SCHOOL OF PHYSICAL AND MATHEMATICAL SCIENCES

INTRODUCTION

The mission of the School 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 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 four programmes namely, Physical Sciences, Mathematical Sciences, Information Technology and Earth Sciences.

The areas of emphasis of the programme are:

- Level 100 students have a wider field from which to select subjects;
- At Level 200 students now more options in the selection of programmes;
- Internship/industrial attachment has been introduced as a course in most programmes;
- Students have the opportunity to take elective courses from other related disciplines;

Highlights of the Programme

1. The Level 100 programmes have been structured in such a way that students are grouped into broad areas where they read/take related subjects. This is to afford the students a broad menu of programmes at Level 200 to choose from, depending on their interest and performance at Level 100.
2. The Computer Science and Information Technology programmes have been structured to enable students from the two programmes to take as many common courses as possible.
3. There is a combined-major programme in Actuarial Science and Mathematics.
4. There is the Geophysics Programme in the Department of Physics.
5. Earth Science students may graduate with any of the following areas of specialization depending on elective courses taken at Level 300 and Level 400:

- Geology
- Applied Geophysics
- Applied Geology

NUMBER OF CREDITS TO BE TAKEN PER SEMESTER

Level 100
15 – 18 credits per Semester including UGRC courses.

Single-Major

Level 200
15 – 18 credits per Semester

Level 300
15 – 18 credits per Semester

Level 400
15 – 18 credits per Semester

Combined-Major

Level 200
18 – 21 credits per Semester (min of 9 credits per Semester from each subject)

Level 300
18 – 21 credits per Semester (min of 9 credits per Semester from each subject)

Level 400
18 – 21 credits per Semester (min of 9 credits per Semester from each subject)

Major-Minor

Level 200
18 – 21 credits per Semester (min of 9 credits per Semester from each subject)

Level 300
18 – 21 credits per Semester (6 credits per Semester from the minor subject)

Level 400
18 – 21 credits per Semester

For practical sessions students will require a white laboratory coat. All students offering computer science will require a laptop.

From Level 200 to 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 departments concerned, indicate their preference for **Single Major**, **Combined Major** or **Major and Minor** degree by the end of Second Semester of Level 100.

UNIVERSITY AND SCHOOL REQUIRED COURSES

In addition, students shall take the following University and School required courses:

- Academic Writing I (at Level 100 for all students)
- Critical Thinking and Practical Reasoning (at Level 100 for all students)
- General Mathematics (at Level 100 for all students). Students offering MATH 121: Algebra and Trigonometry or MATH 123: Vectors and Geometry, are exempted.
- Understanding Human Societies (at Level 100 for all students)
- Introduction to African Studies (at Level 200 for all students)
- Academic Writing II (at Level 200 for all students)

PROGRESSION TO THE NEXT LEVEL

A student shall be deemed to have satisfied the requirements for progression if he/she has:

- Satisfied departmental requirements for entry to subjects at the next level
- 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:

- He/she has passed all University and School required courses
- He/she has passed at least 120 credits
- He/she must not have failed more than 16 credits of core and prescribed electives, provided the failed grades are not lower than Grade E

STRUCTURE OF LEVEL 100 PROGRAMME

PHYSICAL SCIENCES

FIRST SEMESTER

Code	Title	Credits	Pre-requisites
Core			
UGRC		3 - 6	
PHYS 105	Practical Physics I	1	
PHYS 143	Mechanics and Thermal Physics	3	
CHEM 113	Foundation Chemistry I	3	
CHEM 120	General Chemistry Laboratory I	1	
MATH 121	Algebra and Trigonometry	3	
Total		**14-17**	
Electives: Select 3 credits			
DCIT 101	Introduction to Computer Science	3	
EASC 101	Physical Geology	3	
MATH 123	Vectors and Geometry	3	
ABCS 101	Introductory Animal Biology	3	

Students who wish to be considered for Geophysics at Level 200 should take EASC 101

SECOND SEMESTER

Code	Title	Credits	Pre-requisites
Core			
UGRC		3 - 6	
PHYS 106	Practical Physics II	1	
PHYS 144	Electricity and Magnetism	3	
CHEM 114	Foundation Chemistry II	3	
*CHEM 122	General Chemistry Laboratory II	1	
MATH 122	Calculus I	3	
Total		**14-17**	
Electives: Select 3 credits			
DCIT 104	Programming Fundamentals	3	
EASC 104	Historical Geology	2	
EASC 106	Geological Field Excursions	1	
MATH 126	Algebra and Geometry	3	
BOTN 104	Growth of Flowering Plants	3	

Students who wish to be considered for Geophysics at Level 200 should take EASC 104 and EASC 106. CHEM 122 Course is available only for students from SPMS

MATHEMATICAL SCIENCES

FIRST SEMESTER

Code	Title	Credits	Pre-requisites
Core			
UGRC		3 - 6	
MATH 121	Algebra and Trigonometry	3	
MATH 123	Vectors and Geometry	3	
STAT 111	Introduction to Statistics and Probability I	3	
Total		**12-15**	
Electives: Select 3 to 4 credits			
PHYS 105	Practical Physics I	1	
PHYS 143	Mechanics and Thermal Physics	3	
DCIT 101	Introduction to Computer Science	3	
ABCS 101	Introductory Animal Biology	3	
ECON 101	Introduction to Economics I	3	

Students who wish to be considered for a combined programme in Mathematics and Actuarial Science at Level 200 should take ECON 101

SECOND SEMESTER

Code	Title	Credits	Pre-requisites
Core			
UGRC		3 - 6	
MATH 122	Calculus I	3	
MATH 126	Algebra and Geometry	3	
STAT 112	Introduction to Statistics and Probability II	3	
Total		**12-15**	
Electives: Select 3 to 4 credits			
DCIT 104	Programming Fundamentals	3	
PHYS 106	Practical Physics II	1	
PHYS 144	Electricity and Magnetism	3	
ECON 102	Introduction to Economics II	3	
BOTN 104	Growth of Flowering Plants	3	

Students who wish to be considered for a combined programme in Mathematics and Actuarial Science at Level 200 should take ECON 102

EARTH SCIENCES

FIRST SEMESTER

Code	Title	Credits	Pre-requisites
Core			
UGRC		3-6	
PHYS 105	Practical Physics I	1	
PHYS 143	Mechanics and Thermal Physics	3	
CHEM 113	Foundation Chemistry I	3	
CHEM 120	General Chemistry Laboratory I	1	
EASC 101	Physical Geology	3	
Total		**14-17**	

Electives: Select 3 credits			
MATH 121	Algebra and Trigonometry	3	
MATH 123	Vectors and Geometry	3	
STAT 111	Introduction to Statistics and Probability I	3	

SECOND SEMESTER

Code	Title	Credits	Pre-requisites
Core			
UGRC		3-6	
PHYS 106	Practical Physics II	1	
PHYS 144	Electricity and Magnetism	3	
CHEM 114	Foundation Chemistry II	3	
EASC 104	Historical Geology	2	
EASC 106	Geological Field Excursions	1	
Total		**13-16**	
Electives: Select 3 credits			
MATH 122	Calculus I	3	
MATH 126	Algebra and Geometry	3	
STAT 112	Introduction to Statistics and Probability II	3	

INFORMATION TECHNOLOGY

FIRST SEMESTER

Code	Title	Credits	Pre-requisites
Core			
UGRC		3-6	
STAT 111	Introduction to Statistics and Probability I	3	
DCIT 101	Introduction to Computer Science	3	
MATH 121	Algebra and Trigonometry	3	
Total		**12-15**	
Electives: Select 3 to 6 credits			
MATH 123	Vectors and Geometry	3	
DCIT 105	Mathematics for IT Professionals	3	
DCIT 107	Information Systems	3	

Students who wish to be considered for Computer Science at Level 200 should take MATH 123

SECOND SEMESTER

Code	Title	Credits	Pre-requisites
Core			
UGRC		3-6	
DCIT 104	Programming Fundamentals	3	
DCIT 108	Basic Electronics for IT Professionals	3	
Total		**9-12**	

Electives: Select 6 to 9 credits

DCIT 102	Computer Hardware Fundamentals	3	
MATH 122	Calculus I	3	
MATH 126	Algebra and Geometry	3	
UGBS 104	Principles of Management	3	

Students who wish to be considered for Computer Science at Level 200 should take MATH 122

COURSE DESCRIPTIONS

CHEM 113: Foundation Chemistry I
This course is designed to provide students with the fundamental concepts in general chemistry. Topics to be considered will include: measurements and presentation of data, uncertainty in measurements, significant figures; Normal distribution of data, Precision, Accuracy and Propagation of errors in calculations. Acid- base concepts such as Bronsted-Lowry's concept ($\geq 10^{-6}$ M); strength of acids and bases; levelling effect of water; pX scale; Hydrolysis of salts (cations and anions) are dealt with. The course concludes with and introduction to redox reactions and its applications; Solubility of sparingly soluble salts and their important terms including ionic product constants; Ksp; common-ion effect and selective precipitation

CHEM 114: Foundation Chemistry II
This course provides a foundation for knowledge in organic chemistry to students. Concepts to be discussed will include structural determination of organic molecules involving the use of major purification techniques, qualitative and quantitative analysis and the use of spectroscopic techniques in structure elucidation. Students will be introduced to the concept of functional groups with a focus on alkanes and cycloalkanes, alkenes and alkynes including for sources, formation, uses and reactions where necessary. Stereochemistry of these hydrocarbons as well as other fundamental organic concepts will be introduced to give a good foundation for subsequent courses in organic chemistry at higher levels.

CHEM 120: General Chemistry Laboratory I
This practical course exposes the students to basic techniques in volumetric analysis including: preparation of standard solutions, acid/base titrations; redox titrations involving permanganate, and iodimetry. Applications of volumetric analysis such determination of solubility product constants, purity of reagents, determination of water of hydration will be explored. Throughout the course, attention is drawn to uncertainties in measurements, the use of significant figures, propagation of errors, precision, and accuracy in order to ensure the application of the knowledge gained in the theory.

