		
MASC 414	Population Genetics of Marine Organisms	2
MASC 416	Coastal Ecosystems of West Africa	2
MASC 418	Current Research in Oceanography	2
MASC 422	Marine Geophysics	2
MASC 424	Introductory Marine Meteorology	2
MASC 426	Ocean Dynamics and Regional Oceanography	2

SINGLE MAJOR IN FISHERIES SCIENCE

LEVEL 200
FIRST SEMESTER
Core

Code	Title	Credits
UGRC 210	Academic Writing II	3
MASC 201	Introductory Oceanography	3
MASC 203	Aquatic Ecology	3
FISH 201	Introduction to Fisheries Science	3
FISH 203	Introduction to Limnology	3
Total		**15**

SECOND SEMESTER
Core

Code	Title	Credits
UGRC 220	Introduction to African Studies	3
MASC 202	Marine Resources and Man	2
MASC 204	Oceanography and Fisheries Practical I	2
FISH 202	Principles of Aquaculture	3
Total		**10**

LEVEL 300
FIRST SEMESTER
Core

Code	Title	Credits
FISH 313	Introduction to Aquaculture	3
FISH 317	Introductory Research Methods	3
FISH 321	Ichthyology	2
FISH 327	Fisheries Practical I	2
Total		**10**
Electives (Select 6-8 credits)		
FISH 315	Fish Microbiology	2
FISH 323	Fish Disease and Pathology	2
FISH 325	Marine Fisheries	3
FISH 329	Fish and Fisheries of West Africa	2

SECOND SEMESTER
Core

Code	Title	Credits
FISH 312	Fish Physiology	2
FISH 326	Fisheries Field Course	4
FISH 328	Fisheries Practical II	2
FISH 332	Industrial internship	2
Total		**10**
Electives (Select 5-7 credits)		
FISH 314	Principles of Fisheries Management	2
FISH 316	Fishing Technology	2
FISH 318	Inland Fisheries	3

LEVEL 400
FIRST SEMESTER
Core

Code	Title	Credits
FISH 400	Project	3
FISH 411	Introductory Fisheries Taxonomy	2
FISH 417	Fisheries Data Management	2
FISH 427	Fisheries Practical III	2
Total		**9**
Electives (Select 6-9 credits)		
FISH 415	Fisheries and Aquatic Wildlife Management	3
FISH 421	Fisheries and Higher Vertebrate Interactions	2
MASC 423	Coastal Management	3
FISH 425	Fish Stock Assessment	2
FISH 429	Fisheries Economics	2
MASC 441	Global Climate Change and the Marine and Coastal Environment	2

SECOND SEMESTER
Core

Code	Title	Credits
FISH 400	Project	3
FISH 412	Aquaculture Engineering and Practice	3
FISH 428	Fisheries Practical IV	2
Total		**8**
Electives (Select 7 credits)		
FISH 414	Fish Processing and Utilization	3
FISH 418	Current Research in Fisheries	2
FISH 422	Fish Chemistry and Toxicology	2
FISH 424	Fisheries Trade and Marketing	2
FISH 426	Fisheries Governance and Institutional Framework	2

MAJOR – MINOR IN MARINE SCIENCE

LEVEL 200
FIRST SEMESTER
Core

Code	Title	Credits
UGRC 210	Academic Writing II	3
MASC 201	Introductory Oceanography	3
MASC 203	Aquatic Ecology	3
Total		**9**

SECOND SEMESTER
Core

Code	Title	Credits
UGRC 220	Introduction to African Studies	3
MASC 202	Marine Resources and Man	2
MASC 204	Oceanography and Fisheries Practical I	2
Total		**7**

LEVEL 300
FIRST SEMESTER
Core

Code	Title	Credits
MASC 311	Nautical Science	3
FISH 317	Introductory Research Methods	3
MASC 327	Oceanography Practical I	2
Total		**8**

SECOND SEMESTER
Core

Code	Title	Credits
MASC 326	Oceanography Field Course	4
MASC 328	Oceanography Practical II	2
FISH 332	Industrial Internship	2
Total		**8**

LEVEL 400
FIRST SEMESTER
Core

Code	Title	Credits
MASC 400	Project	3
MASC 417	Oceanographic Data Management	2
MASC423	Coastal Management	3
MASC 427	Oceanography Practical III	2
Total		**10**
Electives (Select 5-8 credits)		
MASC 419	Marine Affairs	2
MASC 421	Marine Hydrography and Cartography	3
MASC 425	Marine Sedimentology	3
MASC 429	Marine Natural Products and Biotechnology	2
MASC 431	Marine Turtle Ecology and Conservation	3
MASC 433	Application of Remote Sensing and Geographic Information System in Marine Science	3
MASC 435	Waterbird Ecology and Conservation	2
MASC 437	Introductory Coastal Engineering	2
MASC 439	Marine Geochemistry	2
MASC 441	Global Climate Change and the Marine and Coastal Environment	2

SECOND SEMESTER

Core

Code	Title	Credits
MASC 400	Project	3
MASC 428	Oceanography Practical IV	2
Total		**5**
Electives (Select 10 credits)		
MASC 414	Population Genetics of Marine Organisms	2
MASC 416	Coastal Ecosystems of West Africa	2
MASC 418	Current Research in Oceanography	2
MASC 422	Marine Geophysics	2
MASC 424	Introductory Marine Meteorology	2
MASC 426	Ocean Dynamics and Regional Oceanography	2

MAJOR – MINOR IN FISHERIES SCIENCE

LEVEL 200

FIRST SEMESTER

Core

Code	Title	Credits
UGRC 210	Academic Writing II	3
FISH 201	Introduction to Fisheries Science	3
FISH 203	Introduction to Limnology	3
Total		**9**

SECOND SEMESTER

Core

Code	Title	Credits
UGRC 220	Introduction to African Studies	3
FISH 202	Principles of Aquaculture	3
Total		**6**

LEVEL 300

FIRST SEMESTER

Core

Code	Title	Credits
FISH 313	Introduction to Aquaculture	3
FISH 317	Introductory Research Methods	3
FISH 321	Ichthyology	2
FISH 327	Fisheries Practical I	2
Total		**10**

SECOND SEMESTER

Core

Code	Title	Credits
FISH 312	Fish Physiology	2
FISH 326	Fisheries Field Course	4
FISH 328	Fisheries Practical II	2
FISH 332	Industrial internship	2
Total		**11**

LEVEL 400

FIRST SEMESTER

Core

Code	Title	Credits
FISH 400	Project	3
FISH 411	Introductory Fisheries Taxonomy	2
FISH 417	Fisheries Data Management	2
FISH 427	Fisheries Practical III	2
Total		**9**
Electives (Select 3-6 credits)		
FISH 415	Fisheries and Aquatic Wildlife Management	3
FISH 421	Fisheries and Higher Vertebrate Interactions	2
MASC 423	Coastal Management	3
FISH 425	Fish Stock Assessment	2
FISH 429	Fisheries Economics	2
MASC 441	Global Climate Change and the Marine and Coastal Environment	2

SECOND SEMESTER

Core

Code	Title	Credits
FISH 400	Project	3
FISH 412	Aquaculture Engineering and Practice	3
FISH 428	Fisheries Practical IV	2
Total		**8**
Electives (Select 7 credits)		
FISH 414	Fish Processing and Utilization	3
FISH 418	Current Research in Fisheries	2
FISH 422	Fish Chemistry and Toxicology	2
FISH 424	Fisheries Trade and Marketing	2
FISH 426	Fisheries Governance and Institutional Framework	2

COURSE DESCRIPTIONS

MASC 201: Introductory Oceanography

History of oceanography. Oceanography as a science. Geologic and evolutionary history of the Earth. Internal structure of the Earth, isostasy and plate tectonics. Origin and structure of the ocean basins. The climatic seasons. Shape of the Earth and location systems. Bathymetric and physiographic charts. Hydrologic cycle. Seas and oceans. Seawater – composition, physical and

chemical properties. Distribution of heat in the oceans. Motion in the ocean – wind patterns, surface currents, waves and tides. Life in the oceans. Environmental issues in oceanography.

MASC 202: Marine Resources and Man
The living resources of the sea: major fishing areas, major food species, other commercial resources – e.g. pharmaceutical products. The non-living resources of the sea: oil and gas, minerals, fresh water, energy. Threatened and endangered species: mammals, sea turtles, seabirds, invertebrates. Special habitats: lagoons, estuaries, mangrove forests, coral reefs.

MASC 203: Aquatic Ecology
Aquatic Habitats - Freshwater (lentic and lotic habitats); Marine (brackish, estuaries, lagoons, coastal, shelf, deepsea habitats). Importance of oceans, lakes and reservoirs. Measurement of productivity. The physical and chemical factors in aquatic environments. Biological communities – biodiversity of aquatic ecosystems. Plankton, Neuston, Nekton, Benthos, Periphyton, Awfwuchs, Mangroves/Macroflora. Common weeds in impoundments and their management. Adaptation to aquatic ecosystems - Preventing Desiccation, Maintaining position, Avoiding Crushing by Waves, Respiration, Reproduction, Feeding, Avoiding Predation, Excretion, Preventing, OverheatingAnthropogenic impacts on aquatic ecosystems. Resource exploitation (Fishing and Mining); Alterations of aquatic ecosystems; Pollution (agricultural, domestic and industrial Effluents). Conservation and management of aquatic ecosystems. Water and sustainable development- the crisis in water resources and need for management. Traditional methods; National and International Regulations and Global Agreements. Hydrobiological problems in the tropics-man-made lakes and water-borne diseases associated with impoundments.

MASC 204: Oceanography & Fisheries Practical I
The practical will be based on topics covered during the entire year.

FISH 201: Introduction to Fisheries Science
Scope of Fisheries Science. History of fishing. Diversity of fisheries. Taxonomic classification of fishes. Common fish resources, their exploitation and management. The fishing industry in western Africa: artisanal (both marine and inland) semi-industrial, industrial, aquaculture. The socio-economic setting of fishing communities. Economic importance of fisheries.

FISH 202: Principles of Aquaculture
Basic definitions and terminologies in aquaculture and mariculture: standing crop, carrying capacity, etc. Fish husbandry: aquatic farming systems (pond, cage, pen, raceways, etc), intensive and extensive systems. Characteristics of desirable species for culture. Cultured species of tropical Africa. Water quality and fish health. Economic importance of aquaculture.

FISH 203: Introduction to Limnology
Characteristics of streams and rivers and lakes. Formation and classification of lakes. Major man-made and natural lakes of Africa. Abiotic factors influencing productivity in the fresh water environment. Primary and secondary production in freshwater ecosystems. Tropical freshwater-water-borne diseases. Invasive aquatic weeds. Ecological adaptations of freshwater organisms. Crisis in the world's freshwater resources.

MASC 311: Nautical Science
General Ship knowledge: ship cargoes, merchant fleet, classification societies, International load line, ship tonnage, shift of ships center of gravity. Field exercises: Practical seamanship, anchors and markings, ropes, tackles, knots, splices. First Aid, fire fighting, swimming, snorkelling and

diving. Navigation: Earth, mercator and gnomonic charts, other charts, datum, information from charts and publications, distances, the nautical mile, the knot, position lines and position fixes, dead reckoning, estimated position, observed position. Chartwork exercises: Compass rose, gyro, and magnetic compass courses. Running fixes: Taking of bearings and laying down courses, courses and distances made good. Marine research vessels: equipments and operation.

MASC 312: Marine Ecology I

The nature and global distribution of marine organisms and habitats. Ecological concepts. Primary and secondary production in the ocean. Measurement of productivity. Trophic interactions and flows of material and energy in marine food webs. Plankton communities: larval ecology, Life history strategies (r- and K-selection) and population dynamics. Intertidal environment: physical factors, biological patterns, adaptations of intertidal organisms; Biological interactions (Competition, predation and patch dynamics). Ecological methods: quantifying physical patterns; behavior; biological patterns. Anthropogenic impacts on the ocean.

MASC 313: Coastal Wetlands

Definition and Classification of Wetlands; Wetland Hydrology; Wetland Soils; Patterns in Wetland Vegetation; Gas Transport in Wetland Plants; Introduction to Wetland Delineation; Wetland Assessment (Functions and Values); Economic Valuation of Wetlands; Wetland Mitigation

MASC 314: Coastal Hydrology

Hydrologic cycle. Tides, waves, currents and their effects on coastal landforms. Tidal land forms – tidal inlets, intertidal flats and coastal wetlands, mangrove ecosystems. Coastal lagoons Estuaries and River deltas. Types of estuaries. Estuarine circulation patterns. Flushing time. Tidal exchanges – rivers and seas; rivers and aquifers, sub-surface flow into the sea.

MASC 315: Coastal Geomorphology

Coastal classifications. Types of Coastlines. Morphology of the coast. Waves and wave-induced currents. Wave types (progressive, Tsunamis, internal and standing waves). Wave effects. Effect of tides on coasts. Coastal sediments. Sediments movements by currents. Sediment movement by wind. Coastal sand dunes. Tidal landforms (wetlands, mudflats, salt marshes and coastal mangrove forests). Other coastal landforms (sandy and rocky shores, cliffs and shore platforms, arches and stacks, pocket beaches, spits, hooks and tombolos, etc). Coastal morphology and sea level. Coastal and shore line protection.

MASC 316: Marine Biogeochemistry

Global hydrological cycle. Chemistry of seawater. Redox chemistry of seawater – importance of oxygen, organic matter production and destruction. Trace metal biogeochemistry. Biogeochemical cycles. Origin of petroleum in the marine environment. Chemistry of marine sediments. Pharmaceutical and other organic products from the sea.