CHEM 122: General Chemistry Laboratory II
This laboratory-based course seeks to equip students with further skills in experimental techniques. Qualitative inorganic analysis such as; determination of aluminium, barium, bismuth, calcium, copper, iron, nickel and silver, as well as the identification of halides, phosphates, sulphates and nitrates; simple organic synthetic preparations such as the synthesis of the analgesic

aspirin from salicylic acid and acetic anhydride with exercises in purification and re-crystallization are some of the practical concepts and applications that will be explored.

PHYS 105: Practical Physics I
In this first of a series of practical physics courses, basic laboratory experiments are conducted to expose students to handling various measuring instruments and to data and error analysis. The course begins with an introduction to physical measurement techniques, data presentation, and error analysis. This is followed by several experiments in mechanics and thermal physics. Additional experiments in other topical areas may be included.

PHYS 106: Practical Physics II
Following from PHYS 105, further basic laboratory experiments are conducted to reinforce the techniques students learned with experiments in electricity and magnetism. Additional experiments in optics, electronics, vibrations, oscillations, and waves may be included.

PHYS 143: Mechanics and Thermal Physics
This course is a calculus-based general physics course that introduces students to basic principles in mechanics and thermal physics. Topics covered in the course include the following: vectors and vector algebra; linear momentum; motion; Newton's laws; force; circular motion; work and energy; rotational motion; gravitation; thermodynamic systems; thermal equilibrium; work and heat; First law of thermodynamics; entropy; gas laws; Kinetic theory of gases.

PHYS 144: Electricity and Magnetism
This course is a calculus-based general physics course that introduces students to basic principles in electricity and magnetism. Topics covered in the course include the following: Electric charge and electric field; Gauss' law; electrical potential; capacitance and dielectrics; electric current, resistance and direct-current circuits; magnetic field and magnetic forces; sources of magnetic fields; magnetic materials; electromagnetic induction; displacement current and Maxwell's equations; inductance; alternating current.

EASC 101: Physical Geology
This course introduces students to the science of the earth and the processes, both internal and external, that act upon it. The course covers the following topics: minerals; volcanism and extrusive rocks; intrusive activities and origin of igneous rocks; weathering and soil; sediments and sedimentary rocks; 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; plate tectonics; mountain building.

EASC 104: Historical Geology
The course provides students with an understanding of the principles of historical geology and how these principles are applied in unravelling Earth's history. It begins with discussions on concepts and principles, followed by a chronological discussion of Earth and life history. It then discusses the lessons learned from the geologic past to understand and place in context some of the global issues facing the world today, such as exploitation and depletion of natural resources, global climate warming, and decreasing biodiversity.

EASC 106: Geological Field Excursions
This course allows students to visit appropriate facilities or selected areas of interest and is designed to reinforce geological concepts learnt in class. This presents a useful and interesting way to learn about the environment and geological processes. Study trips may include visits to large and small industrial firms throughout the entire country, or tunnel projects that are underway, as well as natural geological environments.

DCIT 101: Introduction to Computer Science
This is an introduction to computers and how they work, their classification and historical development. Topics covered in class will include: Application of computers; Data representation in Computers; Peripherals; Files; Systems Engineering; Databases; Computer
architecture; Assembly language; Data Communications and networking; Systems software; Programming concepts; Algorithms and data structures.

DCIT 102: Computer Hardware Fundamentals
This course explains the basic principles of how computers work. It provides a comprehensive understanding of the essential components associated with computers with a focus on PCs. Topics include: The microprocessor, motherboard, memory, graphics and sound adapters, input and output devices, and storage media. An overview of operating systems and other software, as well as the various methods used to connect computers to each other and the Internet, are presented. The course also addresses recent advances in computer architectures and computer hardware and how they affect computer performance. Presentations of actual hardware are included so that students can gain experience in identifying the various internal and external components of a PC.

DCIT 104: Programming Fundamentals
Problem Solving and Programming are essential skills for IT students and IT professionals. Learning how to solve a problem using a structured programming language provides a strong foundation for a successful career. Topics include: The importance of algorithms in the problem-solving process; Properties of good algorithms, Algorithms for solving simple problems; the use of a programming language to implement, test, and debug algorithms for solving simple problems. Define and use data of both primitive and reference types effectively. Simple and complex static data structures. Design solutions to problems using procedural techniques. Decide on an appropriate repetition and/or selection structures for given problems, describe the mechanics of parameter passing and the issues associated with scoping. Apply effective debugging strategies.

DCIT 105: Mathematics for IT Professionals
This course will cover some particularly important area of discrete structures, set theory and graph theory as well as basics of counting. Graph theory concepts are used in networks, operating systems, and compilers. Set theory concepts are used in software engineering and
in databases. Topics to be covered include Sets Venn diagrams, Cartesian product, Power sets, Cardinality of finite sets; Relations, Reflexivity, symmetry, partial orders; Functions, Surjections, injections, bijections, Inverses, Composition; Trees, Properties, Traversal strategies, Undirected graphs, Directed graphs, Weighted graphs, Spanning trees/forests, Graph isomorphism; Counting arguments, Set cardinality and counting, Sum and product rule, Inclusion-exclusion principle,

Arithmetic and geometric progressions, The pigeonhole principle, Permutations and combinations, Pascal's identity, The binomial theorem, Solving recurrence relations.

DCIT 107: Information Systems

This course is designed to introduce students to contemporary information systems (IS) and demonstrate how these systems are used throughout global organizations. The focus of this course will be on the key components of information systems and how these components can be integrated and managed to create competitive advantage. Students will gain an understanding of how information is used in organizations and how IT enables improvement in quality, speed, and agility. The course also provides an introduction to systems and development concepts, technology acquisition, and various types of application software that have become prevalent or are emerging in modern organizations and society.

DCIT 108: Basic Electronics for IT Professionals

This course presents an overview of the fundamentals of electric/electronic circuit analysis. It starts with the basics of electricity and magnetism which form the basic building blocks of understanding "Basic Electronics" and moves to simple circuit components such as power supplies, resistors, capacitors, and inductors. The course also provides an introduction to the actual circuit design, construction, test, and measurement. Each lesson provides a sufficient background to help students understand the principles that underlie the operation of electric and electronic circuits. Laboratory demonstrations are given to reinforce the concepts learned from lectures and homework.

MATH 121: Algebra and Trigonometry

This course is a precalculus course aiming to develop the students' ability to think logically, use sound mathematical reasoning and understand the geometry in algebra. It includes advanced levels of topics addressed in high school such as: arrangements, selections and the binomial theorem. 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.

MATH 123 Vectors and Geometry

Vectors may be used very neatly to prove several theorems of geometry. This course is about applying vector operations and the method of mathematical proof (of MATH 121) to geometric problems. The areas of study include: vector operations with geometric examples; components of a vector and the scalar product of vectors. Coordinate geometry in the plane including normal vector to a line, angle between intersecting lines, reflection in a line, angle bisectors and the equation of a circle, the tangent and the normal at a point.

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 both separable variable type and using an integrating factor.

MATH 126: Algebra and Geometry
This is a course which highlights the interplay of algebra and geometry. It includes topics such as: polar coordinates; conic sections. Complex numbers, Argand diagram, DeMoivre's theorem, roots of unity. Algebra of matrices and determinants, linear transformations. Transformations of the complex plane. Sketching polar curves and some coordinate geometry in 3 dimensions. Vector product and triple products.

MATH 101: General Mathematics I
The aim of this course is to equip students with sufficient elementary algebra and calculus to allow them to solve elementary problems in the biological and physical world. Topics from high school mathematics courses are revised and in some cases extended. The main focus is to provide sufficient precalculus and trigonometry to allow students to apply calculus to problem solving.

STAT 111: Introduction to Statistics and Probability I
This course introduces students to basic principles in Statistics and Probability. Topics to be covered include the following: The definition, reduction and interpretation of data; Introduction to basic concepts of Probability; Random Events and Random Variables, and Bayes Theorem. Students will be given overview of computational statistics and an introduction to the R, Minitab and Stata computing environment. The statistical software R, Minitab and Stata will be used to execute concepts learned in class. One hour Lab session a week will be organized for students.

STAT 112: Introduction to Statistics and Probability II
This course is aimed at enhancing students understanding of basic principles in Statistics and Probability. Relative frequency function, Introduction to probability distributions, some univariate probability distributions; Bernoulli, Binomial, Poisson, Uniform distributions. Simulation of random variables from probability distributions; Bernoulli, Binomial, Uniform distributions using R, Minitab and Stata: mean, variance, mode of probability distribution. Writing simple codes to generate discrete random values of the Bernoulli, Binomial and Poisson distributed random variables. One hour Lab session a week will be organized for students.

LEVEL 200 - 400
TYPE OF DEGREE PROGRAMMES
The SPMS will continue to run three types of programmes:
1. Single-Subject Major
2. Major – Minor
3. Combined –Major

Single-Major Programmes
1. Actuarial Science
2. Applied Geology
3. Applied Geophysics
4. Chemistry
5. Computer Science
6. Geology
7. Geophysics

8. Information Technology
9. Mathematics
10. Physics
11. Statistics

Combined-Major Programmes

1. Actuarial Science and Mathematics
2. Chemistry and a Biological Science programme
3. Chemistry and Geology
4. Chemistry and Physics
5. Geology and Marine Science
6. Geology and Physics
7. Mathematics and a Biological Science programme
8. Mathematics and Statistics

Major-Minor

1. Geology with Physics
2. Mathematics with Computer Science
3. Mathematics with Physics
4. Mathematics with Statistics
5. Physics with Computer Science
6. Physics with Geology
7. Physics with Mathematics
8. Statistics with Computer Science
9. Statistics with Mathematics

ADMINISTRATION

Professor Sandow Mark Yidana	**-**	**Dean**
Ms. Mawuena A. Abortta	-	School Administrator
Mr. John Victor Mensah Nkrumah	-	Principal Accounting Assistant
Ms. Mildred Eyiah	-	Senior Administrative Assistant
Mr. Paul Appiah Datsomor	-	Administrative Assistant
Miss Judith Mensah-Sena	-	Research Assistant

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

Mary Anti Chama	**-**	**Senior Lecturer**
B.Sc. (University of Ghana)		*(Head of Department)*
PhD (University of Ghana, Gh)		
Ivan Addae-Mensah	**-**	**Emeritus Professor**
BSc. (University of Ghana), M.Sc (University of Ghana)		

PhD (Cambridge University, UK)

Vincent K. Nartey - **Professor**

B.Sc.(University of Cape Coast), M.Sc. (KNUST),

Ph.D (Graz University, Austria)

William A. Asomaning - Associate Professor

B.Sc. (University of Ghana), M.Sc. (University of Ghana)

PhD (Sussex University, UK)

Derick Carboo - **Associate Professor**

B.Sc. (University of Ghana), MSc. (Hamburg University)

PhD (Hamburg University)

Robert Kingsford-Adaboh - **Associate Professor**

B.Sc (University of Cape Coast), M.Sc (Okayama University)

Ph.D (Okayama University, Japan)

Louis K. Doamekpor - **Associate Professor**

B.Sc (University of Ghana), MPhil (University of Ghana)

PhD (Saga University, Japan)

Dorcas Osei-Safo - **Associate Professor**

B.Sc. (University of Ghana)

Ph.D (University of Ghana)

Kweku Kyeremeh - Associate Professor

B.Sc. (University of Ghana),

Ph.D (University of Aberdeen, Scotland)

Emmanuel Y. Osei-Twum - **Visiting Scholar**

B.Sc. (Ghana)

Ph.D (McMaster Univ. Canada)

Frederick L. Phillips - Senior Lecturer

B.Sc. (University of Ghana),

PhD (Imperial College of Science and Tech., London)

Raphael K. Klake - Senior Lecturer

B.Sc. (University of Cape Coast), MPhil (University of Ghana),

Ph.D (State University of New York.,US)

Richard K. Amewu - **Senior Lecturer**

B.Sc. (KNUST, Ghana)

Ph.D, (University of Liverpool, UK)

Enock Dankyi - Senior Lecturer

B.Sc. (University of Ghana) MPhil (University of Ghana),

Ph.D (University of Ghana)

Jerry Joe E. K. Harrison - Senior Lecturer

B.Sc. (University of Ghana), MPhil (University of Ghana),

Ph.D (Rutgers University, USA)

Richard K. Boakye Owoare - Senior Lecturer

M. Sci., (King's College, London) Ph.D (King's College, London)

Collins Obuah - **Senior Lecturer**

B.Sc., (University of Ghana), MSc., (University of Johannesburg)

Ph.D, (University of Johannesburg, South Africa)

Michael Kojo Ainooson - Senior Lecturer

B.Sc. (University of Ghana), MSc. (University of Johannesburg)

Ph.D (Georg-August University, Göttingen, Germany)

Louis Hamenu - **Senior Lecturer**

B.Sc. (University of Ghana,), Msc. (Hanbat National)

Ph.D (Hanbat National, South Korea)

Anita Oppong - Lecturer

B.Sc. (University of Ghana), MPhil (University of Ghana),

Ph.D (University of Rhode Island, USA)

Bozumeh Som - Lecturer

B.Sc. (University of Cape Coast, Ghana),MSc. (East Tennessee State University, USA),

Ph.D (University of South Carolina, USA)

Daniel Moscoh Ayine-Tora - Lecturer

B.Sc., (University of Ghana), MPhil (University of Ghana),

Ph.D (University Of Auckland, New Zealand)

NON-ACADEMIC STAFF

Mr. Solomon Sarfo Sam	–	Senior Administrative Assistant
Ms. Dinah Ekua Ahema Acquah	–	Senior Administrative Assistant
Mr. Mohammed Abu	–	Library Assistant
Mr. Eric Coffie	–	Senior Technologist
Mr. Thomas Mensah	–	Senior Technologist
Mr. Samuel Owusu-Atuah	–	Principal Technician
Mr. David Bakomnaah	–	Principal Technician
Ms. Grace Ntiamoah	–	Principal Technician
Mrs. Angelina Noi	–	Senior Technician
Ms. Iklimatu Mohammed-Rasheed	–	Senior Technician
Mr. Mawufemor Babe	–	Senior Technician

Mr. Divine Cudjoe Amuzu – Technician

Mr. Samuel Nortey Yebuah – Technician

Mr. Abdul-Rashid Sulaiman – Technician

Mr. Ernest Ntiamoah – Technician

Mr. Patrick Lartey Junior – Assistant Technician**Duration of programme**

Four (4) years

SINGLE MAJOR IN CHEMISTRY

LEVEL 200

SEMESTER 1

Core Courses

Code	**Title**	**Credits**
CHEM 217	Physical Chemistry I	2
CHEM 215	Structure and Bonding	2
CHEM 233	Organic Chemistry I	2
CHEM 271	Analytical Chemistry I	2
CHEM 203	Practical I	1
Total		**9**

SEMESTER 2

Core Courses

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 Courses

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 Courses

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 Courses

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**

Elective Courses (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 438	Medicinal Chemistry	2
CHEM 491	Petroleum Chemistry and Technology	2
CHEM 493	Mineral Processing	2
CHEM 495	Pulp and Paper Chemistry and Technology	2

SEMESTER II

Core Courses

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**

Elective Courses (Select 2 credits from each Group)

Group A		
CHEM 424	Molecular Spectroscopy	2

CHEM 452	Solid state Chemistry	2
CHEM 474	Elements of Forensic Chemistry	2
Group B		
CHEM 492	Industrial Chemistry	2
CHEM 494	Textile Chemistry and Technology	2
CHEM 496	Environmental Chemistry	2

COMBINED MAJOR IN CHEMISTRY

LEVEL 200

FIRST SEMESTER

Core Courses		
Course Code	**Course Title**	**Credits**
UGRC 210	Academic Writing	3
CHEM 213	Physical Chemistry I	2
CHEM 233	Organic Chemistry I	2
CHEM 271	Analytical Chemistry I	2
CHEM 203	Practical I	1
Total		**10**

SECOND SEMESTER

Core Courses		
Course Code	**Course Title**	**Credits**
UGRC 220-238	Introduction to African Studies	3
CHEM 234	Organic Chemistry II	2
CHEM 252	Inorganic Chemistry I (s-block elements)	2
CHEM 204	Practical II	1
Total		**8**

LEVEL 300

FIRST SEMESTER

Core Courses		
Course Code	**Course Title**	**Credits**
CHEM 343	Chemistry of Aromatic Compounds	3
CHEM 355	Inorganic Chemistry II (p-block elements)	3
Total		**6**
CHEM 311	Physical Practical	2
CHEM 351	Inorganic Practical	2

SECOND SEMESTER

Core Courses		
Course Code	**Course Title**	**Credits**
CHEM 312	Thermodynamics I	2

CHEM 344	Carbanions and their Reactions	2
CHEM 374	Analytical Chemistry II	3
Total		**7**
Electives (*Select 2 credits*)		
CHEM 332	Organic Practical	2
CHEM 372	Analytical Practical	2

LEVEL 400

FIRST SEMESTER

Core Courses		
Course Code	**Course Title**	**Credits**
CHEM 405	Reaction Kinetics	2
CHEM 441	Chemistry of Natural Products	3
CHEM 400	Project Work	3
Total		**8**

Elective Courses		
Course Code	**Course Title**	**Credits**
CHEM 401	Thermodynamics II	2
CHEM 403	Symmetry, Group Theory and Applications	2
CHEM 423	Polymer Chemistry & Technology	2
CHEM 438	Medicinal Chemistry	2

CHEM 439	Organometallic Chemistry	2
CHEM 471	Nuclear and Radiochemistry	2
CHEM 473	X-Ray Crystallography	2
CHEM 491	Petroleum Chemistry	2
CHEM 493	Mineral Processing	2
CHEM 495	Pulp & Paper Chemistry Technology	2
Total		

SECOND SEMESTER

Core Courses		
Course Code	**Course Title**	**Credits**
CHEM 454	Transition Metal Chemistry	3
CHEM 472	Instrumental Methods of Chemical Analysis	3
CHEM 400	Project Work	3
Total		**9**

Elective Courses		
Course Code	**Course Title**	**Credits**
CHEM 402	Quantum Chemistry	2
CHEM 412	Surface Chemistry and Colloids	2

CHEM 414	Molecular Structure	2
CHEM 452	Solid State Chemistry	2
CHEM 474	Elements of Forensic Chemistry	2
CHEM 492	Industrial & Environmental Chemistry	2
CHEM 494	Textile Chemistry and Technology	2
CHEM 496	Environmental Chemistry	2

Course Outlines

CHEM 203: Analytical Chemistry Laboratory I

This laboratory-based course is designed to complement theoretical lectures in quantitative analytical chemistry. This component provides students with experience in the analysis of environmental samples. Students are introduced to safety in the analytical laboratory, titration of acid-base mixtures, total alkalinity, hydrolysis of salts, pH of buffer solutions and solubility products, rates of chemical reactions, iodometric titrations, determination of hardness in varied water samples, analysis of commercial bleaching products and silver in alloys (Volhard's method). Additionally, solution preparation, basic skills in titrimetry, pH measurements, etc. are surveyed at the beginning of the course.