MASC 318: Marine Invertebrates and Tetrapods

Taxonomic diversity of major invertebrate groups. Invertebrate life cycle and larval forms. Important migratory species: marine reptiles (turtles); marine birds (population trend and status; bird diversity, bill shape and pursuit patterns, range and country distribution, important bird areas (IBAs), threats and impact, the roles of Birdlife International and other relevant NGOs in their conservation)); representative members of the cartilaginous fish (sharks and rays- main types of shark fisheries and fishing methods; global shark catch and trade trends); marine mammals (representative sirenians, cetaceans and pinnipeds, diving physiology, aerobic dive limit,

apneustic breathing patterns, echolocation, whaling, ecological status of marine mammals and their protection).

MASC 319: Marine Non-living Resources and Industry
Types & characterisation of marine non-living resources; their exploration, development and constraints.

MASC 321: Principles of Remote Sensing and Geographic Information Systems
Principles of remote sensing. Electromagnetic Radiation. Interaction of Light with atmosphere and surfaces. Satellite observation systems. Principles of image processing. Digital Image Processing – acquisition, correction, calibration and interpretation. Introduction to Geographic Information Systems. Satellite-based positioning systems. Datums and map projections. Digitization. Database management systems. Basic spatial analysis. Data visualization (maps). Data quality and documentations.

MASC 323: Coastal Tenure and Ethnobiology
Importance of relationships between people, biota, and the coastal environment – past and present. Marine and coastal tenure. Property rights. Traditional environmental knowledge. Community-based environmental awareness raising programmes. Environmental education and management frameworks in relation to marine and coastal resources. Introduction to approaches for educating children and adults. The importance of incorporating environmental knowledge in customary marine tenure, and its value in modern management practices. The decline in environmental knowledge and its consequences on biological education and environmental management. Cultural heritage in adopting a marine and coastal conservation ethos. The importance of the coasts and seas as sources of music, poetry, art and creative crafts. The development of sustainable tourism. The roles, responsibilities and engagement of Ghanaian and international NGOs and other civil organizations in the governance of marine and coastal resource management. Sustainability of educational programmes.

MASC 324: Aquatic Biodiversity and Conservation
Principles of biodiversity and conservation. measurement and analysis of biodiversity; Patterns of species diversity. Indicators of Biodiversity. Conservation of aquatic resources – Protected areas, Heritage sites, Ramsar sites etc. Convention on Biological Diversity. Resource valuation. National case studies of institutional and legislative framework for biodiversity conservation. Biodiversity and climate change; climate change impacts on aquatic biodiversity. Key biodiversity areas (KBAs) in Ghana and key stone species.

MASC 325: Aquatic Plants Identification and systematics. Structure and reproduction of the major groups (green, brown and red macroalgae). Zonation and factors affecting distribution of aquatic plants. Marine plants and their production (sea grasses and mangroves). Economic importance of aquatic plants. Alien and invasive aquatic plants. Algal blooms including harmful microalgae.

MASC 326: Oceanography Field Course
Field visits for practical exposure. Designing, planning and execution of scientific investigations in Oceanography. This may involve laboratory activities. Assessment is based on an oral presentation and submission of field reports.

MASC 327: Oceanography Practical I
Practical covering all core courses in First Semester.

MASC 328: Oceanography Practical II (
Practical covering all core courses in Second Semester.

MASC 329: Behaviour of Aquatic Animals
Concepts of animal behaviour. Behavioural ecology (learning, stimuli, feeding, communication, courtship and mating, migration, protection, territoriality, social organization, orientation, rhythms, hormones and pheromones). Case studies on behaviour of named aquatic organisms.

FISH 312: Fish Physiology
Introduction & scope of fish physiology. Internal environment and composition of body fluids. Osmotic and ionic regulation water and salt balance, kidney structure and function. Functional adaptations to environmental change. Vascular transport and gaseous exchange - the heart and the cardiac cycle, respiratory organs, air-breathing fishes, transport of respiratory gases. Introduction to fish nutrition. Bioenergetics and metabolism (digestion and absorption). Fish locomotion Effect of changes in pressure and depth on fishes. Colouration in fishes. Sensory systems. Fish reproduction. Endocrine systems - pituitary hormones, non-pituitary endocrine functions.

FISH 313: Introduction to Aquaculture
Water as environment for aquaculture; characteristics for selection of fish for aquaculture; energy budget of fish of typical fish for aquaculture. Aquaculture systems and techniques. Concepts of integrated aquaculture. Mariculture. Principal food chain in fish ponds. Control of aquatic plants, predators and diseases. Status of aquaculture in West Africa Biotechnology and aquaculture. General economics of aquaculture.

FISH 314: Principles of Fisheries Management
Definition and scope of fisheries management. Management measures and approaches (e.g. fishery and area closure, fish quotas, licensing,). General management objectives guided by the FAO Code of conduct for responsible fisheries. Fishery regulation and policies. Fisheries law of Ghana. IUCN categories and criteria for threatened animals. Threatened species. Extinction in the aquatic wild. Exclusive Economic Zone (EEZ). Special conservation areas e.g. Marine protected areas and Ramsar sites. Framework survey of fisherfolks and communities. Traditional management and community-based management. Problems in the management of tropical multispecies stocks.

FISH 315: Fish Microbiology
Introduction to general microbiology. Fish micro-organisms & pathogens – types, morphological characteristics, processes, mechanisms, disease and prevention. Microbial causes of fish spoilage-enzymatic breakdown of fish molecules, roles of glycolytic and autolytic enzymes. Food and water-borne diseases, fish infections and intoxication. Microbiological methods for assessment of fish quality. Spoilage of fish and influence of temperature. Food contamination and public health microbiology. Importance of potable water in fish processing. Microbial risk assessment, quality control, and microbiological standards in fish consumption and international trade. Sampling, culture techniques, and analysis. Microbial preservation techniques to preserve fish quality and increase shelf life. Survey of tropical fish processing methods including traditional and industrial. Genetic modification of fish and their importance in aquaculture. Nutrient interactions and fish health. Fish immunology. Introduction to fish endocrinology with particular reference to the pituitary hormones, testicular and ovarian steroids and their importance in fish reproduction.

FISH 316: Fishing Technology
Basic terms and definitions of fishing gears. Fishing gears and methods (traps, hook and lines, stationery nets, towed nets and dredges, surrounding nets, fish aggregation devices (FADs)). Indigenous fishing gears. Gear selectivity. Fishing gear construction. Netting. Availability of fish to gear. Characteristics of common fishing gears employed in Ghanaian waters. Types of fishing crafts and their operation. Maintenance of crafts and gears. Electronic and acoustic fishing methods. Landing facilities. Harmful fishing practices. Destructive effects of fishing.

FISH 317: Introductory Research Methods
Types of data and their manipulation (samples and population, variables in environment, accuracy and data precision, frequency distributions, computations using spreadsheet). Descriptive statistics. Estimation and hypothesis testing. Univariate and multivariate statistics. Parametric and non-parametric tests. General experimental design. Introduction to modeling.

FISH 318: Inland Fisheries
Status and importance of inland fisheries. Diversity of lacustrine, riverine and estuarine fishes. Reservoir and floodplain fisheries. Habitat improvement. Environmental factors limiting inland capture fisheries. Adaptations to extreme environmental conditions - riverine fish migration, hatchling migration, fish gates or fish passes, etc, Impact of other uses of freshwater ecosystems e.g. forestry, agriculture, urbanization, damming, terrestrial animals etc.). Aquaria and ornamental fishes. Socio-economic aspects of inland fisheries, including the role of women in the inland fishing industry. Effects of bad fishing practices on inland ecosystems.

FISH 321: Ichthyology
Fish evolution and diversity. Classification and identification of fishes. Fish anatomy (internal and external structure) and function. Modes of reproduction. Fertilization and early development of fishes. Sex differentiation. General characteristics of organismic growth. Feeding categories and adaptations. Fish migration. Methods of studying fish migrations.

FISH 323: Fish Diseases and Pathology
Host-pathogen-environment relationship, Identification and diagnosis of fish diseases. Causative agents - bacteria, virus, parasites etc. Infections and diseases of fish in Africa - viral disease, bacterial infections, fungal and parasitic infections. Environmental and nutritional diseases. Transboundary fish diseases. Fish immunology. Control and management of fish diseases. Public health and fish consumption.

FISH 325: Marine Fisheries
Status and importance of marine fisheries (global and national). Types of fisheries. Marine fisheries of the world. Common marine fishes in Ghana. Factors affecting fish abundance. Fish sampling strategies. Methods for determining and/or measuring growth, spawning season, food habits, migration, catch and effort. Marking and tagging fish. Impacts of fishing on marine ecosystems. Aquaria and ornamental fishes. Contemporary issues in fishing – e.g. overfishing, bycatch, discards and trash fish, Illegal, Unregulated and Unreported (IUU) fishing; Monitoring, Control and Surveillance (MCS), and fisheries extension. Socio-economic aspects of fisheries including gender, poverty reduction and alternative livelihood.

FISH 326: Fisheries Field Course
Field visits for practical exposure. Designing, planning and execution of scientific investigations in Fisheries. This may involve laboratory activities. Assessment is based on an oral presentation and submission of field reports.

FISH 327: Fisheries Practical I
Practical covering all core courses in First Semester.

FISH 328: Fisheries Practical II Practical covering all core courses in Second Semester.

FISH 329: Fish and Fisheries of West Africa
Fisheries resources of West Africa other than fishes and (molluscs, bivalves, gastropods, cephalopods, echinoderms, sea urchins, and crustaceans) – their diversity, occurrence and distribution. Types of fisheries (artisanal, industrial and recreational) in both marine and inland waters. Capture methods in the sub-region. Fisheries and partnership agreements in the sub-region. Traditional and cultural practices in fishing communities. Role of women in the fishing industry. Exclusive Economic Zones (EEZ). Role of regional and sub-regional bodies e.g. NEPAD in fisheries capacity building and development.

FISH 332: Industrial Internship
Students will be attached to relevant stakeholder institutions for a period of six (6) weeks during the long vacation. Students will be assessed from reports received from supervisors at the industry as well as report written by students of learning outcomes during the internship.

MASC 400: Project
A supervised individual investigation in oceanography

MASC 414: Population Genetics of Marine Organisms
Maintenance of genetic diversity (evidence of balancing selection in heterogeneous environment, genetic polymorphisms), speciation (Genetic basis of prezygotic and postzygotic isolation), temporal variation and cohort analysis, genetic patchiness, hybridization (genetic restoration, controlled crosses). Genetics of populations (Hardy-Weinberg equilibrium).

MASC 416: Coastal Ecosystems of West Africa
Ecosystesm of the coast of West Africa– wetlands including estuaries, lagoons, and mangroves; shores (muddy, sandy and rocky), beach rocks, sand dunes etc. Distinguishing features of the coasts. Threats and adaptations of ecosystems to anthropogenic and human impacts such as climate change. Special case studies.

MASC 417: Oceanographic Data Management
Oceanography today, Information Technology and Scientific Communication, Principles of Data Management, Oceanographic Data Management Process. Principles of Information Management, Oceanographic Information Management Process.

MASC 418: Current Research in Oceanography
Acquaintance with current research in Oceanography through seminars, audio-visuals, article review etc. Experts in the subject will be invited to give presentations to students on selected topics.

MASC 419: Marine Affairs
International conventions (e.g. United Nation Convention on the Law of the Sea, Ramsar Convention, Convention on Biodiversity, Marine Pollution Convention, Convention for International Trade in Endangered Species of the Wild). FAO Code of Conduuct for Responsible Fisheries. National policies on Marine affairs e.g. National Policy on Fisheries and Aquaculture; Fisheries Law of Ghana. Legal and institutional framework e.g. Ghana Maritime Authority.

MASC 421: Marine Hydrography and Cartography
Introduction & history of mapping, sea bed type and subbottom profiling, circulation and water movements, waves and tides measurements, sidescan sonar, multibeam bathymetry theory and application (multibeam data processing) , Depth soundings, hydrographic survey design (data density, efficiency, coverage), Map datums and vertical datums, ROV, acoustic tracking, motion correction, GIS, GPS principles and vessel navigation. Data models, NIMA and USGS data types, Imagery in mapping; cartographic communication, representation of spatial data; map design, digital mapping, topographic mapping, thematic mapping.

MASC 423: Coastal Management
Introduction to the coastal zone and its resources. Principles of coastal zone management. Coastal profile of West Africa – ecosystems, current issues, socio-economic status, etc. Natural and anthropogenic impacts on the coastal zone. Case studies on erosion, biodiversity loss, ecotourism, pollution, fisheries degradation, and environmental impact assessment. Tools for Integrated Coastal Zone Management (ICZM). Sectoral versus integrated management. Institutional re-arrangements and governance. Introduction to management plans.

MASC 422: Marine Geophysics
Creation, evolution and destruction of ocean basins. Continental margins and sea floor. Plate Tectonics. Basic principles of seismology. Application of geophysical techniques in sea floor studies. . Basic principles of seismic data acquisition and processing. Interpretation of marine geophysical data.

MASC 424: Introductory Marine Meteorology
The Earth and its Atmosphere; Temperature & Energy; Heat budget of the ocean; Seasonal and Daily Temperatures; Air-sea-land interactions; Atmospheric water; Condensation; Atmospheric Stability & Cloud Development; Precipitation; The Atmosphere in Motion; Global Circulation; Air Masses & Fronts.

MASC 425: Marine Sedimentology
Sedimentary materials and their origin: Terrigenous clastic particles, sedimentary carbonates, silica, phosphates, organic matter, evaporites. Marine sedimentology and sedimentary petrology. Properties of sedimentary particles: Grain size, shape, surface and orientation. Analysis and classification of sediments and sedimentary rocks. Composition, textures and structures of sedimentary rocks. Lithification and diagenesis. Fossil fuels. Marine sedimentary environments: Tidal flats, deltas and lagoons, littoral, shelf and deep sea.