CHEM 204: Organic Chemistry Laboratory I

This laboratory-based course seeks to complement theoretical lectures in basic organic chemistry. Here students are taught skills such as synthesis of organic compounds (e.g., esters, acids, ketones) requiring basic heating under reflux, distillation, crystallization, extraction, filtration, melting point determination and spectroscopic (UV) analysis. Additionally, students are made to engage in the qualitative analysis of alcohols, carboxylic acids, aldehydes, ketones, amines and phenols.

CHEM 215: Structure and Bonding

This course seeks to provide students with fundamental knowledge in atomic structure and bonding in elements and molecules. A qualitative treatment of the Quantum Mechanical Model of the atom is introduced and discussed. Other topics will include quantum numbers, shape of orbitals, electronic configuration of atoms, chemical periodicity, and models of chemical bonding. Valence Bond concepts such as orbital overlaps, electron-pair sharing, sigma- and pi-bonds, hybridization (as mathematical combination of atomic orbitals LCAO), Valence bond description of simple molecules, VSEPR, as well and qualitative Molecular Orbital model are discussed.

CHEM 216: Chemistry of Materials

As a follow-up to structure and bonding, this course looks at the binding forces in various solid materials including metals, alloys, molecules, covalent and ionic crystals and their related properties and internal structures. The geometric and energetic factors affecting ionic crystals are discussed, together with the effects of polarization, and the changes that result on introduction of complex ions - the later illustrated with silicates. Study of the structures of a variety of materials, selected from e.g., silicates, glasses, polymers/plastics, composites, ceramics, nanomaterials, as well as new materials such as nanomaterials are also discussed.

CHEM 217: Physical Chemistry I

This course is designed to introduce students to some fundamental concepts in physical chemistry with a focus on chemical reactions and equilibrium and kinetics of reactions. Topics to be considered under Chemical Reactions and equilibrium will include Enthalpy of reactions, heat capacities, Born-Haber cycle (Hess' law), Bond energies, standard enthalpies of formation, Entropy, Gibbs free energy and spontaneity, relationship between free energy, enthalpy and entropy. Under kinetics, topics to be considered will be differential rate law, rate constants, order of reactions, effects of concentration, temperature (Arrhenius equation), mechanical slope method (No integrated rate laws), and the concept of reaction mechanism.

CHEM 233: Organic Chemistry I

This course builds on the knowledge gained in CHEM 114 by providing students with a sound understanding of some important concepts in Organic Chemistry. The phenomenon of stereochemistry which plays a very vital role in Organic Chemistry reactions and the applications of Organic molecules is extensively treated. The treatment includes an in-depth review of Stereochemistry both configurational and conformational. In addition, compounds with more than one chiral centre, pairs of enantiomers, diastereomers, meso compounds, racemic mixtures and their resolution, and stereoisomerism of disubstituted cycloalkanes are all considered. Some important classes of Organic Compounds such as alkenes, alcohols and ethers are discussed with special emphasis on their nomenclature, properties, preparations and reactions.

CHEM 234: Organic Chemistry II This course is focused on some important functional groups including aldehydes, ketones, carboxylic acid and their derivatives as well as amines. The course seeks to give a stronger foundation in organic chemistry for a beginner. Structure, nomenclature, physical properties, laboratory preparations and reactions of these functional groups are discussed as well as important concepts in organic chemistry to further aid in the understanding of students.

CHEM 252: Inorganic Chemistry I

This course deals with the systematic chemistry of the s-block elements namely the main group elements. Group 1A (the alkali metals, Group IIA (the alkaline Earth Metals) and Group IIB (Zinc, Cadmium and Mercury) including their organometallic compounds will be covered. Physical and chemical periodic trends including atomic and ionic size, ionization energies, electronegativity and metallic character will be discussed. Anomalous position of hydrogen on the periodic table and

properties of its isotopes will be covered. Properties of compounds of these elements including, oxides, hydroxides, halides, carbonates, carbides will also be highlighted.

CHEM 271: Foundation Chemistry III

This course builds on the knowledge gained in CHEM 113 and involves the 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 Ksp, dissociation constants, Potentiometric titrations, Conductance and applications of conductivity measurements are discussed.

CHEM 272: Analytical Chemistry I

This course introduces students to some fundamental principles of analytical chemistry. The course begins with an introduction to analytical chemistry, the analytical process, units, concentration and stoichiometry. Calibration curves and their use in estimating concentrations, experimental errors and statistical analysis for evaluating the data are explored. Finally sampling techniques, quality assurance and quality control, as well as gravimetric analysis and applications are discussed.

CHEM 301: Mathematics for Chemists

This course is tailored to suit chemistry majors and intends to give basic mathematical skills to the chemist especially those in physical chemistry. 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 and some numerical techniques e.g., Newton-Raphson method are taught.

CHEM 311: Physical Practical

This laboratory course is designed to impart basic techniques in physical chemistry to students. The course requires students to undertake experiments involving refractometry, potentiometry, conductimetry, spectrophotometry, and polarimetry. The use of adsorption isotherms, partitioning, and kinetic studies will be used to further illustrate physical chemistry phenomenon already taught in theory.

CHEM 312: Thermodynamics I

This course deals with the fundamentals of thermodynamics by treating the Grammar and Vocabulary of thermodynamics; and moves on to discuss State variables and equations of state; this is followed by full treatment of the Zeroth and First laws of thermodynamics, and Thermochemistry. The Second law of Thermodynamics, Spontaneity and equilibria are the treated in full followed by an introduction to the Third Law of Thermodynamics.

CHEM 332: Organic Practical

This course will be laboratory-based and will focus on the synthesis of organic compounds using basic skills such as heating under reflux, distillation, crystallization, solvent extraction, solvent partitioning, filtration, thin layer or gravity column chromatography and melting point determination. Other important activities will include the use of infrared, ultraviolet and ^{1}H NMR spectroscopy to confirm the structures of synthesized materials, Methods in multi-step synthesis of compounds such as dibenzalacetone, 1-bromo-3-chloro-5-iodobenzene, benzocaine, sulfanilamide, ferrocene and 2,4-dinitroaniline, and Tests for functional groups.

CHEM 341: Spectroscopy and Structure Elucidation

This course will cover the determination of organic structures using infrared (IR) spectroscopy, ultraviolet-visible (UV) spectroscopy, mass spectrometry (MS) and nuclear magnetic resonance (NMR) spectroscopy (^{1}H and ^{13}C). The underlying principles in each method are outlined and the structural features which may be deduced from spectra are discussed. Structure elucidation problems involving the joint application of IR, UV, MS, ^{1}H- NMR and ^{13}C- NMR for small molecules using real or computer simulated spectra and Tables of data (IR, UV, and NMR) will be discussed into detail.

CHEM 343: Chemistry of Aromatic Compounds

This course focuses on aromatic compounds and their chemical reactions including mononuclear and polynuclear aromatics. The course will begin with evidence of aromaticity from physical and chemical properties of benzene. Other important considerations will include: The use of Huckel's rule and chemical/physical properties to determine aromaticity, Structure and nomenclature of arenes, reactions - hydrogenation, oxidation, and side chain halogenation. Electrophilic aromatic substitution and their use in synthesis, addition-elimination reactions and the benzyne mechanism.

The course will conclude with applications, classification, nomenclature and chemistry of aromatic amines and diazonium salts as well as their importance especially in synthesis and coupling.

CHEM 344: Carbanions and their Reactions

This course covers the study of a selected series of organic reactions involving reactive intermediates, mainly carbanions. Emphasis is placed on the understanding of their reaction mechanisms. Students are expected to expand their knowledge of C-C bond forming reactions using reactive intermediates with specific emphasis on carbanions and associated species such as enolates, organometallics, ylides, cyanides and acetylides. Reactions to be covered include the participation of carbanions in SN2 alkylation reactions, 1,2-additions to carbonyl functional groups and in 1,4-additions such as the Michael Reaction.

CHEM 346: Molecular Rearrangement Reactions

The course will teach the key fundamentals of molecular rearrangement reactions. Classification of rearrangement reactions based on the nature of the migrating group/atom, Nucleophilic/aniotropic (intermolecular and intramolecular), electrophilic or cationotropic, free radical. The five (5) types of skeletal rearrangements- Electron deficient skeletal rearrangement (Wagner-Meerwin Rearrangement, Pinacol-Pinacolone Rearrangement, Semipinacol Rearrangement, Tiffeneau-Demjanov Rearrangement), Electron rich skeletal rearrangement (Benzilic acid Rearrangement, Wittig Rearrangement, Sommelet-Hauser Rearrangement, Radical rearrangement, Rearrangements on an aromatic ring (Fries Rearrangement, Claisen Rearrangement, Rearrangements of Derivative of aniline, Sigmatropic rearrangement (Stevens Rearrangement, Ene Reaction, Cope Rearrangement).

CHEM 351: Inorganic Chemistry Laboratory

This laboratory-based course is designed to impart basic techniques in inorganic synthesis to students. The course also requires students to separate, purify and dry their products for analysis using standard spectroscopic techniques. Selected experiments include Qualitative inorganic analysis, Simple complexation reactions, Chelation reactions, Preparation of double salts, Stabilization of “unstable” species through complexation, Determination of dissolved oxygen in water, Interpretation of infra-red spectra of samples obtained by students.

CHEM 352: Coordination Chemistry

This is an introductory course to Transition Metal Ions and their complexes. The d-orbital occupation and electronic configuration of M^{2+} ions, common oxidation numbers and their colours. General properties of TM Elements. Useful Definitions - ligand, chelate, coordination number. Common Stereochemistries (Coordination number = 2-12) will be reviewed. Crystal Field Theory. Shapes of d-orbitals, the energy of the d-orbitals with respect to the effect of octahedral, tetrahedral and square planar crystal fields. High-spin, Low-spin complexes and the spectrochemical series. Stability of Metal Complexes. Systematic approach to naming and complexes. Magnetic Moments of octahedral, tetrahedral and square planar complexes. Isomerism. Stereoisomerism and Structural isomerism.

CHEM 355: Inorganic Chemistry (p-block Elements)

This course involves the systematic study of the p-block elements groups 13 (3A) to 18 (8A) as well as the chemistry of the non-metals. Trends within and between groups; reasons for and causes of trends in ionization energy, electron affinity, electronegativity, oxidation states, inert pair effect, role of valence shell d-orbitals, electrode potential and conductivity. The general increase in metallic character of the p-elements (as evidenced by both physical and chemical properties) as one goes down the group.

CHEM 372: Analytical Chemistry Practical

This Laboratory-based course is designed to give students the opportunity to acquire hands on experience in basic chemical techniques and methods. The course is made up of selected experiments which are complete in themselves, students may be required to perform their own sampling, preparation of reagents and standards, etc. Some of the experiments are argentometric determination of halides, complexometric (EDTA) analysis of real samples, ion exchange chromatography, Spectrophotometric determinations involving use of calibration curves and standard chelating agents, soil analysis for pH, phosphate, nitrogen, gravimetric analysis.

CHEM 374: Analytical Chemistry II

This course is designed to impart basic techniques of analytical chemistry to students. Topics to be treated include discussion of Evaluation of analytical data, covering treatment of errors, error propagation and hypothesis testing; UV-VIS spectrophotometry, including discussion of Beer-Lambert's Law, its limitations, Calibration curves and Measurement of absorbance, Matrix effect and Standard addition techniques; Atomic Absorption Spectrometry: The AAS experiment, Instrumentation (for Flame AAS), Background correction with D_2-Lamp, Interferences in AAS, Optimization of signal-to-noise ratio, and Application; Separatory methods involving discussion

of Partition coefficient, Solvent extraction procedures and Application in chelation–extraction of inorganic species; Gravimetric methods: discussion of Desirable properties of a precipitate for gravimetry, Applications.

CHEM 400: Project

CHEM 401: Thermodynamics II This course builds on the introduction to thermodynamics and focusses on its applications. Some of the topics to be covered include Chemical potential and phase equilibria, solutions and colligative properties, electrolytes and the Debye-Hückel theory, electrochemical cells as a source for thermodynamic data, the Nernst equation. Concentration cells Applications of emf measurements: Electrode processes: over-potential, current density, fuel cells, storage cells, photovoltaic cells, electrolysis.

CHEM 402: Quantum Chemistry

The course will introduce students to 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. The initial experiments promoting quantum theory; de Broglie's relationship, Postulates and terminology of quantum mechanics, Application of the postulates to specific cases, Quantum mechanical tunneling, The Variation Principle and its application to molecular orbital calculations will be discussed.

CHEM 403: Symmetry, Group Theory, and Applications

This course seeks to introduce students to the principles of symmetry and group theory. Topics will include, Symmetry elements and operations, arrangement of symmetry operations into classes, Group theory- Point groups, and assignment of point groups to molecules using flow charts, Non-degenerate representations, Reducible representations and reduction to irreducible representations, Degenerate representations. Application of symmetry and group theory - The symmetry properties of molecules and their use to predict chemical bonding, vibrational spectra, hybridization and optical activity will be discussed.

CHEM 405: Reaction Kinetics

This course seeks to aid students to develop both a conceptual and a quantitative understanding of rates of chemical reactions. Quantitative description of reaction rates and mechanisms will also be explored. Some topics to be treated will include Experimental techniques in chemical kinetics, Elementary kinetics, Theories of reaction rates, Reactions in Solution, Homogeneous and heterogeneous catalysis Enzyme kinetics, and reaction dynamics. Photochemical sources of energy for kinetic reactions.

CHEM 412: Surface Chemistry and Colloids The course is focused on the principles and chemistry of Surfaces and the application of Thermodynamics to Interface Phenomena. Topics will include: the concept of Interfacial Tension/Free Energy and Work associated with interface formation, Physical phenomena related to surface tension and Capillarity, Vapor pressure of curved surfaces, Surface tension and temperature and spreading of liquids, Gibbs equation, Surfactants and Detergency, Insoluble surface films, Double layer Potential, Adsorption and Adsorption Isotherms, Finally, applications of adsorption, Surface catalysis, Determination of surface area of adsorbents, Adsorption of solutes by solids, Colloids and other dispersions, Effects of Surface forces on colloids, Preparation and properties of Colloids will be discussed.

CHEM 414: Molecular Structure

The course examines electrical and magnetic properties of molecules in relation to molecular structure and spectra at the basic level. Relationship between molecular shape and symmetry is examined. Molecular electronic structure parameters like Bond radii, Bond energy, bond moments, Electronegativity and Born-Oppenheimer Approximation. The study would also introduce to students basic Computational Concepts. Applications of theories to Molecular modeling, Computer aided Drug design (CAMD) Quantum Mechanical Methods, Ab initio Calculations and Semi-empirical Methods. Molecular Modelling of simple organic molecules. Use of Density Functional Methods to solve problems.

CHEM 423: Polymer Chemistry and Technology

The course is intended to develop fundamental understanding for polymers and polymerization reactions. Functionality concepts and applications in industrial synthesis of polymers, with reference to rubber, plastics, fibers, coatings and adhesives industries will be covered. Mechanisms and kinetics of polymerization will be dealt with. Common concepts within polymer classes and the recognition of the potential value of polymeric materials and their areas of application will be

highlighted. The student will be made to become familiar with current topics in polymer science and recognize sustainability issues in polymer chemistry.

CHEM 438: Medicinal Chemistry This course will introduce students to some fundamental concepts in medicinal chemistry by providing an in-depth look at how pharmacologically active molecules are designed to treat human diseases. An overview of modern medicinal chemistry, from first principles of drug action to design and development of potential therapeutics, shall be introduced. The action and behaviour of pharmaceutical compounds and the relationship between their structure, their chemical and therapeutic properties, shall be explored. Structure activity relationships will be explored through case studies. Methods of drug discovery including the development of drugs from natural products, computer modelling, and rational drug design shall be discussed.

CHEM 439: Organometallic Chemistry The course introduces students to organometallic compounds, their chemistry and reactions. Topics will include preparation and reactions of the organometallic compounds of the Main Group elements, and of the d-block elements. The use of Organometallic compounds as useful synthetic intermediates will also be studied. Applications of organometallic complexes in organic synthesis and industrial catalysis will also be covered. In addition, recent developments in organic synthesis, which involves the use of organometallic compounds. The role of organometallic compounds in catalysis will be discussed.

CHEM 441: Chemistry of Natural Products

This course introduces students to some important compounds and groups of compounds from natural sources. Topics will include: Monosaccharides, Disaccharides and Polysaccharides, Syntheses of alpha-(or 2-)amino acids, determination of primary structures and description of the secondary, tertiary, and quaternary structures of peptides, syntheses of peptides. The chemical structures of Coenzyme A, ATP and ADP, NAD and NADH. Chemistry of DNA and RNA. Terpenoid compounds, methods of extraction, The Isoprene Rule and Biosynthesis of terpenes, structure elucidation of some specific examples, carotenoids and natural rubber as polyterpenoid compounds. Steroids, classes - sterols, bile acids, sex hormones, adrenal cortex hormones - structures of above and their biological functions, introduction to Conformational Analysis. Alkaloids, medicinal properties, extraction from plant source and classification based on nuclear structures. Brief chemical properties of alkaloids. Brief chemistry of oxygen heterocyclic compounds, especially flavonoids. The structures and colours of cyanidin, an anthocyanin, in different pH media.

CHEM 452: Solid State Chemistry

This is an introductory course that begins with an exploration of the fundamental relationship between atomic structure, crystal structure, and crystal chemistry. Also examined are crystal defects, non-stoichiometry, and solid solutions. The concept of bonding in solids will be studied in regarding the chemical properties of "aggregates of molecules," including crystals, metals, glasses, semiconductors, polymers, and biomaterials. The synthesis, processing, and fabrication methods of solids and real-world examples drawn from industrial practices relating to semiconductor manufacturing, energy generation and storage, emerging technologies (e.g., photonic and biomedical devices), and the environmental impact of chemical processing (e.g., recycling glass, metal, and plastic) will be studied. Finally, we will conclude by looking at the physical properties of solids (electrical, magnetic, and optical) and some physical/spectroscopic characterization techniques all relating to solids.

CHEM 454: Transition Metal Chemistry

This course introduces students to some general characteristics of d and f block elements. Topics will include coordination chemistry: structure and isomerism, stability, theories of metal- ligand bonding (CFT and LFT), mechanisms of substitution and electron transfer reactions of coordination complexes. Electronic spectra and magnetic properties of transition metal complexes, lanthanides and actinides. Metal carbonyls, metal- metal bonds and metal atom clusters, metallocenes, transition metal complexes with bonds to hydrogen, alkyls, alkenes and arenes, metal carbenes, use of organometallic compounds as catalysts in organic synthesis, Bioinorganic chemistry of Na, K. Mg, Ca, Fe, Co, Zn, Cu and Mo.

CHEM 471: Nuclear & Radiochemistry

The course is designed to introduce fundamental concepts in nuclear and radiochemistry and their applications. Topics will include, Radioactive Decay and Nuclear Stability, types of radioactive decay, the Kinetics of radioactive decay, radioisotope dating, the interconversion of matter and energy, The mass defect, nuclear binding energy, natural radioactivity, nuclear transmission: particle accelerators and the trans-uranium elements, the effect of nuclear radiation on matter: excitation and ionization emissions, application of radioisotopes: application of ionizing and non-ionizing radiation, Nuclear fission and fusion and their applications in energy and weapons production.