MASC 426: Ocean Dynamics and Regional Oceanography
Ocean mass-heat budgets. Ocean fluid dynamics: Coriolis effect, Ekman transport, Ekman pumping, geostrophy, Rossby and Kelvin waves, westward intensification, Sverdrup balance. Deep sea processes: Ocean waves, tides, thermohaline processes, vertical circulation, coastal and equatorial upwellings, ocean circulation. Shelf and nearshore processes: Transitional and shallow water waves, wave induced currents, shallow sea circulation and stratification, tides in shallow seas, local upwelling dynamics, fronts in shallow seas, shallow sea water masses. Regional Oceanography: Water mass formation, Oceanography of the Atlantic, Pacific, Indian, Arctic and Antarctic oceans. Oceans and climate: El Nino and Southern Oscillation (ENSO).

MASC 427: Oceanography Practical III
Practical covering all core courses in First Semester.

MASC 428: Oceanography Practical IV
Practical covering all core courses in Second Semester.

MASC 429: Marine Natural Products and Biotechnology
Introduction and scope of marine natural products and biotechnology application. Marine resources (biological and chemical diversity), history of marine natural products, marine natural product classes. Chemical ecology of marine invertebrates. Classification of chemical metabolites and chemical defence systems. Isolation and analysis of marine natural products. Searching for drugs from the sea. Nucleic acids and protein biosynthesis. Recombinant DNA and genetic engineering in marine systems. Application of biotechnology to marine pollution, ecosystem disease and harmful algal blooms. Current topics and new technologies in marine molecular biology, mutagenesis, microbial diversity etc.

MASC 431: Marine Turtle Ecology and Conservation
Turtle Population Ecology, Taxonomy and Foraging ecology. Behaviour - Orientation, Navigation, Natal Beach Homing, Sea Turtle Locomotion - Mechanics, Energetics, Habitat Utilization, Migration and Habitat Use. Life History Patterns. Physiological and diving adaptations. Reproduction – Nesting Embryonic Development and Sex Determination, Conservation - Human Impacts and threats, Contemporary Fisheries Related Mortality and Turtle Excluder Devices. Conservation strategies.

MASC 433: Application of Remote Sensing and Geographic Information System in Marine Science
Overview of Remote sensing (RS) and Geographic Information Systems (GIS). Hardware and software requirements. Monitoring the environment. Application of RS and GIS in oceanography and fisheries – e.g. global climatology, productivity, bathymetry, water quality, ocean colour, habitat classification and mapping, measurement of ecological indicators, aquaculture, monitoring and assessment of hazards and disasters. Future of RS and GIS. Careers in RS and GIS.

MASC 435: Waterbird Ecology and Conservation
Taxonomy and diversity of waterbirds; Vulnerability of waterbirds to climate variations; Interactions between climate change stressors; Adaptive capacity of waterbirds; Foraging ecology and trophic mechanisms; Disturbances of waterbirds (sea level rise and rainfall patterns, anthropogenic disturbances); Migration and breeding. State of world's birds; threatened aquatic bird species of the world or Ghana. Management and conservation strategies of waterbirds. Important bird areas (IBAs) of the world.

MASC 437: Introductory Coastal Engineering
The coastal environment, history of coastal settlements, coastal zone management and coastal defence principles. Coastal morphology. Coastal system behavior, factors influencing coastal systems. Wave theory, surf zone process. Tidal theory, coastal water level variations. Coastal transport process. Field measurements, physical and numerical models. Design concepts and philosophy. Coastal structures – harbours, jetties, marina, underground cables, pipelines, etc.

MASC 439: Marine Geochemistry
Thermodynamic and kinetic approaches to the description of processes which control chemical distributions in the ocean. Basic chemical equations and their ability to explain and predict oceanic observations. Topics include metal chemistry, reactive transient reactions, dissolved organic carbon, and gas exchange. Simple computer modeling.

MASC 441: Global Climate Change and the Marine and Coastal Environment Global warming – definition and terminologies. History and trends. Driving forces. Greenhouse gas effect. Major causes, impacts, threats, and opportunities for the marine and coastal environment. Sea level rise and its implications on coastal development. Assessment, vulnerability, adaptation, enhancement, sustainability, and mitigation of impacts on coastal ecosystems and coastal communities. Worldwide efforts at potential solutions and international agreements. Communicating climate change.

FISH 400: Project
A supervised individual investigation in fisheries

FISH 411: Introductory Fisheries Taxonomy
Principles and scope of fisheries taxonomy. The binomial system of naming species; fish origins and diversity in shapes and feeding; Trophic categories in fishes; scope of classification; method of classification; Classification of major groups of fishes; Primitive bony fishes (Coelacanth, *Latimeria chalumnae*, the three living lung fishes, *Protopterus*, *Lepidosiren*, and *Neoceratodus*). Introduction to the use of FAO Fish Species Identification keys with particular reference to species of major importance to fisheries- Elasmobranchs (Sharks and rays), Mollusca (squids, octopus, oysters and clams; Crustacea (crabs, lobsters, shrimps); aquatic plants (e.g. *Laminaria* as source of food and additive); high seas fisheries resources- baleen whales and cetaceans (toothed whales and dolphins); Tuna stocks in principal world fish markets (albacore (*Thunnus alalunga*), big eye (*Thunnus obesus*), yellowfish (*Thunnus albacares*), skipjack (*Katsuwonnus pelamis*), bluefin (*Thunnus thynnus*); Bill fishes in principal world fish markets (Atlantic bluefin marlin, Atlantic whitefish marlin, black marlin, striped marlin, indo-pacific marlin, and the sword fish); Classification of top species produced in world aquaculture. The role of genetics or genetically modified organisms in fisheries. Taxonomy. Identification of unusual fish species and their adaptations e.g. deep sea fishes.

FISH 412: Aquaculture Engineering and Practice
Global status and importance of aquaculture. Design and construction of aquaculture facilities e.g. ponds, cages. Fish feeds formulation, preparation, storage and feeding. Design, construction and operation of fish hatchery. Tilapia and African catfish culture. Constraints to production and their mitigation. Fish health management. Environmental impacts of aquaculture developments. Basic genetic principles (molecular genetics and cytogenesis. Tools for genetic engineering (triploidy, gynogenesis, androgenesis, monosex populations, inbreeding etc). Tools for breeding: hereditabiligy and monosex selection. Aquaculture as a business. Genetically modified organisms.

FISH 414: Fish Processing and Utilization
Principles of fish processing and preservation. Methods of fish processing and preservation by artisanal and industrial fisheries in the tropics. Types of fish products - chilled fish, dried fish, salted fish, smoked fish, fish oil, fish meal, fermented products. Fish handling and storage. Effects of bumper harvest. Fish spoilage. Fish utilization. Fish by-products. Fish marketing. Local and foreign markets for diversified fish products. Quality control and packaging.

FISH 415: Fisheries and Aquatic Wildlife Management
Effects of fisheries on the aquatic ecosystem. Definition and scope of fisheries management. General management objectives guided by the FAO Code of conduct for responsible fisheries. Fishery management scopes: single-species management compared with multi-species and multi-gear management; ecosystem management. Traditional management and community-based

management. Fisheries management approaches. Management strategies and measures. Fishery regulation and policies. Fisheries law of Ghana. IUCN categories and criteria for threatened animals. Threatened species. Extinction in the aquatic wild. Exclusive Economic Zone (EEZ). Special conservation areas and their roles. Framework survey of fisherfolks and communities. Problems in the management of tropical multispecies stocks. Marine mammals of the world and their protection needs.

FISH 417: Fisheries Data Management
Data gathering, verification and processing. Standardization of data collection systems. Tools for fisheries data collection e.g. Frame surveys. Fisheries Dependent and fisheries independent data (experimental). Time series data. Fisheries monitoring and feedback mechanisms. Gathering and use of Social and Economic information. Statistical and modeling tools. Information and Computer Technology and fisheries data management. Communicating scientific fisheries information. Timely distribution and utilization of data for management purposes**.**

FISH 418: Current Research in Fisheries Acquaintance with current research in Fisheries through seminars, audio-visuals, article review etc. Experts in the subject will be invited to give presentations to students on selected topics.

FISH 421: Fisheries and Higher Vertebrate Interactions
Impacts of fisheries on marine mammals, turtles and birds. Impacts of birds, mammals, etc. on fisheries. Fishing and stock fluctuations: effect of fishing on the 'optimum' take; cannibalism and fishing interactions; impact of trawling on seabed; effects of discards and industrial fisheries on stocks. Food and habitat interactions. Spatial and temporal competition between fish and higher vertebrates. Modelling interactions between man, vertebarates and fish resources. Management of shared resources of fishes and higher vertebrates.

FISH 422: Fish Chemistry and Toxicology General introduction to aquatic toxicology, fish biochemistry, chemistry and toxicology. Molecular composition of fish- water, carbohydrates, lipids, proteins, nucleic acids. Chemistry of fish nutritional quality. Biochemical mechanisms of adaptations of fish to the marine environment. Special emphasis on the effects of pressure, temperature, salinity, dissolved oxygen and light on the physiology and biochemistry. Current and future impact of various pollutants and toxic substances on fish life; human health and the environment. General types of aquatic toxicants. Biotoxins. Toxic fishes. Impact of pesticide residues and oil spills, offshore mining, shipping, long-lived toxic organic compounds such as PCBs and heavy metals in fisheries; impacts of dumping of chemical slops in the marine environment. Chemistry of fish decay. Techniques for the assessment of toxicity in fish. Fish immunotoxicology, environmental genotoxicology and carcinogenicity tests.

FISH 424: Fish Trade and Marketing
Important species traded and marketed. Trader types and function (small and large scale). Trends in world fish trade; endangered species due to trading and marketing; the supply chain; transaction systems; distribution channels of fish; consumer needs and value adding to fish. Quality assurance - labelling and certification. WTO Agreements and COFI sub-committee on fish trade. Other institutional and legal frameworks.

FISH 425: Fish Stock Assessment
Fish stock assessment as a management tool. Status of world fisheries. Trends of national fish production and consumption. Types of overfishing. Key fish species targeted for stock assessment in Ghanaian coastal waters; constraints that hinder fish stock assessment in tropical waters.

Collection of fishery data for stock assessment: catch, effort and abundance data, size composition data and other biological data. Simple methods for the estimation of growth and mortality parameters using size composition data. Measurement of status of fishery: CPUE, stock size, fishery mortality rate and other indicators. Estimation of Maximum Sustainable Yield (MSY) and optimal fishing effort using Schaefer's Surplus Production Model as technical reference point for providing management advice. Introduction to stock assessment tools.

FISH 426: Fisheries Governance and Institutional Framework
Complexities of fisheries management Integrated fisheries management, ecosystem and precautionary approach to fisheries. Definition of 'governance'. Need for fisheries governance & institutional framework. Role of coastal states enshrined in UNCLOS (1982). Fisheries institutional implications of role enshrined in e.g. FAO CCRF, FAO Committee on Fishing (COFI), UN Fish Stocks Agreement. The EEZ. International, national, and local policy, legal and institutional framework. International instruments. Other important international organisations in fisheries governance. Regional fisheries bodies and international organizations. National governance of fisheries – formal and traditional. Fisheries Law of Ghana. Essential institutional features for effective fisheries management. Rights based fisheries. Small scale fisheries. Science in fisheries governance. Corruption and other constraints to effective fisheries governance. Structural change and adjustment in the fisheries sector to improve fisheries governance. Multi-stakeholder processes in governance for responsible fisheries. Case studies in self-governance in the fisheries sector.

FISH 427: Fisheries Practical III
Practical covering all core courses in First Semester.

FISH 428: Fisheries Practical IV Practical covering all core courses in Second Semester.

FISH 429: Fisheries Economics
Studies of resource economics and economic theories with application to fisheries. Bioeconmic theories and models of fisheries. Dynamic optimization and the economics of shared stocks. The socio-economics of fishing communities in the African setting. Status and importance of world fish trade. Producer-consumer linkages. Product type and processing. Equipment and installation. Prices, costs and internal rate of returns.

DEPARTMENT OF PHYSICS

INTRODUCTION

Degree programmes leading to a BSc Major in Physics, BSc Major in Physics and Minor in another subject, and BSc Minor in Physics are available. To qualify for entry into any of these programmes, a candidate must have taken PHYS 105, PHYS 106, PHYS 143 and PHYS 144.

The BSc Major in Physics programme is designed to provide a comprehensive foundation in physics and preparation for advanced studies, both in physics and related fields. The programme provides 69 credits from Level 200 to 400 core courses. From Level 300 onwards, students can select from a variety of electives, representing various specialized areas of physics.

The BSc Major and Minor programmes are designed to provide students with the flexibility of pursuing their interests in other subjects while still acquiring a foundation in physics. Two options are available: BSc Major in Physics with a Minor in another subject and BSc Minor in Physics. The Major in Physics option provides 53 credits from core courses at Levels 200, 300, and 400. Students are at liberty to pursue their interests in other subjects at Levels 200 and 300. At level 400 an additional choice from a specialized area in physics is also available. The Minor in Physics option provides 12 credits at Level 200 and 18 credits at Level 300. There are no electives for the Minor option.