CHEM 472: Instrumental Methods of Chemical Analysis

This course is focused on the principles and application of analytical instrumentation. Topics will include resolution, sensitivity, selectivity, and sample pre-treatment techniques. A detailed

consideration and applications of some selected methods including basic principles of chromatography, gas chromatography, liquid chromatography (Normal and reversed phase), HPLC, GC-MS, etc. x-ray fluorescence spectrophotometry (XRF), x-ray diffraction techniques such as powder and single crystal (XRD), neutron activation analysis (NAA), voltammetric stripping analysis, nuclear magnetic resonance spectroscopy will be performed.

CHEM 473: X-ray Crystallography

This course is intended to give students a basic understanding of X-ray crystallography. Principles and Techniques governing Powder and Single Crystal X-ray crystallography would be taught. Differences and similarities between the powder and single crystal techniques would be taught. X-ray generation, interaction of X-ray with matter and Scattering patterns and crystal growth experiments as part of single crystal diffraction studies. Relate Bragg reflections and diffractions to X-ray diffraction patterns in both powder and single crystal diffractions. The concept of small building blocks, unit cell, cell lattice constants, Symmetry, Crystal systems theory and experiments are covered.

CHEM 474: Elements of Forensic Chemistry

This course introduces students to the techniques of forensic chemistry as they relate to crime scene investigation and on-going analysis of evidence obtained after a crime is committed. The course involves the basic chemistry concepts, origins of foreign science, evidence collection and preservation, documentation, fingerprint development, toxicology and drug testing, foreign techniques and instrumentation, explosives, and arson investigation.

CHEM 491: Petroleum Chemistry and Technology

The purpose of this course is to provide the student with an understanding of petroleum chemistry. It addresses the processes involved in the formation, and the chemical composition and properties, of petroleum (oil and gas). The course provides knowledge of the processes of petroleum refining and of petroleum products as well as alternative fuels and reviews the chemical basis for most of the important production processes. The topics of petrochemicals will be discussed. The course also takes a look at the petroleum fractions and the methods for analyzing them.

CHEM 492: Industrial Chemistry

The course introduces some fundamental principles of industrial chemistry. Topics will include: 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, H_3PO_4, 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 such as, global warming, acid rain, smog, ozone depletion, eutrophication, toxic metals and carcinogens will be discussed.

CHEM 493: Mineral Processing

The course introduces students to the fundamentals of mineral processing and will involve the following: 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), and Gold refining technology.

CHEM 494: Textile Chemistry and Technology

This course introduces students to the chemical principles and applications underlying the textile industry. Topics will include, Physical and chemical properties of raw materials, natural fibres of animal origin such as wool or of plant origin such cotton are selected for discussions. Structure of the constituent fibers, physical and chemical properties for example, the helical structure of wool or cotton, grading parameters such as length, diameter, crimp, colour as quality indicators of fibres. Physical and chemical changes in these materials during preparation of yarns for weaving, treatment of fabric after weaving (dyes, dyestuffs, printing etc): treatments of textile industrial waste.

CHEM 495: Pulp and Paper Chemistry and Technology

This course introduces students to the use of wood, non-woody, and agricultural waste as viable industrial raw material in paper making and other products. Students are introduced to the basic chemistry of wood and separation techniques involving chemical and mechanical methods. Alternate fiber sources for both hardwood and softwood and their seasonal availability is discussed. The main chemical components of wood, cellulose, hemicelluloses and extractives, take the students through various chemical reaction methods for wood technology towards paper making, conversion of wood to paper with particular emphasis on the organic, physical and surface chemistries that are involved. The various uses of paper are listed and discussed at the end of the course.

CHEM 496: Environmental Chemistry

Environmental chemistry refers to the study of chemistry in natural systems and changes that occur when perturbed by anthropogenic activities, including the release of chemicals into the environment. The goal of environmental chemistry is to understand the chemical reactions and processes that control the environmental systems and how anthropogenic activities impact these. This course examines current global and local environmental issues underpinned by chemistry.

DEPARTMENT OF COMPUTER SCIENCE

INTRODUCTION

This is the Information Technology age and at its core is Computer Science. The study of computer science is therefore critical if society is to take full advantage of the benefits Information Technology has to offer and make rapid economic advances. Computer science involves the study and development of applications that allow for our everyday use of computers, the software systems that support these applications, and the means and methods used to produce both applications and systems that behave reliably, correctly and ethically. At the heart of Computer Science lies the skill of computer programming and employers who hire Computer Scientists expect adept programmers with knowledge of current techniques and tools and the ability to apply sound engineering principles to the development, construction and maintenance of computer programs. The range of courses available in the department and the skills acquired by students enable them to find employment in many diverse fields of the economy and prepare our graduates for the computing industry, working in a project team (or research and development team), and to enable the graduate to bring specialist skills to that team. The course also provides the platform for further study or research through exposure to established and emerging technologies and methods, and to active fields of research in Computer Science.

The Department offers two undergraduate degree programmes, Bachelor of Science in Computer Science Single-Major (3:2:1:1) and Major-Minor (3:2:2:1) as well as Bachelor of Science in Information Technology
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
DCIT 101: Introduction to Computing
DCIT 104: Programming Fundamentals

Every student in the Department of Computer Science must own his or her own laptop. Students should consult the Department for the appropriate specification.

FACULTY

ACADEMIC STAFF

Ebenezer Owusu *BSc (Ghana), MSc. (Ghana) PhD (China*)	-	**Senior Lecturer** **(Head of Dept.)**
Ferdinand Apietu Katsriku	-	**Assoc Professor**

MEng(Kharkov), MSc(St Andrews),
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Samuel Winful - **Lecturer (Part Time)**
BSc (Ghana), MSc. (Ghana)

Grace Gyamfua Yamoah - **Assistant Lecturer (On Leave)**
BSc (All Nations), MSc.

NON-ACADEMIC STAFF

Gladys Boatemaa – Senior Administrative Assistant

Elizabeth Y. Qquaye – Administrative Assistant

Umar Iddriss Faruq – Principal Library Assistant

COMPUTER SCIENCE
PROGRAMME STRUCTURE

SINGLE MAJOR IN COMPUTER SCIENCE

LEVEL 200

SEMESTER I

Code	Title	Credits
Core		
UGRC 210	Academic Writing II	3
DCIT 201	Programming I	3
DCIT 203	Digital and Logic Systems Design	3
DCIT 205	Multimedia and Web Design	3
DCIT207	Computer Organization and Architecture	3
MATH 223	Calculus II	3
Total		**15**
Electives	**Students may select 3 credits from other departments**	

SEMESTER II

Code	**Title**	**Credits**
Core		
UGRC 220	Introduction to African Studies	3
DCIT202	Mobile Application Development	3
DCIT204	Data Structures & Algorithm I	3
DCIT206	Systems Administration	3
DCIT208	Software Engineering	3
Total		15
Electives: Select 3-6 credits		
DCIT 200	Internship	1
DCIT 212	Numerical and Computational Methods	3
DCIT 214	Information Modeling and Specification	3

Students who wish to be considered for Computer Science programme should select DCIT 212

LEVEL 300
SEMESTER I

Code	**Title**	**Credits**
Core		
DCIT 301	Operating Systems	3
DCIT 303	Computer Networks	3
DCIT 305	Database Fundamentals	3
DCIT 313	Introduction to Artificial Intelligence	3
MATH 359	Discrete Mathematics	3
Total		16
Electives: Students may select 3 credits		
DCIT 307	Mini-Project	1
DCIT 309	Embedded Systems and IoT	3
DCIT 311	Machine Learning	3

SEMESTER II

Code	Title	Credits
Core		
DCIT 302	Human Computer Interaction	3
DCIT 304	Research Methods	3

DCIT 308	Data Structures and Algorithms II	3
DCIT 312	Information Security Management	3
DCIT 318	Programming II	3
Total		15
Electives: Select 3-6 credits		
DCIT 306	Cloud Computing	3
DCIT 316	Computational models for Social Media Mining	3

LEVEL 400
SEMESTER I

Code	Title	Credits
Core		
DCIT 400	Project	3
DCIT 401	Social, Legal, Ethical and Professional Issues	3
DCIT 407	Image Processing	3
Total		9
Electives: Select 6-9 credits		
DCIT 403	Designing Intelligent Agents	3
DCIT 405	Statistical Models and Methods for Data Science	3
DCIT 411	Bioinformatics	3
DCIT 417	Network Performance Analysis and Modeling	3
DCIT 423	Network Servers and Infrastructure	3

SEMESTER II

Code	Title	Credits
Core		
DCIT 400	Project	3
DCIT 402	Management Principles in Computing	3
DCIT 418	Systems and Network Security	3
DCIT 428	Wireless Systems and Networks	3
Total		12
Electives: Select 3-9 credits		
DCIT 404	Advanced Databases	3
DCIT 406	Advanced Computer Networks	3
DCIT 408	Compilers	3
DCIT 426	Telecommunication Systems	3
DCIT 412	Computer Vision	3
DCIT 414	Data Mining and Warehousing	3
DCIT 416	Digital Signal Processing	3
DCIT 422	Information Visualization	3

COMBINED PROGRAMME IN COMPUTER SCIENCE

Students can major or minor in Computer Science. The Level 400 courses are for students who opt for a major in Computer Science only. Students minoring in Computer Science shall take at least 9 credits of any of the underlisted courses per semester at level 200 and 6 credits per semester at level 300. Students who intend to major in Computer Science shall take 9 credits per semester at level 200 and 12 credits per semester at level 300.

LEVEL 200
SEMESTER I

Code	Title	Credits

Core		
CBAS 210	Academic Writing II	3
DCIT 201	Programming I	3
DCIT 203	Digital and Logic Systems Design	3
MATH 223	Calculus II	3
Total		**12**

SEMESTER II

Code	**Title**	**Credits**
Core		
UGRC 220	Introduction to African Studies	3
DCIT202	Mobile Application Development	3
DCIT204	Data Structures & Algorithm I	3
DCIT208	Software Engineering	3
Total		**12**
	Select 9 credits from above	

LEVEL 300

SEMESTER I

Code	**Title**	**Credits**
Core		
DCIT 301	Operating Systems	3
DCIT 303	Computer Networks	3
DCIT 305	Database Fundamentals	3
Minor students shall select 6 credits from above Major students shall select all 9 credits. In addition, they shall select 3 credits from the electives below		**6-9**
Electives: Major students shall select minimum 3 credits from below		
DCIT 309	Embedded Systems and IoT	3
DCIT 313	Introduction to Artificial Intelligence	3

SEMESTER II

Code	**Title**	**Credits**
Core		
DCIT 302	Human Computer Interaction	3
DCIT 308	Data Structures and Algorithms II	3
Total	Major and minor students shall select all 6 credits above	**6**
Electives: Major students shall select all 6 credits		
DCIT 304	Research Methods	3
DCIT 318	Programming II	3

LEVEL 400

SEMESTER I

Code	**Title**	**Credits**
Core		
DCIT 400	Project	3
DCIT 401	Social, Legal, Ethical and Professional Issues	3
DCIT 407	Image Processing	3
Total		**9**
Electives		

DCIT 403	Designing Intelligent Agents	3
DCIT 405	Statistical Models and Methods for Data Science	3
DCIT 411	Bioinformatics	3
DCIT 417	Network Performance Analysis and Modeling	3
DCIT 423	Network Servers and Infrastructure	3

SEMESTER II

Code	Title	Credits
Core		
DCIT 400	Project	3
DCIT 402	Management Principles in Computing	3
DCIT 418	Systems and Network Security	3
DCIT 428	Wireless Systems and Networks	3
Total		**12**
Electives: Select minimum of 3 credits		
DCIT 404	Advanced Databases	3
DCIT 406	Advanced Computer Networks	3
DCIT 408	Compilers	3
DCIT 426	Telecommunication Systems	3
DCIT 412	Computer Vision	3
DCIT 414	Data Mining and Warehousing	3
DCIT 416	Digital Signal Processing	3
DCIT 422	Information Visualization	3

COMPUTER SCIENCE

Course Description

CBAS 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.

UGRC 220 African Studies

This course introduces students to the field of African Studies including Africa ‘s histories, peoples and cultures. The course will help students appreciate the contemporary value of African Studies as an area of enquiry and engage with discourses on African realities. It begins with a general introduction to the discipline, its history and values; continues with an introduction to Gender Studies in Africa; and thereafter students select from an extensive and diverse menu of electives ‘. While all students take the general introduction and the introduction to gender, students are registered into the electives that they will take in the second half of the semester.
The general introduction serves as the springboard from which to launch the entire course.

DCIT 200: Internship

Student in is now being recognized as adding value to student education. This scoring course provides students with opportunity to gain practical insight into the working world. Students will be encouraged to seek internship opportunities with companies. The idea is that this will help them come up with practical ideas for their project work.

DCIT 201: Programming I

This course is expected to give students the understanding of object-oriented methodology, the approach to modular and reusable software systems. Object orientation will be discussed from ground up, pointing out and explaining key concepts of object orientation, its justification and how it is applied in Software Engineering. Students will be exposed to at least four language implementation to the covered principles and concepts- Java, C#, Python and PHP. Topics include: Classes and Objects, Object Design and Programming – Encapsulation, Abstraction, Inheritance, Polymorphism, Composition, Aggregation, Method overloading, Interfaces, Exception Handling, Collections, etc. This course will ensure that students have adequate practical exposure.

DCIT 202: Mobile Application Development

This course deals with 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. Topics include an introduction to Objective-C, XCode IDE and will focus on designing, implementing and running of applications using the simulator for the various Apple devices. Students will leverage on their object oriented programming skills for concepts like classes, objects, inheritance, exception handling, and graphical user interface design.

DCIT 203: Digital and Logic Systems Design

This course will provide an overview of principles and Techniques of modern digital systems. This course exposes individuals to a wide array of classic as well as state of the art digital electronics technology. Topics Include: Introduction to numbers systems and codes, logics circuits, combinational and sequential logic, storage elements, digital arithmetic, integrated circuit logic families. An Overview of Technologies and Application of wide array of digital components used within state of the art IT Systems. An understanding of the applications of such digital devices embedded within telecommunications systems, storage systems, computing systems, multimedia systems, and computer networks.

DCIT 204: Data Structures and Algorithms I

This course introduces students to the fundamentals of computer algorithms, with emphasizes on methods useful in practice. Topic includes the Big-O notation, algorithms and their efficiency, basic algorithm strategies and approaches to problem solving. Approaches such as Sorting and searching algorithms, divide and conquer method, dynamic programming, greedy programming paradigms, graph theory and graph algorithms will be discussed.

DCIT 205: Multimedia and Web Design

This course delivers sound training in the latest web technologies that are relevant to build modern and feature-rich web applications. It provides insight into state-of-the-art web design practice and introduces emerging topics in web development such as package management and version control. Topics include: Introduction to HTML, CSS and JavaScript, understanding frameworks and tools for modern web development, exploring CSS frameworks – bootstrap and foundation, exploring JavaScript frameworks – VueJS, AngularJS, ReactJS, NodeJS, package management with npm and a gentle introduction to version control using github.

DCIT 206: Systems Administration

This course provides students with the skills and concepts that are essential to the administration of operating systems, networks, software, file systems, file servers, web systems, database systems and system documentation, policies, and procedures. Topics include: Installation, Configuration, Maintenance (service packs, patches), Client Services Support, Server services, thus, database, web, network services, Content management and deployment, Server administration and management, User and group management, Backup management, Security management, Disaster recovery, Resource management and Automation management.

DCIT 207 Computer Organization and Architecture

This course introduces students to understand and appreciate computer system's functional components, their characteristics, performance, interactions and in particular, the challenge of harnessing parallelism to sustain performance improvements now and into the future. Topics include CPU clock speed, cycles per instruction, memory size, and average memory access time, Organization of von Neumann machine, Instruction sets, format and types, Assembly/machine language programming, addressing modes, Subroutine call and return mechanisms, I/O and interrupts, Shared memory multiprocessors/multicore organization, Memory Organization and Architecture.

DCIT 208: Software Engineering

The course introduces students to concepts, techniques and principles of software engineering. The course covers software development process, from software characteristics to programming practices. Topics include the characteristics of software, software environments, software engineering, software myths, software realities, product vs processes, risks, project lifecycles, software processes, project management, people management, software requirements, analysis and specification, design software requirements, system models, architectural and detailed design, user interface design, programming practices.

DCIT 212: Numerical and Computational Methods
This course introduces students to numerical and computational methods appropriate for performing iterative methods for solving nonlinear equations; direct and iterative methods for solving linear systems; approximations of functions, derivatives, integrals and error analysis. Topics include Solving Numerical Algebraic and Transcendental Equations, Bisection Methods, False Position Method, Newton Raphson Method, Successive Approximation Method, Simultaneous Linear Algebraic Equations, Gauss Elimination Method, and Jacobi Method. Students will be expected to implement a range of numerical methods with Matlab and/or Python.

DCIT 214: Information Modeling and Specification
The course introduces students to database systems, modeling issues and the translation of models into relational tables. Topics include analysis and design in the software engineering lifecycle, develop object-oriented designs by applying established design principles, develop use-case and scenario descriptions of the requirements, develop descriptions of design models using UML diagrams, understand the role and influence of design patterns and frameworks in software design.

MATH 223: Calculus II
The first and the second derivatives of functions of a single variable and their applications. Topics include integration as a sum; definite and indefinite integrals; improper integrals. The logarithmic and exponential functions, the hyperbolic functions and their inverses. Techniques of integration including integration by parts, recurrence relations among integrals, applications of integral calculus to curves: arc length, area of surface of revolution. Ordinary differential equations: first order and second order linear equations with constants coefficients. Applications of first order differentials equations.

DCIT 301: Operating Systems
This course introduces students to basic principles of operating systems. Topics include: 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. Other 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.

DCIT 302: Human-Computer Interaction (HCI)
This course introduces students to designing interactions between human activities and the computational systems that support them, and with constructing interfaces to afford those interactions in HCI. Topics Include: Principles of user interface design, development, and programming, User psychology and cognitive science, menu system design, command language design, icon and window design, graphical user interfaces, web-based user interfaces. Principles of user interface design. Others include; Concepts for objectively and quantitatively assessing the usability of software user interfaces, designing Interaction, Programming Interactive Systems, User-Centered Design and Testing, New Interactive Technologies, emerging technologies are discussed.

DCIT 303: Computer Networks
This course covers both the Introduction to Networks and Routing and Switching Essentials in CCNA. The principles of IP addressing, and the fundamentals of Ethernet concepts, media, and operations are introduced to provide a foundation for the curriculum. At the end of the course students will be able to build simple LANs, perform basic configurations for routers and switches, and implementing IP addressing schemes, configure and troubleshoot routers and switches and resolve common issues with RIPv1, RIPv2, single-area and multi-area OSPF, virtual LANs, and inter-VLAN routing in both IPv4 and IPv6 networks.

DCIT 304: Research Methods
This course focuses on developing students researching and writing skills in the computing sciences domain. Students investigate different methods applicable and suitable for their research problem. Topic include examining different methods of acquiring knowledge, role of economic research, identification of a research problem and stating of research questions and hypotheses. Other topics are review of literature, purpose and principles of research design and the measurement design, methods of data collection and analysis; descriptive and inferential statistics; interpretation of data and proposal, and research writing.

DCIT 305: Database Fundamentals
In this course, students will be introduced to relational database concepts, E/R diagrams, normalization, and structured query language (SQL). Students will write and execute queries and sub-queries, create database objects (tables. views, indexes, sequences, functions, triggers, stored procedures), and manipulate data in tables. Topics covered in this course will include: Database Concepts and Architecture, Database Modelling and Design, Entity-Relationship Model, Normalization, Data Manipulation Language (DML), Data Definition Language (DDL), Data Control Language (DCL), Sub-queries, Multiple Tables, Database Views, Database Triggers, Stored Procedures, Decision and Control Structures, PL/SQL, and Transaction Processing.