FACULTY

George K. Nkrumah-Buandoh *BSc MPhil PhD (Ghana) ICTP Dip. (Trieste)*	-	Senior Lecturer/ **Head of Department)**
Robert D. Baëta *MSc (Ghana) MSc PhD (Brist) CPhys FInst.P*	-	Professor Emeritus
Josef K.A. Amuzu *MSc (Ghana) PhD (Camb)*	-	Professor
E.K. Agyei *BSc (Lond) MSc PhD (McMaster)*	-	Associate Professor
Godfrey K. Adanu *MSc (Ghana) MSc (Brist) PhD (Kumasi)*	-	Associate Professor
Robert Kwadjo *MSc (Ghana) PhD (Camb)*	-	Senior Lecturer
Victor C.K. Kakane *BSc (Kumasi) MSc PhD (Ghana)*	-	Senior Lecturer
Amos Kuditcher *MSc PhD (Ann Arbor)*	-	Lecturer
Michael K.A Addae-Kagyah *BSc (Ghana) PhD (Logan, Utah)*	-	Lecturer
Merkin E. Baidoe-Adeleye *MCE BSc MSc (Ilorin)*	-	Lecturer
Allison F. Hughes *BSc MSc (Ghana)*	-	Lecturer
Abraham Amankwah *Dip Ed BSc (Cape Coast) MSc (Bremen)*	-	Lecturer
Victor K. Kattah *BSc (Kumasi) MPhil (Ghana)*	-	Lecturer
Alfred A. Yankson *BSc Dip Ed (Cape Coast) MPhil (Ghana)*	-	Lecturer

Martin N.Y.H. Egblewogbe *BSc MPhil (Ghana)*	-	Lecturer
Godfred B. Hagan *BSc MPhil (Ghana)*	-	Lecturer
George Kusi-Appiah *BSc (Kumasi) MSc (Tromsø) MPhil (Leeds)*	-	Lecturer
Joana A.M. Hodasi *BSc MPhil (Cape Coast)*	-	Assistant Lecturer

PROGRAMMME STRUCTURE

LEVEL 100
Select either Group A or Group B

GROUP A
FIRST SEMESTER
Core

Code	**Title**	**Credits**
UGRC 150	Critical Thinking and Practical Reasoning	3
MATH 121	Algebra and Trigonometry	3
PHYS 105	Practical Physics I	1
PHYS 143	Mechanics and Thermal Physics	3
CHEM 111	General Chemistry I	3
Select one course		
STAT 101	Introduction to Statistics	3
CSCD 110	Computer Applications	3
EASC 101	Physical Geology	3
Total		**16**

SECOND SEMESTER
Core

Code	**Title**	**Credits**
URGC 110	Academic Writing I	3
UGRC 130	Understanding Human Society	3
CHEM 112	General Chemistry II	3
CHEM 110	Practical Chemistry	1
PHYS 106	Practical Physics II	1
PHYS 144	Electricity and Magnetism	3
MATH 122	Calculus I	3
Total		**17**

GROUP B
FIRST SEMESTER
Core

Code	Title	Credits
UGRC 150	Critical Thinking and Practical Reasoning	3
MATH 121	Algebra and Trigonometry	3
STAT 101	Introduction to Statistics	3
CSCD 101	Introduction to Computer Science I	3
PHYS 105	Practical Physics I	1
PHYS 143	Mechanics and Thermal Physics	3
Total		**16**

SECOND SEMESTER
Core

Code	Title	Credits
URGC 110	Academic Writing I	3
UGRC 130	Understanding Human Society	3
MATH 122	Calculus I	3
PHYS 106	Practical Physics II	1
PHYS 144	Electricity and Magnetism	3
Select one course		
CSCD 102	Introduction to Computer Science II	3
STAT 102	Elementary Probability	3
Total		**16**

SINGLE MAJOR IN PHYSICS

LEVEL 200
FIRST SEMESTER
Core

Course Code	Course Title	Credits
UGRC 210	Academic Writing II	3
MATH 223	Calculus II	3
PHYS 205	Practical Physics III	1
PHYS 241	Atomic Physics and Quantum Phenomena	2
PHYS 245	Electromagnetism I	3
Select one course		
STAT 203	Elementary Statistical Methods	3
MATH 225	Algebra	3
Total		**15**

SECOND SEMESTER

Core

Course Code	Course Title	Credits
UGRC 220	Liberal and African Studies	3
PHYS 206	Practical Physics IV	1
PHYS 242	Oscillations and Waves	2
PHYS 244	Mathematical Methods I	3
PHYS 246	Nuclear Physics I	2
PHYS 248	Introduction to Physics of Materials	2
PHYS 256	Computational Methods in Physics I	2
Total		**15**

LEVEL 300

FIRST SEMESTER

Core

Course Code	Course Title	Credits
PHYS 305	Practical Physics V	I
PHYS 343	Physics of Large Systems I	2
PHYS 345	Electromagnetism II	3
PHYS 359	Physics of Solids I	2
PHYS 351	Optics	3
Total		**11**
Electives (Select a minimum of 4 credits)		
PHYS 361	Physics of the Atmosphere	2
PHYS 347	Electronics I	3
PHYS 365	Physics of the Ocean	2

SECOND SEMESTER

Core

Course Code	Course Title	Credits
PHYS 306	Practical Physics VI	1
PHYS 342	Mechanics and Fields	3
PHYS 344	Mathematical Methods II	3
PHYS 352	Quantum Mechanics I	3
PHYS 354	Special Relativity	2
Total		**12**
Electives (Select a minimum of 4 credits)		
PHYS 356	Computational Methods in Physics II	3
PHYS 362	Principles of Applied Geophysics	2
PHYS 364	Principles and Applications of Neutron Activation Analysis	2
STAT 306	Design of Experiments	3

LEVEL 400
FIRST SEMESTER
Core

Course Code	Course Title	Credits
PHYS 410	Project	3
PHYS 401	Seminar I	1
PHYS 443	Physics of Large Systems II	3
PHYS 459	Physics of Solids III	2
Total		**9**
Electives (Select minimum of 6 credits)		
PHYS 447	Electronics II	2
PHYS 455	Energy Systems	2
PHYS 461	Principles of Radioactive Dating	2
PHYS 465	Principles of Telecommunications	2

SECOND SEMESTER
Core

Course Code	Course Title	Credits
PHYS 410	Project	3
PHYS 402	Seminar II	1
PHYS 446	Nuclear Physics II	2
PHYS 448	Particle Physics	2
PHYS 452	Quantum Mechanics II	3
PHYS 454	Contemporary Physics	2
Total		**13**
Electives (Select a minimum of 2 credits)		
PHYS 462	Basic Meteorology	2
PHYS 466	Physics of the Nanoscale	2
PHYS 468	Introduction to Cosmology and Astrophysics	2

MAJOR – MINOR IN PHYSICS

LEVEL 200
FIRST SEMESTER
Core

Course Code	Course Title	Credits
UGRC 210	Academic Writing II	3
PHYS 205	Practical Physics III	1
PHYS 241	Atomic Physics and Quantum Phenomena	2
PHYS 245	Electromagnetism I	3
Total		**9**

SECOND SEMESTER
Core

Course Code	Course Title	Credits
UGRC 220	Liberal and African Studies	3
PHYS 206	Practical Physics IV	1
PHYS 242	Oscillations and Waves	2
PHYS 244	Mathematical Methods I	3
Total		**9**

LEVEL 300
FIRST SEMESTER
Core

Course Code	Course Title	Credits
PHYS 305	Practical Physics V	I
PHYS 343	Physics of Large Systems I	2
PHYS 345	Electromagnetism II	3
PHYS 351	Optics	3
Total		**9**

SECOND SEMESTER
Core

Course Code	Course Title	Credits
PHYS 306	Practical Physics VI	1
PHYS 342	Mechanics and Fields	3
PHYS 352	Quantum Mechanics I	3
PHYS 354	Special Relativity	2
Total		**9**

LEVEL 400
FIRST SEMESTER
Core

Course Code	Course Title	Credits
PHYS 410	Project	3
PHYS 401	Seminar I	1
PHYS 443	Physics of Large Systems II	3
PHYS 449	Physics of Solids II	3
Total		**10**
Electives (Select minimum of 5 credits)		
PHYS 447	Electronics II	2
PHYS 455	Energy Systems	2
PHYS 461	Principles of Radioactive Dating	2
PHYS 465	Principles of Telecommunications	2

SECOND SEMESTER

Core

Course Code	Course Title	Credits
PHYS 410	Project	3
PHYS 402	Seminar II	1
PHYS 446	Nuclear Physics II	2
PHYS 448	Particle Physics	2
PHYS 452	Quantum Mechanics II	3
PHYS 454	Contemporary Physics	2
Total		**13**
Electives (Select a minimum of 2 credits)		
PHYS 462	Basic Meteorology	2
PHYS 466	Physics of the Nanoscale	2
PHYS 468	Introduction to Cosmology and Astrophysics	2

COURSE DESCRIPTIONS

PHYS 105: Practical Physics I

PHYS 106: Practical Physics II

Basic Laboratory experiments to expose students to handling various measuring instruments and to data and error analysis.

PHYS 143: Mechanics and Thermal Physics

Mechanics

Properties of Vectors: Geometrical representation, multiplication (dot product and cross product), the three-dimensional Cartesian co-ordinate system, Components of a vector, Direction Cosines, Linear Independence, Magnitude of a vector, Geometrical methods of vector addition, The sine rule and the cosine rule, Vectors in two dimensions

Linear Momentum: Conservation Law, Direct and indirect collisions, The co-efficient of restitution

Motion: Newton's laws, equations of motion, Motion in one dimension, Parametric equations of motion, Motion in two dimensions, Projectile motion, Relative velocity

Force: Addition of Forces, Equilibrium, Impulse, Tension and the motion of connected masses, Friction

Circular motion: Uniform circular motion, Motion in a vertical circle, the conical pendulum

Work and Energy: Work done by a constant force, Work done by a varying force, Work and kinetic energy, Work and potential energy, Conservation of energy, Conservative and non-conservative forces – definition and examples

Rotational motion: Centre of mass, Moment of inertia, Angular momentum, Rotational kinetic energy, Torque

Gravitation: Kepler's laws, The law of Universal gravitation, Gravitational potential energy, Escape velocity

Thermal Physics

Microscopic and Macroscopic Definitions: Thermodynamic systems, Simple systems, Closed systems, Open systems, Isolated systems, Thermodynamic properties, States

Processes, Paths, Intensive and extensive quantities

Thermal Equilibrium: Temperature, Adiabatic walls, Diathermal walls, Thermometers and thermometric properties, Comparisons of thermometers, Thermometric scales and conversions, Zeroth law of thermodynamics

Work and Heat: Thermodynamic equilibrium – conditions, Chemical equilibrium, mechanical equilibrium, thermal equilibrium, Effects of conditions not satisfied, Change of state, Quasi-static processes, Work done, Work depends on path, Isothermal processes, Isobaric processes, Isochoric (isovolumetric) processes, Adiabatic processes, Concept of heat, Internal energy, Heat capacity, Specific heat, Heat flow (Conduction, Radiation, and Convection)
First law of thermodynamics: Cyclic processes, Non-cyclic processes, Nature of stored energy, First law and its implications under (i) Isothermal processes (ii) Isobaric processes (iii) Isochoric processes
Application: Introduction to entropy
Gas Laws: Properties of an ideal gas, Charles Law, Boyle's Law, Gay Lussac Law, Kelvin temperature scale (absolute temperature)
Kinetic theory of Gases: Assumptions, Force exerted on the walls of the container, Pressure, Equation of state, Molecular velocities: (i) Mean velocity (ii) mean square velocity (iii) root mean square velocity, Equipartition of Energy

PHYS 144: Electricity and Magnetism

Electricity

Electric Charge and Electric Field: Electric charge, Conductors, insulators and induced charges, Coulomb's law, Electric field and Electric forces, Charge distributions, Electric dipoles
Gauss' Law: Charge and electric flux, Gauss' Law, Application of Gauss' Law
Electrical Potential: Electric potential energy and work, electric potential
Capacitance and Dielectrics: Capacitors (parallel plate capacitors, spherical, and cylindrical shaped capacitors) and dielectrics, Capacitors in series and parallel, Charging and discharging a capacitor, time constant, Energy storage in capacitors
Electric Current, Resistance and Direct-current circuits: Electric current, Resistivity and Resistance, Electromotive force and electric circuits, Energy and power in Electric circuits, Resistors in series and Parallel, Kirchoff's Rules, Electrical measuring instruments

Magnetism

Magnetic Field and Magnetic Forces: Magnetic field, Magnetic field lines and Magnetic flux, Motion of charged particles in a magnetic field, Electric and magnetic fields acting together – application to velocity selectors, Magnetic force on a current-carrying conductor, Force and Torque on a current loop (a magnetic dipole moment)
Sources of Magnetic fields: Magnetic field of a moving charge, Magnetic field of a current element, Magnetic field of a straight current-carrying conductor, Force between parallel conductors, Magnetic field of a circular current loop, Ampere's law and its applications, Magnetic materials
Electromagnetic Induction: Faraday and Lenz's laws, Motional electromotive force, Induced electric fields, Eddy currents, Displacement current and Maxwell's equations
Inductance: Mutual inductance, Self-induced inductance, Inductors and magnetic-field energy, R-L and L-C circuits, L-R-C series circuits
Alternating current: Phasors and alternating current, Resistance and reactance, L-R-C series circuit, Band-Pass filters, Power in alternating-current circuits, Power factor, Resonance in alternating-current circuits, Transformer

PHYS 205: Practical Physics III

PHYS 206: Practical Physics IV

Laboratory experiments illustrating modern experimental techniques and error analysis.

PHYS 241: Atomic Physics and Quantum Phenomena

Quantum Phenomena

Blackbody radiation and Planck's hypothesis, photons and electromagnetic waves, photo-electric effect, Compton Effect, double-slit experiment, wave properties of particles, uncertainty principle, Schrödinger equation, particle in a square well potential (particle in a box).

Atomic Physics

Atomic structure, the Bohr atom, line spectra and energy levels, angular momentum: orbital angular momentum, spin angular momentum, multiplets, spectroscopic terms; fine structure, hyperfine structure, Stark and Zeeman effects, x-ray production and scattering, continuous spectrum.

PHYS 242: Oscillations and Waves

Simple, damped and forced oscillations; decay of oscillations, resonance; general properties of waves; waves in one dimension; superposition of waves; dispersion and group velocity; Doppler effect; waves in physical media; waves in two and three dimensions, circular and spherical wave fronts.

PHYS 244: Mathematical Methods I

Calculus of functions of several variables, partial differentiation, total differential, Euler's theorem on homogeneous functions; Constrained and unconstrained extrema, multiple integrals; Jacobian; Scalar and vector fields; Line, surface and volume integrals; Vector operators, grad, div and curl; Gauss, Stokes and Green's theorems; Ordinary differential equations with variable coefficients, series solutions

PHYS 245: Electromagnetism I

Electric field and potential gradient; Gauss's law and it's applications; electric field around conductors; Dielectric medium: polar and non-polar molecules, electric polarization and bound charges; Displacement vector; Gauss's Law in dielectrics; Potential energy of a charge distribution in the presence of dielectrics; Boundary conditions on **E** and **D**; Magnetic fields, magnetic force law and concept of magnetic induction **B**: Biot-Savart law, Lorentz force; Electromagnetic induction.

PHYS 246: Nuclear Physics I

Radioactivity, nuclear radiation; Detection of nuclear radiation; Structure and properties of the nucleus; binding energy and nuclear forces; Fission and fusion; Applications of radioactivity – Dating, radiology, radiotherapy, analysis.

PHYS 248: Introduction to Physics of Materials

Forces between atoms and molecules and their consequences; Elastic modulae – Young's, Shear, Bulk; Poisson ratio, non-elastic behaviour; Flow properties of fluids; Continuity equation, hydrostatic equation, Euler's and Bernoulli's equations, Kelvin's circulation theorem, Reynold's number.

PHYS 256: Computational Methods in Physics I

Limits of computation; Introduction to numerical methods—Functions and roots, Approximation, Interpolation, Systems of linear equations, Least squares, Numerical differentiation and integration, Finite differences; Realistic projectile motion; Oscillatory motion and chaos; Solar system; Potentials and fields of charges and currents; Waves.

PHYS 305: Practical Physics V
Laboratory experiments including those fundamental to modern physics and those illustrating modern experimental techniques. Students are introduced to Scientific Report writing and making references.

PHYS 306: Practical Physics VI
Laboratory experiments including those fundamental to modern physics and those illustrating modern experimental techniques. Students are introduced to Scientific Report writing and making references.

PHYS 342: Mechanics and Fields
Divergence and curl of a vector; Force Fields, conservative and non-conservative forces; Gravitation; Equipotential surfaces; Gradient of a potential; Gauss's law and applications; Central forces and applications to two-particle systems; Orbits; Escape velocity; Drag; Motion with variable mass; Statics of rigid bodies; Moment of inertia; Angular momentum; Motion of a top; Centrifuges; Gyroscopic motion; Lagrange's and Hamilton's equations.

PHYS 343: Physics of Large Systems I
Laws of thermodynamics and applications; Heat engines, heat pumps, entropy, thermal pollution and global warming; Unavailability of energy; Heat death; Thermodynamic potentials – Gibbs functions, Helmholtz functions and Free energy functions; phase change

PHYS 344: Mathematical Methods II
Vector and Tensor Analysis; Determinants, Matrices and Group Theory; Infinite Series; First Order Differential Equation; Functions of Complex Variables; Second Order Differential Equations; Special Functions - Bessel Functions, Gamma Functions, Beta Functions, Legendre Functions; Fourier Series; Partial Differential Equations; Integral Functions - Fourier Transform, Laplace Transform

PHYS 345: Electromagnetism II
Electromagnetic potentials: scalar and vector potentials; Poisson and Laplace equations; General methods of solving electrostatic problems; Electrostatic boundary value problems; Method of images; Magnetic materials, magnetization, magnetic field intensity **H**, magnetic susceptibility, relative permeability, hysteresis; Multipole fields; Maxwell's equations; derivation of the electromagnetic wave equation, its solutions, and some applications; Electromagnetic waves in dielectric and conducting media; skin effect.

PHYS 347: Electronics I
Voltage, current and resistance; Voltage dividers; Thévenin's and Norton's equivalent circuits; Diodes and diode circuits; design of regulated power supply, basic transistor circuits (Bipolar-Junction Transistors and Field-Effect Transistors); Operational amplifiers (linear applications only); Introduction to digital electronics (Number systems, Boolean algebra, logic gates, combinational logic circuits, Karnaugh maps).

PHYS 351: Optics
Fermat's principle; phenomena of geometrical and physical optics; thick lenses; apertures; interference; diffraction; polarization of EM waves; double refraction; lasers; holography; fibre optics; optical instruments; resolution.

PHYS 352: Quantum Mechanics I
Principles of quantum mechanics; Time-independent Schrödinger equation; Interpretation of wave properties as probability amplitudes; Superposed energy states; Uncertainty principle; Lifetimes; Moving wave packets; One dimensional scattering; Potential wells and barriers, tunnelling; probability currents; Harmonic oscillator; Formalism of quantum mechanics.

PHYS 354: Special Relativity
Invariance of Physical Laws; relativity of time intervals; Relativity of length; Lorentz transformation; Doppler effect for electromagnetic waves; Relativistic momentum; Relativistic work and energy; Newtonian Mechanics and Relativity.

PHYS 356: Computational Methods in Physics II
Random systems; Monte Carlo methods; Random walks, diffusion, and the Ising model; Phase transitions; Molecular dynamics; Variational and Spectral methods; Hartree-Fock method: helium atom, hydrogen ion; Periodic potentials and band structures; Self-organized criticality; Fractals; Protein folding; Neural networks.

PHYS 359: Physics of Solids I
Lattice translation vectors, symmetry operations; types of lattices; simple crystal structures; effect of deformation on crystals and their properties; crystal diffraction and the reciprocal lattice; Bragg's Law; experimental diffraction methods; reciprocal lattice vectors; Brillouin zones; structure and atomic form factors; Lattice vibrations; Lattice heat capacity; thermal conductivity.

PHYS 362: Principles of Applied Geophysics
Magnetic surveying – principles, geomagnetic field, interpretations, instruments and applications
Electrical surveying – resistivity of rocks and minerals, current flow in the ground, methods, instruments, interpretation, applications
Induced polarization surveying – principles, measurements, field investigations, applications
Electromagnetic surveying – principles, detection of electromagnetic fields, methods, interpretation and applications
Geophysical borehole logging – principles, natural gamma radiation logging, resistivity methods, self potential, temperature, calliper
Seismology

PHYS 364: Principles and Applications of Neutron Activation Analysis
Irradiation facilities: Neutron Sources; Nuclear Reactors Source; Isotopic Neutron Sources; Neutron Generator (Accelerator) Sources
Kinetics of activation: Irradiation Scheme (Conditions); Gamma Ray Spectrometry (Measurement of Gamma Rays). Absolute Method; Relative (Comparative) Method; K_0 Method
Measurement and evaluation: Qualitative Analysis; Quantitative Analysis
Applications of neutron activation analysis: Environmental Studies - Pollution Studies; Forensic Investigations; Archaeological Studies, Biochemistry; Semiconductor Materials Studies; Geological Science; Soil Science; Epidemiology Studies

PHYS 366: Physics of the Atmosphere
The Atmosphere – an introduction: Origin and composition of the atmosphere; Distribution of constituents; Charged particles; Temperature distribution
Thermodynamics of water vapour and moist air: Thermodynamics of dry and moist air, stability; changes of phase and latent heat; Adiabatic processes, moisture variables; Thermodynamic diagrams

Radiation: Fundamental physics of atmospheric electricity, radiation laws; Solar and terrestrial radiation, applications, ozone hole, atmospheric energy transport; Global energy balance.

PHYS 368: Physics of the Ocean
Physical properties of the ocean and seawater, sound and light; T-S forcing and conservation laws, Global T-S distribution; Equations of continuity and motion; Balance of forces; the effect of Earth's rotation; Ocean currents; Deep currents and general ocean circulation; Surface waves; Tides and long-period waves; Oceanographic instrumentation; El Nino.

PHYS 410: Project Work
Students undertake a limited research project under supervision of a Senior Member. A final report is required. Students are expected to report on their findings at a departmental seminar.

PHYS 401: Seminar I
Students attend weekly seminars and present proposals for their research project.

PHYS 402: Seminar II
Students attend weekly seminars and report on their research findings.

PHYS 443: Physics of Large Systems II
Probability distribution functions; velocity distributions; distributions in phase space; transport phenomena; fluctuation; Statistical Mechanics; ensembles and distribution functions; entropy and ensembles; the micro-canonical ensemble; the canonical ensemble; Bose-Einstein statistics (black body radiation); Fermi-Dirac statistics (free-electron gas).

PHYS 446: Nuclear Physics II
Nuclear properties: nuclear sizes, masses, densities, and abundances; Nuclear models; nuclear reactions; nuclear fission and fusion; nuclear reactors

PHYS 447: Electronics II
Multivibrators (SR, D, JK and T-type flip-flops), Counters, Shift registers, Semiconductor memories, Introduction to Microprocessors and Microcomputers

PHYS 448: Particle Physics
Elementary particles and their interactions; hadrons and electrons, spin and anti-particles, conservation laws, quark model, field particles, electro-weak theory, standard model, grand unification theory

PHYS 449: Physics of Solids II
Lattice translation vectors, symmetry operations; types of lattices; simple crystal structures; crystal diffraction and the reciprocal lattice; Bragg's Law; reciprocal lattice vectors; Brillouin zones; Lattice vibrations; Lattice heat capacity; thermal conductivity. Free electron Fermi gas; Fermi distribution, heat capacity of an electron gas; electrical conductivity; Wiedemann – Franz law; metals; insulators.

PHYS 452: Quantum Mechanics II
Quantum mechanics in three dimensions; Hydrogen atom; General properties of angular momentum in quantum mechanics; System of identical particles; Electron spin; Time-independent perturbation theory; Variational principles; The WKB approximation; Scattering.

PHYS 454: Contemporary Physics
This course is at an introductory level, dealing with selected topics taken from current trends in Physics. It is aimed at motivating students in the subject and ensuring a general literacy in the frontiers of Physics. Areas covered include recent advances in fields such as Unification, General Relativity and Black Holes.

PHYS 455: Energy Systems
Review of energy sources; conventional and non-conventional, renewable and non-renewable. Nuclear energy – fission, fusion, breeder reactors; solar energy – physical problems connected with conversion; technological problems and applications. Fossil fuels, hydro-power, wind power, tidal power; bio-chemical energy, Conservation and storage

PHYS 459: Physics of Solids III
Free electron Fermi gas; Fermi distribution, heat capacity of an electron gas; electrical conductivity; motion in magnetic fields; Wiedemann – Franz law; Energy Bands; Bloch functions; weakly perturbing lattice potential; holes; effective mass; metals; insulators; semiconductors; semiconductor crystals; intrinsic carrier concentration; thermo-electric effects in semiconductors; semi metals; p-n junctions; solar cells and photovoltaic detectors.

PHYS 461: Principles of Radioactive Dating
Radioactive decay, Types of radioactive clocks: decay clock accumulation clock. Fundamental requirements of radiometric dating, Useful radioactive decay schemes. Analytical techniques – fundamental mass spectrometry, Isotope dilution, analytical errors. Typical radiometric dating methods – K-Ar, Ar40/Ar39, Rb-Sr, U-Pb, Sm-Nd. Fission Track method of dating

PHYS 462: Basic Meteorology
Structure of the atmosphere; weather processes and weather systems, including climatic process. Data analysis, instruments, and weather system models, Global distribution of principal climatic elements with emphasis on physical causes. Physics of moist air; physics of aerosols; condensation of water vapour on aerosols; cloud physics. 1D and 3D climate models, applications, global warming

PHYS 465: Physics of Telecommunications
Network theorems, Circuit theory, Transmission lines, Attenuators and filters, Low and high frequencies amplifiers, Oscillator circuits; Modulation, demodulation, and detection circuits, Noise, Transmission of information, Microphones and sound reproducers, Telephony, High frequency transmission lines and waveguides, Ultra-high frequency devices, Wave propagation and aerials, Radio transmission systems, Microwaves and laser, Fiber optics

PHYS 466: Physics at the Nanoscale
Carbon Nanotubes: Carbon allotropes; Synthesis and production techniques of carbon nanotubes
Physical properties of carbon nanotubes; Functionalisation, dispersion, separation, and characterisation of carbon nanotubes; Applications: Polymer- and metal- composites, X-ray tubes, Field emission displays (FED), transistors, sensors, etc.; Safety and risk
Nanocrystals: Classification; Types of nanocrystals; Wide-band gap semiconductor nanocrystals
Modification of physical properties from bulk crystal to nanocrystal; Methods of preparation
Hybrid materials; Applications – sensors, photovoltaics, luminescent devices, electronics, lasers
Theory: Quasiparticles: electrons, holes, excitons; Basic theoretical methods: effective mass approximation, adiabatic approximation, tight-binding approach; Electron states in confined dimensions; weak confinement, strong confinement.

PHYS 468: Introduction to Cosmology and Astrophysics
Modern view of the Universe, Astronomical nomenclature and conventions, Order of magnitude reasoning, Stars and Stellar evolution, Galaxies and Large-Scale structures. Relativistic Astrophysics and Cosmology.

DEPARTMENT OF PSYCHOLOGY

The Department of Psychology was established in 1967 under the Faculty of Social Studies. It has trained and continues to train hundreds of young men and women at both undergraduate and postgraduate level and provides services to other departments such as Social Work, Medicine, Public Health and Pharmacy. It is one of the largest Departments in the University in terms of student numbers, with over three thousand, five hundred (3,500) students even though it is housed in a very small temporary structure. Despite these constraints, the Department continues to work towards its long term mission and is becoming a centre of excellence. Three attractive professional programs namely, Clinical, Industrial and Organizational and social Psychology are presently offered at the postgraduate level. The department currently has two professors, one associate professor, four senior lecturers and ten lecturers on its teaching staff.

FACULTY

Charity S. Akotia *BA (Ghana) MA (Laurier) PhD (Gh)*	-	Senior Lecturer/Head
Samuel A. Danquah *BSc MSc (McGill) PhD (Wales)*	-	Professor
Christopher C. Mate-Kole	-	Professor
J.Y. Opoku *BSc (Ghana) PhD (Aberd)*	-	Associate Professor
Adjepong Afrifa *BSc (Ghana) MA MPhil PhD (Col)*	-	Senior Lecturer
Robert Akuamoah-Boateng *BA (Ghana) MA (NY) PhD (Cantab)*	-	Senior Lecturer
Benjamin Amponsah *BA (Ghana) M.Phil, PhD (NTNU)*	-	Senior Lecturer
Samuel Atindanbila *BA PCE (UCC) M.Phil (Ghana) PhD(Gh)*	-	Lecturer
Charles B. Wiafe-Akenteng *BA MPhil (Ghana)*	-	Lecturer
Adote Anum *BA MPhil (Ghana), PhD (Brock)*	-	Lecturer
Mawell A. Asumeng *BA MPhil (Ghana) PhD(Surrey)*	-	Lecturer
Margaret Amankwah-Poku *BA MPhil (Ghana)*	-	Lecturer
Joseph Osafo *BA MPhil (Ghana)*	-	Lecturer
Angela A. Gyasi-Gyamerah *BA MPhil (Ghana)*	-	Lecturer
Inusah Abdul-Nasiru *BA MPhil (Ghana)*	-	Lecturer
Annabella Opare-Henaku *BA (Ghana) MPhil (Bergen)*	-	Lecturer
Stephen Kumaku *BA MPhil (Ghana)*	-	Lecturer

PROGRAMME STRUCTURE

LEVEL 100
First Semester

COURSE CODE	COURSE TITLE	CREDIT
*UGRC 110	Academic Writing 1	3
*UGRC 120	Numeracy Skills	3
*UGRC 130	Science and Technology in our Lives	3
*UGRC 150	Critical Thinking and Practical Reasoning	3
PSYC 101	Elements of Psychology	3
OTHER SUBJECTS	2 Courses from 2 other assigned Departments	6
	Minimum Credits Required	**15**

Note: Students to choose any 2 courses (6 credits) of the UGRC

Second Semester

COURSE CODE	COURSE TITLE	CREDIT
*UGRC 110	Academic Writing 1	3
*UGRC 120	Numeracy Skills	3
*UGRC 130	Science and Technology in our Lives	3
*UGRC 150	Critical Thinking and Practical Reasoning	3
PSYC 102	Psychology for Everyday Living	3
OTHER SUBJECTS	2 Courses from 2 other assigned Departments	6
	Minimum Credits Required	**15**

Note: Students to choose any 2 courses (6 credits) of the UGRC

LEVEL 200
First Semester

COURSE CODE	COURSE TITLE	CREDIT
*UGRC 210	Academic Writing II	3
*UGRC 220	Liberal and African Studies	3
PSYC 211	Introduction to General Psychology	3
PSYC 223	Biological Psychology	3
OTHER SUBJECTS	2 Courses from 2 other assigned Departments	6
	Minimum Credits Required	**15**

Second Semester

COURSE CODE	COURSE TITLE	CREDIT
*UGRC 210	Numeracy/Liberal and African Studies	3
*UGRC 220	Liberal and African Studies	
PSYC 222	Motivation and Emotion	3
PSYC 224	Introduction of Experimental Psychology	3
OTHER SUBJECTS	2 Courses from 2 other assigned Departments	6
	Minimum Credits Required	**15**

*Note: Students to choose UGRC 210 or UGRC220 (3 credits).

LEVEL 300 COURSES

A Psychology Major student will take 3 Core courses and at least 1 elective course for each semester.
A **Combined Psychology student** is required to take 3 Core courses in the year (including PSYC 331 and PSYC 334 and at least two elective courses in a year (15 credits).
A **Minor Psychology student** is required to take any two electives courses, one for each semester.

Level 300 Majors

First Semester

COURSE CODE	Core Courses (9 credits)	CREDIT
PSYC 331	Statistics for Psychologists	3
PSYC 333	Psychology of Personality	3
PSYC 335	Developmental Psychology I	3
	Any ONE elective Course (3 credits)	
PSYC 337	Learning	3
OTHER SUBJECT	Any ONE Course from the other assigned Department	3
	Minimum Credits Required	**15**

Second Semester

COURSE CODE	Core Courses (6 credits)	CREDIT
PSYC 332	Cognitive Psychology I	3
PSYC 334	Research Methods in Psychology	3
	Any Two elective Course (3 credits)	
PSYC 336	Developmental Psychology II	3
PSYC 338	Abnormal Behaviour	3
PSYC 342	Psychological Tests and Measurement	3
OTHER SUBJECT	**Any ONE Course from the other assigned Department**	3
	Minimum Credits Required	**15**

Level 400 courses

A **Psychology Major student** is required to take 4 Core courses (9 credits) and at least two electives in the first semester.
Research Project (PSYC 490) is a Core for major students, which covers two semester work. In addition to the long essay, one core and at least two electives must be taken in the second semester.
A **Combined Psychology student** should take a total of 3 core courses in the year and at least two electives (15 credits).

First Semester

COURSE CODE	Core Courses	CREDIT
PSYC 441	Cognitive Psychology II	3
PSYC 443	Social Psychology	3
PSYC 449	Practicals in Cognition II	2
PSYC 491	Research Seminar	1
	Elective Courses	
PSYC 445	Clinical Psychology	3
PSYC 447	Education Psychology	3
PSYC 451	Guidance and Counselling	3
PSYC 453	Psychology of Religion	3
PSYC 455	Introduction to Neuropsychology	3
PSYC 457	Industrial Psychology	3
PSYC 459	Military Psychology	3
PSYC 461	Atypical Behaviour	3
PSYC 463	Health Psychology	3
	Minimum Credits Required	**15**

Second Semester

COURSE CODE	Core Courses	CREDIT
PSYC 490	Research Project	6
PSYC 444	Psychology and National Development	3
	Elective Courses	
PSYC 446	Comparative Psychology	3
PSYC 448	Community Psychology	3
PSYC 452	Environmental Psychology	3
PSYC 454	Applied Social Psychology	3
PSYC 456	Organizational Psychology	3
PSYC 458	Sports Psychology	3
PSYC 464	Psycholinguistics	3
PSYC 462	Political Psychology	3
	Minimum Credits Required	**15**

COURSE DESCRIPTIONS

PSYC 101 Elements of Psychology
This course is designed to introduce students to the history, basic theories, research methods and principles of Psychology. It is aimed at laying the foundation for higher level courses in Psychology. At the end of the course, it is expected that students will have basic knowledge of some psychological theories and principles underlying behaviour and also be in the position to relate what they have learnt to issues of everyday life.

PSYC 102 Psychology for Everyday Living
This course deals primarily with issues of everyday life. It employs psychological principles, theories and research findings in an attempt to explain and understand matters of everyday life. Its main objective is to demonstrate the relevance and applicability of psychology in the daily life of the individual and thus draw links between what students learn in the lecture halls and what they experience in real life. Specific topics to be covered include motivation and goal setting, community and diversity, assertiveness and leadership, problem solving and creativity.

LEVEL 200 COURSES
First Semester
PSYC 201 Introduction to General Psychology
This course is designed to introduce students to Psychology as a discipline and a profession. The emphasis is on the history of psychology, the different orientations available in the field and the basics of research in psychology. The course will also look at two interesting areas in psychology namely, intelligence and social Behaviour. By the end of this course, students should know what psychology is, why it is important for them to study psychology and be adequately prepared for building up on their knowledge in higher levels of their study in psychology.

PSYC 203 Biological Psychology
This course examines the neurobiological bases of behaviour. The course will cover the nature of neurons and neuronal communication, the translation of the external world into internal perceptions (vision, hearing, touch, etc.) and the role of the nervous system in the cognition skills of thinking, learning, memory, and language.

Second Semester
PSYC 202 Motivation and Emotion
This course is intended to introduce students to motivational causes of behaviour and the emotions experienced. Understanding motivation and emotion is fundamental to understanding human behaviour. Emphasis will be placed on the theories, sources and types of motivation and emotion. At the end of the course, students should be able to understand motivational causes of behaviour and the expression of emotions.

PSYC 204 Introduction to Experimental Psychology
This course is designed to introduce students to the general principles of experimental research method. Emphasis will be placed on design, control of extraneous variables and ethics governing psychological research. At the end of the course, it is expected that students will be able to design simple experiment, identify flaws in basic design and control for extraneous variables.

LEVEL 300
First Semester
PSYC 331 Statistics for Psychologists
This course deals with statistics and the behavioural sciences. It delves into descriptive and inferential statistics, populations, samples, parameters, etc. furthermore, the concept of variability, strategy of inferential statistics, the normal curve and inferences about the means of two populations will also be discussed. One way analysis of variance, two way analysis of variance, parametric and non-parametric methods, chi square, Kruskal–Wallis H test, the Wilcoxon test and the rank-sum test will also be taught.

PSYC 333 Psychology of Personality
The course emphasizes the major personality theories, research and measurements of personality. It will explore the foundations of normally functioning individuals as well as problems. The topics will include definitions, psychodynamic, traits, cognitive, phenomenological/existential theories associated with personality development. The effect of folk stories, "Kweku Ananse" stories on personality development will be examined.

PSYC 335 Developmental Psychology I
This course is concerned with understanding and explaining the changes that occur between conception and adolescence. Emphasis is placed on the major changes that occur in the physical, cognitive and the psychosocial domains and their implications for parents, educators, and helping professionals.

***PSYC 337 Learning**
This course basically deals with the psychology of learning and its application to everyday life situations. It covers the various types of learning (e.g. Pavlovian, Instrumental, observational and verbal learning). Specific topics that are taught include: reasons for using animals in research in learning, elements/features of classical and instrumental conditioning, use of reinforcement and punishment, learning principles and behaviour change. Others are cognitive learning, observational learning and various types of verbal learning. At the end of the course, students should be able to apply learning principles to their own life situations as well as that of others around them.
*The course has a compulsory practical component.

Second Semester
***PSYC 332 Cognitive Psychology I**
This course is to provide a survey of selected problem areas in cognitive psychology with emphasis on memory. Both experimental work and theoretical accounts of memory will be covered. Topics include structural and processing accounts of memory – how people acquire, store, transform, retrieve and communicate information.
*The course has a compulsory practical component.

PSYC 334 Research Methods in Psychology
The course is intended to provide the student with basic skills needed to conduct psychological research, develop critical thinking skills regarding research and gain the capacity to design and conduct research as well as writing research reports. Topics include an overview of the scientific approach to knowledge, definitions of basic concepts, types of scientific research, design, sampling, questionnaire construction, interviews and report writing.

PSYC 338 Abnormal Psychology
This course is designed to introduce students to the psychology of abnormal behaviour. It explores the history, definitions and current status of abnormal behaviour. The topics include the five paradigms or theoretical models of psychodynamic trait, phenomenological, cognitive and behavioural approached to abnormal behaviour. It will examine research, abnormal patterns of functioning and methods of treatment.

PSYC 336 Developmental Psychology II
This course examines basic themes in life-span development: the concept of adulthood, physical development including changes in sense organs, cardiovascular organs, sex, reproductive organs and their psychological consequences. Others are health, vitality and diseases, the process of ageing, cognitive and psychosocial development during adulthood, retirement and widowhood, culture and aging.

PSYC 342 Psychological Tests and Measurements
This course of study is designed to expose students to the basic conceptual, theoretical, technical and methodological principles in the development, administration and interpretation of psychological measurements. It is essential that students who intend to offer this course have good background in Basic Statistics and/or Statistics for psychologist.

LEVEL 400
First Semester
PSYC 490 Research Project
This course is research based and runs through the first semester to the second semester. Students are expected to select a topic of their own, conduct an empirical study on it, write a research report and submit to the Department.

PSYC 441 Cognitive Psychology II
The course builds up on Cognitive Psychology I and aims to acquaint the student with important theoretical principles and findings in cognitive psychology along with the methods by which this knowledge is acquired. Some of the areas of interest are sensation and perception, attention, visual imagery, thinking and reasoning, decision-making, problem solving, language and comprehension, individual and gender differences in cognition etc. Application of cognitive psychology to real-world settings and implications will be emphasised.

PSYC 443 Social Psychology
This course focuses on the study of the social dimensions of human behaviour. Unlike other domains of psychology that focus mainly on the individual as the unit of analysis, social psychology examines behaviour in its social context. Students will be introduced to the main theories, research methods and major research findings in social psychology. Emphasis will also be placed on key concepts such as attribution, cognition, attitudes, social influence and many more. At the end of this course, students should be able to demonstrate an understanding of the basic principles of social influences on behaviour.

PSYC 449 Practicals in Cognition II
This course is the practical component of PSYC 401, and is compulsory for all students offering PSYC 401. Students are expected to participate in experiments based on the theories learned in PSYC 401 after which they submit a research report.

PSYC 445 Clinical Psychology

This is an introductory course designed for level 400 students. The course focuses on a thorough survey of the field, which does not go into all the details typically found in "graduate study only". The topics explore the history of clinical psychology, including Ghanaian development of the field, its scope, functions and future perspective. The course also covers the latest developments in clinical research and techniques in health psychology, behaviour medicine, psychopathology and mental health.

PSYC 447 Educational Psychology

This course is designed to give insight into the problems of teaching and learning and to develop the necessary professional skills and competencies for prospective educationist/teachers to enable them effectively understand, predict and control the behaviour of learners in the educational process. To this end, the course should more importantly be perceived as an area of applied psychology rather than a unique subject matter.

PSYC 451 Guidance and Counselling

This course is designed to provide an insight into guidance and counseling. Specific topics to be covered include the historical development of guidance and counseling, the counseling process, techniques of counseling, the therapeutic relationship, theory and practice of counseling, special problems in counseling and ethical issues in counseling.

PSYC 453: Psychology of Religion

Psychology of religion deals with the application of psychological principles, theories and methods of research in studying religious behaviour, religious cognition, religious motivation, the role of religion in human life. The course draws on the contributions of other fields of psychology and focuses on the attitudes, values and experiences of people and their relationship with the supernatural. Topics to be covered include the emergence of psychology of religion, approaches to the study of psychology of religion, religious experience, religion and morality, and religion, coping and adjustment and functions of religion in adult life.

PSYC 455 Introduction to Neuropsychology

This is a course that will introduce students to a general overview of the anatomy of the brain (both cortical and subcortical). The course is also designed to help students understand the functions of the structures of the brain with respect to human behaviour and diseases that are brain-related. The course will be in two parts. The first part is an overview of selected brain functions (e.g. perception, language, memory, attention, sensory/motor control, executive functions) in both normal functioning and brain damage syndromes. The second part of the course will review clinical assessment and rehabilitation issues.

PSYC 457 Industrial Psychology

This course is made up of Personnel Psychology and Engineering Psychology. It deals with how psychological principles, theories, concepts and methods are applied to shape individuals for effective job Performance and to also design work, work environments, tools, machines and equipments to match human abilities and limitations. Some of the areas covered in this course are; Job Analysis, Personnel Selection, Training and Development human resource, Job evaluation, Job Design work schedules, Human Factors Engineering characteristics of the work environment, Employee Health, Safety and Accidents at the workplace.

PSYC 459: Military Psychology
This course deals with selected topical issues in the military. These include leadership and group dynamics (unit identity, unit cohesion, morale and heroism), stress and combat performance, combat stress behaviours, combat misconduct stress behaviours, battle fatigue and post-traumatic stress disorders.

PSYC 461: Atypical Development
This course deals with children's abnormalities in the general context of human development. Topics to be covered include mental retardation, social isolation syndromes, infantile autism, minimal brain dysfunction, childhood and adolescent schizophrenia, school phobia truancy, learning disabilities, academic underachievement and delinquent behaviour.

PSYC 463 Health Psychology
Health psychology focuses on the role played by psychological factors in the cause, development and consequences of health and illnesses. The objectives of this course are to expose students to some of the major theoretical and intervention issues in health/illness behaviours. The course will be based on a national health perspective, with the main emphasis on behavioural risk factors which constitute the main health problems in Ghana. Topics to be covered include stress and coping, HIV/AIDS, lifestyle diseases in Ghana and disease prevention and health promotion.

PSYC 491 Research Seminar
This course is for students who are offering PSYC 410 (Research Project). They are expected to verbally present their research proposals prior to going to the field for data gathering.

Second Semester
PSYC 446 Comparative Psychology
Comparative psychologists study differences and similarities in the behaviour of animals of different species. The discipline pays particular attention to the psychological nature of humans in comparison with other animals. At the heart of this perspective is the notion that human beings, like other animals, have an evolutionary history that predisposes them to behave in ways that are uniquely adaptive for survival and reproduction. One of the aims of comparative psychology is to use insights gained from the study of psychological processes in different species of animals to add to our understanding of human psychology. Any way of achieving this aim must depend, to some extent, on understanding the evolutionary relationship between animals and man.

PSYC 448 Community Psychology
This course is designed to help students develop a conceptual and pragmatic understanding of various issues and topics in community psychology. It introduces students specifically to the principles/philosophies of community psychology, community research and program evaluation, types and models of prevention, stress, coping and social support, psychological sense of community and reasons and strategies for social change. At the end of the course, students should be empowered to apply the principles/models of community psychology to social/community problems and to provide appropriate interventions.

PSYC 452 Environmental Psychology
This course aims at exploring the relationship between psychology and the environment with particular emphasis on how the latter influences human behaviour. The course, which is a seminar type, will take a critical look at the natural, the built as well as the psychological environment and how they influence behaviour. The course is thus aimed at creating awareness among students on the effects (with particular attention on the adverse one) the environment has over the quality of

life and how to reduce and/or manage them. At the end of the course, it is expected that students should be able to identify environmental hazards and critically assess the effects of these hazards and how to control or manage them.

PSYC 444 Psychology and National Development

This course is designed to help students understand how psychology can be applied in various areas of national endeavours. The course will treat topics such as introduction to Psychology and National Development, Economic Psychology, Psychology and Health, Psychology and Entrepreneurship, Attitude and Attitude change, Sports Psychology, Psychology and Politics, Psychology and Law, Psychology and Crime Prevention, Psychology and Poverty alleviation.

PSYC 454 Applied Social Psychology

This course will examine how the theories and principles of social psychology can be applied to major issues affecting contemporary societies. Topics to be covered include intergroup conflicts and their management, the role of social psychology in the clinic and in politics and in the courtroom, and determinants of helping behaviour. Topical issues such as attitudes regarding sanitation and health will also be discussed. The course will be an interactive one, providing a forum to share ideas and discuss the strategies that students will develop based on the theories of social psychology.

PSYC 456 Organizational Psychology

This course deals with the application of psychological concepts, theories, methods and ideas to problem of organizations. The course is made up of organizational theory and organizational behaviour. Topics treated include: the nature of organizations, organizational structure, design of effective organizations, organizational development, organizational climate and culture, organizational change, organizational decline, organizational learning, group processes in organizations, employees work attitudes and motivation, communication in organization, conflicts in organizations and organizational commitment.

PSYC 458: Sports Psychology

This course focuses on the psychological and mental factors that relate to participation and performance in sport, exercise and physical activity and how these may improve personal development and well-being throughout the life span. Topics to be covered include an introduction to sports psychology, motivation and self-confidence in sports, aggression and violence in sports, leadership, cohesion and audience effects, relationships in sports and life skill training and transitions in sport.

PSYC 462: Political Psychology

The course examines the psychological factors that explain political behaviour. Theories and researches in both Psychology and Political Science will be examined. Other relevant topics include personality approaches to understanding political leaders and voters, the role of socialization in the formation of political preferences, how voters process political information, form impressions of political candidates and make voting decisions. The role of stereotypes and how they affect the candidate evaluation process, the uses (and abuses) of persuasion in politics, the role of the mass media in politics, the effects of political advertising, attack campaigning, the role of the media in dictating how the public thinks and the role of women and minorities in politics will be discussed.

PSYC 464 Introduction to Psycholinguistics
This course introduces students to the nature of language, the various processes that underlie comprehension and how we produce and acquire language. Specific topics to be covered include comprehension and utilization of sentences, language production, the representation of meaning, language and thought and second language learning and bilingualism.

DEPARTMENT OF STATISTICS

INTRODUCTION

The basic qualification for admission into Level 200-400 programmes is a pass with at least Grade C in Level 100 courses in Mathematics and Statistics, that is, in MATH 121 Algebra and Trigonometry, MATH 122 Calculus I, STAT 111 Introduction to Statistics and STAT 112 Elementary Probability. Probability is the foundation of Statistics and every Statistics course in the programmes that the Department offers has an element of probability in it. The Department runs Single Major (3:2:1:1), Major-Minor (3:2:2:1) and Combined (3:2:2:2) programmes in Statistics**.** At 100 Level there are two 3 credit courses that are mandatory for all students who want to progress to Level 200 with Statistics: MATH 121 Algebra and Trigonometry and MATH 122 Calculus I. To progress to Level 200 Statistics, candidates are required to pass these Level 100 courses.

The Social Science and the Science students who opt for any of the programmes on offer in Statistics will attend lectures together and take the same examination papers. Some minimum level of University Mathematics (Level 100 at least) is required for a good understanding of the Probability courses (STAT 112 Elementary Probability, STAT 221 Introductory Probability I, STAT 224 Introductory Probability II, STAT 331 Probability Distributions, STAT 332 Multivariate Distributions), which are crucial to the Philosophy and Objectives of the Department, namely, to focus our Learning and Training Activities on the logic and principles that should guide rational decision making in conditions of uncertainty. This Philosophy equips our students with skills that all employers consider desirable.

FACULTY

E. N. N. Nortey *BA MPhil (Ghana) PhD (Ghana)*	-	Lecturer/ **Head of Dept**
Marjorie E. Danso-Manu *BA (Ghana) MSc (Lond) PhD (Ghana)*	-	Senior Lecturer
F. O. Mettle *BSc MPhil (Ghana) PhD (Ghana)*	-	Lecturer
I. Baidoo *BS (UMASS) MS PhD (Arizona)*	-	Lecturer
A.Lotsi *BSc (Ghana) MSc (Kaiserslautern)*	-	Lecturer
K. Doku-Amponsah *BA (Ghana) MSc (Kaiserslautern) Ph.D (Bath)*	-	Lecturer
R. Minkah *BSc(Ghana) MSc (Uppsala)*	-	Lecturer

I. G. Akar *MSc (Ghana) MSc PhD (SUNY)*	-	Part–time Lecturer
S. A. Yeboah *BSc (Ghana) MSc FSS (UK)*	-	Part-Time Lecturer
E. Amartey-Vondee *BSc (Ghana) MSc Csat (UK)*	-	Part-Time Lecturer
E. Okyere *BSc (Ghana)MSc(Bangor)MSc, PhD (Gottingen)*	-	Part-Time Lecturer
J. B. Dasah *BSc (Ghana) MSc(Vermont),PhD (NCSU)*	-	Part-Time Lecturer

PROGRAMME STRUCTURE

LEVEL 100 FIRST SEMESTER

Course Code	Course Title	Credits
*UGRC 110	Academic Writing 1	3
* UGRC 130	Science and Technology in our Lives	3
* UGRC 150	Critical Thinking and Practical Reasoning	3
*UGRC 160	Introduction to Literature	3
STAT 111	Introduction to Statistics	3
	2 Courses from 2 other assigned Departments	6
	MINIMUM CREDITS REQUIRED	**15**

*Note: Students to choose any 2 courses (6 credits) of the UGRC

SECOND SEMESTER

Course Code	Course Title	Credits
*UGRC 110	Academic Writing 1	3
* UGRC 130	Science and Technology in our Lives	3
* UGRC 150	Critical Thinking and Practical Reasoning	3
* UGRC 160	Introduction to Literature	3
STAT 112	Elementary Probability	3
	2 Courses from 2 other assigned Departments	6
	MINIMUM CREDITS REQUIRED	**15**

*Note: Students to choose any 2 courses (6 credits) of the UGRC

SINGLE MAJOR IN STATISTICS

LEVEL 200

FIRST SEMESTER

Core

Course Code	Course Titles	Credits
UGRC 210/220	Academic Writing II/Introduction to African Studies	3
STAT 221	Introductory Probability I	3
STAT 223	Elementary Statistical Methods	3
MATH 223	Calculus II	3
MATH 221	Algebra	3
Total		**15**

*Note: Students to choose 1 UGRC course

SECOND SEMESTER

Core

Course Code	Course Title	Credits
UGRC 210/ 220	Academic Writing II/ Introduction to African Studies	3
STAT 222	Data Analysis I	2
STAT 224	Introductory Probability II	3
STAT 226	Official Statistics	2
Total		**10**

LEVEL 300
FIRST SEMESTER

Core

Course Code	Course Title	Credits
STAT 331	Probability Distributions	3
STAT 333	Statistical Methods I	3
STAT 335	Sample Survey Methods	3
MATH 331	Linear Algebra	3
Total		**12**
Electives (Select 3-6 credits)		
MATH 333	Analysis I	3
MATH 353	Calculus III	3
MATH 355	Discrete Mathematics	3

SECOND SEMESTER

Core

Course Code	Course Title	Credits
STAT 332	Multivariate Distributions	3
STAT 334	Statistical Methods	3
STAT 336	Design of Experiments	3
STAT 350	Differential Equations I	3
Total		**12**
Electives (Select 3-6 credits)		
MATH 334	Analysis II	3
CSCD 304	Design and Analysis of Algorithms	3
CSCD 312	Operating Systems	3

LEVEL 400

FIRST SEMESTER

Core

Course Code	Course Title	Credits
STAT 443	Theory of Sampling	3
STAT 445	Regression Analysis	3
STAT 450	Project	3
Total		**9**
Electives (Select 6-9 credits)		
STAT 441	Statistical Inference: Estimation	3
STAT 447	Non-Parametric Statistics	3
STAT 451	Introduction to Stochastic Processes	3
STAT 313	Population Statistics	3
STAT 455	Actuarial Statistics I	3
STAT 457	Economic and Social Statistics I	3
STAT 440	Data Analysis II	3
MATH 421	Advanced Calculus	3
MATH 435	Introductory Functional Analysis Econometrics	3

SECOND SEMESTER

Core

Course Code	Course Title	Credits
STAT 444	Survey Organization and Management	3
STAT 450	Project Work	3
Total		**6**
Electives (Select 9 credits)		
STAT 442	Statistical Inference: Tests of Hypothesis	3
STAT 444	Survey Organization and Management	3
STAT 446	Multivariate Methods	3
STAT 448	Analysis of Experimental Designs	3
STAT 456	Actuarial Statistics II	3
STAT 458	Economic and Social Statistics II	3
MATH 422	Integration Theory and Measure	3
MATH 442	Differential Equation II	3

MAJOR-MINOR IN STATISTICS
LEVEL 200
FIRST SEMESTER
Core

Course Code	Course Title	Credits
UGRC 210/220	Academic Writing II/Introduction to African Studies	3
STAT 221	Introductory Probability I	3
STAT 223	Elementary Statistical Methods	3
Total		**9**

*Note: Students to choose 1 UGRC course

SECOND SEMESTER
Core

Course Code	Course Title	Credits
UGRC 210/220	Academic Writing II/ African Studies	3
STAT 222	Data Analysis I	2
STAT 224	Introductory Probability II	3
STAT 226	Official Statistics	2
Total		**10**

*Note: Students to choose 1 UGRC course

LEVEL 300
FIRST SEMESTER
Core

Course Code	Course Title	Credits
STAT 331	Probability Distributions	3
STAT 333	Statistical Methods I	3
STAT 335	Sample Survey Methods	3
Total		**9**

SECOND SEMESTER
Core

Course Code	Course Title	Credits
STAT 332	Multivariate Distributions	3
STAT 334	Statistical Methods II	3
STAT 336	Design of Experiments	3
Total		**9**

LEVEL 400
FIRST SEMESTER

Core

Course Code	Course Title	Credits
STAT 443	Theory of Sampling	3
STAT 445	Regression Analysis	3
STAT 450	Project	3
Total		**9**
Electives (Select 6-9 credits)		
STAT 441	Statistical Inference Estimation	3
STAT 447	Non-Parametric Statistics	3
STAT 451	Introduction to Stochastic Processes	3
STAT 453	Population Statistics	3
STAT 455	Actuarial Statistics I	3
STAT 457	Economic and Social Statistics I	3
STAT 440	Data Analysis II	3

SECOND SEMESTER
Core

Course Code	Course Title	Credits
STAT 444	Survey Organization and Management	3
STAT 450	Project	3
Total		**6**
Electives (Select 9 credits)		
STAT 442	Statistical Inference: Tests of Hypothesis	3
STAT 446	Multivariate Methods	3
STAT 448	Analysis of Experimental Designs	3
STAT 454	Biometrics	3
STAT 456	Actuarial Statistics II	3
STAT 458	Economic and Social Statistics II	3

COMBINED MAJOR IN STATISTICS

LEVEL 200
FIRST SEMESTER
Core

Course Code	Course Title	Credits
UGRC 210/220	Academic Writing II/Introduction to African Studies	3
STAT 221	Introductory Probability I	3
STAT 223	Elementary Statistical Methods	3
Total		**9**

*Note: Students to choose 1 UGRC course

SECOND SEMESTER
Core

Course Code	Course Title	Credits
UGRC 210/220	Academic Writing II/ African Studies	3
STAT 222	Data Analysis I	2
STAT 224	Introductory Probability II	3
STAT 226	Official Statistics	2
Total		**10**

*Note: Students to choose 1 UGRC course

LEVEL 300
FIRST SEMESTER
Core

Course Code	Course Title	Credits
STAT 331	Probability Distributions	3
STAT 333	Statistical Methods I	3
STAT 335	Sample Survey Methods	3
Total		**9**

SECOND SEMESTER
Core

Course Code	Course Title	Credits
STAT 332	Multivariate Distributions	3
STAT 334	Statistical Methods II	3
STAT 336	Design of Experiments	3
Total		9

LEVEL 400

FIRST SEMESTER

Core

Course Code	Course Title	Credits
STAT 443	Theory of Sampling	3
STAT 445	Regression Analysis	3
Total		**6**
Electives (Select 3-6 credits)		
STAT 441	Statistical Inference Estimation	3
STAT 447	Non-Parametric Statistics	3
STAT 450	Project	3
STAT 451	Introduction to Stochastic Processes	3
STAT 453	Population Statistics	3
STAT 455	Actuarial Statistics I	3
STAT 457	Economic and Social Statistics I	3
STAT 440	Data Analysis II	3

SECOND SEMESTER

Course Code	Course Title	Credits
Electives (Select 9 credits)		
STAT 442	Statistical Inference: Tests of Hypothesis	3
STAT 444	Survey Organization and Management	3
STAT 446	Multivariate Methods	3
STAT 448	Analysis of Experimental Designs	3
STAT 450	Project	3
STAT 454	Biometrics	3
STAT 456	Actuarial Statistics II	3
STAT 458	Economic and Social Statistics II	3
Total		**9**

MINOR IN STATISTICS

LEVEL 200
FIRST SEMESTER
Core

Course Code	Course Title	Credits
UGRC 210/220	Academic Writing II/Introduction to African Studies	3
STAT 221	Introductory Probability I	3
STAT 223	Elementary Statistical Methods	3
Total		**9**

*Note: Students to choose 1 UGRC course

SECOND SEMESTER
Core

Course Code	Course Title	Credits
UGRC 210/220	Academic Writing II/ African Studies	3
STAT 222	Data Analysis I	2
STAT 224	Introductory Probability II	3
STAT 226	Official Statistics	2
Total		**10**

*Note: Students to choose 1 UGRC course

LEVEL 300
FIRST SEMESTER
Core

Course Code	Course Title	Credits
STAT 333	Statistical Methods I	3
STAT 335	Sample Survey Methods	3
Total		6

SECOND SEMESTER
Core

Course Code	Course Title	Credits
STAT 334	Statistical Methods II	3
STAT 336	Design of Experiments	3
Total		6

COURSE DESCRIPTIONS

STAT 111: Introduction to Statistics
Introduction to Statistics. The reduction and interpretation of data.

STAT 112: Elementary Probability
Introduction to basic concepts of Probability, Random event and Random variables. Probability Calculus and some univariate probability distributions.

STAT 221: Introductory Probability I (Pre-req. MATH 121, 122)
Introduction to the concepts of probability, Random Events, and Random Variables. The Probability Calculus, Univariate probability distributions.

STAT 222: Data Analysis I (Pre-Req. STAT 223)
The aim of this course is to give students practice in handling Large data Sets; specifically to provide opportunities for Descriptive and Exploratory Studies.

STAT 223: Elementary Statistical Methods
Bivariate Data Analysis. Time Series and Elements of statistical inference.

STAT 224: Introductory Probability II (Pre-Req. STAT 221)
Bivariate Distributions. Moment Generating Functions; their properties and uses. Sampling distributions. Distributions associated with samples from a Normal population. The Weak Law of Large Numbers and the Central Limit Theorem. Applications.

STAT 226: Official Statistics
Purposes and Scope of Official Statistics. Structure and Work of the National Statistical System. Organisational, Methods and Practices of data collection and dissemination.

STAT 331: Probability Distributions (Pre-req. STAT 221, 204)
Elementary Distribution Theory. Generating Functions. Sequences of random variables; the Central Limit Theorem and its applications.

STAT 332: Multivariate Distributions (Pre-req. STAT 331)
Introduction to Vector Random Variables. Distribution Concepts for Several random variables. Transformations of random vectors. Order Statistics. The multivariate Normal Distribution.

STAT 333: Statistical Methods I (Pre-req. STAT 224)
The first part of a two-semester Course providing a systematic development of the principles and methods of statistical inference, on a largely intuitive basis, with a minimum of mathematical theory. This part deals with the general nature of Statistical Problems, Statistical Models and Problems of Estimation.

STAT 334: Statistical Methods II (Pre-req. STAT 333)
Sequel to STAT 333. General Principles and Procedures of Hypothesis Testing. Parametric and Non-parametric Tests. Simple Linear Regression and Correlation Analysis. The Analysis of Frequency Data.

STAT 335: Sample Survey Methods
Basic Sample Survey procedures and Sample Designs. Estimation of population parameters. Sampling and Non-Sampling Errors.

STAT 336: Design of Experiments (Pre-req. STAT 223)
Basic concepts and principles of experimental Statistics. Analysis of Variance for standard experimental designs. The estimation of treatment Effects.

STAT 440: Data Analysis II (Pre-req. STAT 222, 203)
Summary Statistics for Multivariate Data. Data Presentation and Report Writing. Random Sample Selection. Discrete Analysis. Fitting and Testing Probability Models. Regression and Curve Fitting. Analysis of Experimental Data.

STAT 441: Statistical Inference: Estimation (Pre-req. STAT 331, 303)
The Theoretical basis of the methods of Point and Interval Estimation. Uniformly Minimum Variance Unbiased (UMVU) Estimation, and Maximum Likelihood Estimation.

STAT 442: Statistical Inference: Tests of Hypotheses (Pre-req. STAT 331, 304)
The Theory of Hypothesis Testing. Optimal tests. Uniformly Most Powerful Test. Likelihood Ratio and related procedures.

STAT 443: Theory of Sampling (Pre-req. STAT 224)
Analysis and comparison of various sampling schemes. Optimal designs.

STAT 444: Survey Organisation and Management (Pre-req. STAT 335)
Multi-subject and specialized Socio-Economic Surveys. Household Survey. Planning, Design and Organisation. Error Control. Problems relating to Concepts, Definitions, Classification and Measurement.

STAT 445: Regression Analysis (Pre-req. STAT 334)
The methods of regression analysis extended to situations involving more than one predictor variable. Special emphasis on problems associated with the presence of several predictors.

STAT 446: Multivariate Methods (Pre-req. STAT 332)
Introduction to theory and methods of Multivariate Data Analysis; Estimation and Tests of Hypotheses, Profile Analysis, Multivariate Structure, Discriminant Analysis.

STAT 447: Non-Parametric Statistics (Pre-req. STAT 333, 304)
Some Single Sample problems; the problem of location, The Sign Test, The wilcoxon signs Ranks test. Some Two-Sample Problems: The Chi-Square Test for Homogeneity, The Median Test, The Mann-Whitney-Wilcoxon Test. Chi-Square Tests of Independence. Some Users of Order Statistics Distributions under alternative Hypotheses.

STAT 448: Analysis of Experimental Designs (Pre-req. STAT 336)
Model specialisation for single-factor and multi-factor designs. Main effects, specific effects and interactions. Estimation. Multiple Comparisons. Analysis of covariance.

STAT 450: Project

This is a yearlong project. Student presents a project on a topical issue in Statistics using tools acquired over the period to solve statistical problems.

STAT 451: Introduction to Stochastic Processes (Pre-req. STAT 331)
Stochastic models in the natural and social sciences. Some discrete and continuous time processes. Basic theory and Applications.

STAT 453: Population Statistics
Demographic Concepts and Measures. Collection and Evaluation of demographic data. Analysis of Demographic data. The Dynamics of Population change.

STAT 454: **Biometrics** (Pre-req. STAT 331)
Biological assay, Analysis of quantal responses. Agricultural and Clinical Trials. Sampling and Estimation of Biological Populations.

STAT 455: **Actuarial Statistics I** (Financial Statistics) (Pre-req. STAT 331)
Principles of time value of money. Concepts of Compound Interest and Discounting. Interest or Discount Rates. Compound Interest Functions. Investment Projects appraisals. Stochastic Interest Rate Models.

STAT 456 : **Actuarial Statistics II** (Pre-req. STAT 455, Recommended STAT 453)
Principles of simple life insurance and annuity contracts. Means and variances of payment under these contracts. Determination of expected present value and variances of benefits. Determination of net premiums and net premium policy values. Survival models.

STAT 457: **Economic and Social Statistics I** (Pre-req. STAT 226)
Statistics on Economic and Social Activities and Trends, and their uses. Methods and Sources of Data Collection. Indices and Indicators of Economic Activity. Indicators of Social Development and Living Standard.

STAT 458: **Economic and Social Statistics II** (Pre-req. STAT 447)
Introduction to the System of National Accounts (SNA). The System, its Accounts and their corresponding economic activities. Input-Output Tables. Social Accounting.

ACADEMIC CALENDAR 2012-2013 ACADEMIC YEAR FIRST SEMESTER	
LEVEL 100 STUDENTS	
Level 100 Students Report	Friday, September 14 – Tuesday September 18, 2012
Level 100 Orientation	Wednesday, September 19 – Saturday, September 22, 2012
Teaching Begins	**Monday, September 24, 2012**
Deadline for Registration	Monday, October 1, 2012
Deadline for Deferment	Friday, October 5, 2012
Matriculation	**Saturday, October 13, 2012**
Students' Evaluation of Lecturers	Monday, November 12 – Friday, November 16, 2012
Teaching Ends	Friday, November 23, 2011
Revision Week	Monday, November 26 – Friday, November 30, 2012
First Semester Examinations	Monday, December 3 – Sunday, December 23, 2012
Inter-Semester Break	**Monday, December 24, 2012 –Friday, January 25, 2013**
Distance Learning Revision/Examinations	Wednesday, December 19, 2012- Monday, January, 21, 2013

ACADEMIC CALENDAR 2012-2013 ACADEMIC YEAR SECOND SEMESTER	
ALL STUDENTS	
Students Report	Friday, January 25 - Monday, January 28, 2013
Teaching Begins	**Monday, January 28, 2013**
Deadline for Registration	Monday, February 4, 2013
Deadline for: Add/Drop of Courses/Deferment	Friday, February 15, 2013
Congregation II Faculties of Arts and Social Sciences, School of Graduate Studies	Saturday, March 9, 2013
Aggrey-Fraser-Guggisberg Memorial Lectures	**Wednesday, March 13- Friday March 15, 2013**
Students' Evaluation of Lecturers	Monday, April 22 – Friday, April 26, 2013
Teaching Ends	Friday, April 26, 2013
Revision Week	Monday, April 29 – Friday, May 3, 2013
Second Semester Examinations	Monday, May 6 – Saturday, May 25, 2013
Second Semester Ends	Saturday, May 25, 2013
Long Vacation	**10 Weeks (Saturday, May 25 – Friday, August 2, 2013)**
Distance Learning Revision/Examinations	Monday, June 24 – Friday, July 26, 2013