DCIT 306: Cloud Computing
This course provides a hands-on comprehensive study of Cloud concepts and capabilities across the various Cloud service models IaaS, PaaS, SaaS, and Business Process as a Service (BPaaS). Topics include the evolution of infrastructure migration approaches thus, VMWare/Xen/KVM virtualization, adaptive virtualization, and Cloud Computing/on-demand resources provisioning (IaaS). Mainstream Cloud infrastructure services and related vendor solutions are also covered in detail. PaaS topics cover a broad range of Cloud vendor platforms including AWS, Google App Engine, Microsoft Azure, Eucalyptus, OpenStack as well as storage services that leverage Google Storage, Amazon S3, Amazon Dynamo.

DCIT 307: Mini-Project
Students use information technology as a tool to redesign business processes so the enterprise can achieve its objectives. Student teams analyze the business processes of real organizations, quantify the negative impact caused by current process challenges, then develop and present a compelling Business Case for Change. Students develop skills critical for preparing and delivering effective verbal briefings and presentations.

DCIT 308: Data Structures and Algorithms II
This course introduces students to topics in data structures and relevant algorithms required for their implementation. Topics include analysis techniques (asymptotic worst case, expected time, amortized analysis, and reductions between problems), 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, and weighted graph algorithms.

DCIT 311: Machine Learning
In this introductory course covers the basic theory and algorithms that form the core of machine learning. Machine Learning draws on concepts and results from many fields and forms a key technology in Big Data, and in many financial, medical, commercial, and scientific applications. Topics covered in this course are The Learning Problem, The Linear Model I, Error and Noise, Training versus Testing, Theory of Generalization, The VC Dimension, Bias-Variance Tradeoff, Neural Networks, Overfitting, Regularization, Validation, Support Vector Machines, decision trees, Kernel Methods, Radial Basis Functions, Learning Principles, Deep Learning, Epilogue.

DCIT 312: Information Security Management
This course introduces students to a range of concepts, approaches and techniques that are applicable in Information Security Management Principles. Topics include Knowledge of the concepts relating to information security management, understanding of current national legislation and regulations which impact upon information security management, Awareness of current national and international standards, frameworks and organizations which facilitate the management of information security.

DCIT 313: Introduction to Artificial Intelligence

This course introduces students to 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. Topics include 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. Other topics are state space search, logic, and resolution theorem proving. Application areas may include expert systems, natural language understanding, planning, machine learning, or machine perception.

DCIT 316: Computational models for Social Media Mining
This course will introduce students to computational methods for extracting social and interactional meaning from large volumes of text and speech (both traditional media and social media). The use of computational techniques to model social phenomena and the use of data analytics to learn models of (and to predict) social phenomena using real data will be taught. Topics will include: Sentiment Analysis, Emotion and Mood Analysis, Belief Analysis and Hedging, Deception Detection, Argumentation Mining and Social Power analysis.

DCIT 318: Programming II
The course introduces students to advanced application software development using Microsoft application development platform. It teaches students how to design desktop and web based application software using the design tools available in Microsoft Visual Studio. Topics to be covered in this course include introduction to C# Syntax, Methods, Classes and Inheritance, Exceptions handling and Monitoring, UI design using windows forms, controls, menus, and toolbar, Reading and writing files on to local disk and Accessing a Database using ADO.Net, LINQ and Entity Data Models, Accessing Remote Data using the types in the System.Net namespace, and WCF Data Services, UI design using XAML.

DCIT 400: Project
The project work provides students with experience in carrying out a significant computer science project from conception to completion with minimal supervision and assistance. It comprises of the design, implementation and documentation of a significant software or hardware system, but theoretical investigations are equally valid. Other project ideas which do not fall into any of these categories are also possible. A faculty member and the student will agree on a topic and appropriate scope of work before the project begins. All project work must be done independently by individual students.

DCIT 401: Social, Legal, Ethical and Professional Issues
This course introduces students to legal, social, and ethical issues surrounding software development and computer use. The course is designed to raise students' awareness about ethics in Information Technology and in research. Topics include Professional conduct, social responsibility and rigorous standards for software testing and reliability will be stressed. Issues such as Cyberspace Privacy Laws and Issues, Cyberspace Free Speech Laws and Issues, liability, intellectual property laws and issues, security and crime will be examined in the context of computer use, Professionalism and Workplace issues in the IT field, Contracts and Leadership.

DCIT 402: Management Principles in Computing
This course provides an understanding of the nature and importance of managing and of management as a developed and important science. Topics include 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.

DCIT 404: Advanced Databases
This course introduces students to the skills necessary to become a Database administrators. Topics covered in this course will includes Database Architecture, installation configuration of the Oracle Network Environment, Managing Database Storage Structures, Administering User and Database Security, Oracle object management, Managing Concurrency & Locks, Undo Data, Network environment: oracle shared servers, performance monitoring & management, etc. Other topics include creation of an operational database and management of the structures in an effective and efficient manner, including performance monitoring, database security, user management, performance tuning, and backup/recovery techniques.

DCIT 405: Statistical Models and Methods for Data Science

The course shall cover intermediate topics in probability and statistics required for data scientists to analyze and interpret data. Topics to be covered include: The probability theory and statistical inference used in data science; Probabilistic models, random variables, useful distributions, expectations, law of large numbers, central limit theorem; Statistical inference; point and confidence interval estimation, hypothesis tests, linear regression. Students shall use statistical tools such as XLMiner, SPSS, MS Excel during lab sections.

DCIT 406: Advanced Computer Networks
This course introduces students to Scaling Networks and Connecting Networks in CCNA. Topics include Scaling Networks architecture, components, and operations of routers and switches, Connecting Network WAN technologies and network services, configuration of routers and switches for advanced functionality, configuration and troubleshooting network devices and resolve common issues with data link protocols, implementing IPSec and virtual private network operations in complex networks.

DCIT 407: Image Processing
The course covers techniques and tools for digital image processing, and finally also introduce image analysis techniques in the form of image segmentation. The course is primarily meant to develop on-hand experience in applying these tools to process these images. Hence the programming assignments form a key component of this course. The topics to be covered are: Digital image fundamentals: representation, sampling and quantization, image acquisition, basic relationships between pixels, imaging geometry; Image transforms: discrete Fourier transform, discrete cosine transform, Walsh and Hadamard transforms, Hotelling transform; Image enhancement: in spatial domain and in frequency domain, image smoothing and sharpening.

DCIT 408: Compilers
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. 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 compiler for simple but nontrivial programming language. Modules, interfaces, tools. Topics Include: Compiler Design; Lexical Analysis; Syntax Analysis- grammars, LL (1) parsers, LR (1) parsers; Semantic Processing; Code generation and optimization.

DCIT 411: Bioinformatics
The aim of this course is to introduce students to the computational techniques used in the field of bioinformatics. To reinforce the theory underlying the concepts and techniques of sequence analysis and post-genomic bioinformatics. The course introduces basic concepts of molecule biology, sequence analysis and genomic era biology. It introduces a number of many different tools and their usage, as well as the analysis algorithms behind some of them. Topics include: Basic concepts of molecular biology: genomes, transcriptomes, proteomes. Sequence analysis: genome annotation, sequence alignment, multiple sequence alignment, Phylogenetic analysis, Protein families, Database searching tools.

DCIT 412: Computer Vision
This course will cover essentials of computer vision. Students will learn basic principles of image formation, image processing algorithms and different algorithms for 3D reconstruction and recognition from single or multiple images (video). Applications to 3D modelling, video analysis, video surveillance, object recognition and vision-based control will be discussed

DCIT 414: Data Mining and Warehousing
The course aims to provide students with viable alternatives for managers rather than replacing judgment with an optimized solution. It also aims to enable students to acquire an understanding of the basic concepts and skills associated with decision-making and the modelling of business decisions using data. This course is an 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.

DCIT 416: Digital Signal Processing

This course provides an introduction to digital signal processing for both undergraduate. In this course, a detailed examination of basic digital signal processing operations including sampling/reconstruction of continuous time signals, Fourier and Z-transforms will be given. The Fourier and Z-transforms will be used to analyze the stability of systems, and to find the system transfer function. The discrete Fourier transform (DFT) and fast Fourier transform (FFT) will be studied, etc. Further, computer simulation exercises are intended to familiarize the student with implementation aspects and the application of theoretical knowledge to practical problems.

DCIT 417: Network Performance Analysis and Modeling
This course aims to develop an understanding of the tools and technologies for understanding and improving the performance of communication networks such as the Internet. It will introduce students to quantitative methods for loss and delay analysis in packet networks, using techniques from stochastic traffic modelling, Markov chains, and queueing theory. It will expose students to frameworks for optimization and orchestration of network performance, including emerging paradigms such as SDN. The quantitative methods studied in this course will be applied to practical examples from network architecture and design, in different network domains.

DCIT 418: Systems and Network Security
This course provides a comprehensive study of security principles and practices in computer and network systems. Topics include computer security concepts, attack techniques, security policies, basic cryptographic tools, authentication, access control, network intrusion detection, software security, operating system security, network security, legal and ethical issues in computer security.

DCIT 422: Information Visualization
This course introduces to students 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).

DCIT 423: Network Servers and Infrastructure
Covers IP networking concepts and practices for using DHCP, DNS, secure communication, routing, remote address services, web servers, and network connectivity between operating systems. Students learn TCP/IP, routing architecture, and understand application-level services used in Internet. Through networking lab sessions, students focus on using switches and routers connected in LANs and WANs.

DCIT 426: Telecommunication Systems
This course introduces students to the latest mobile systems. Topics to be covered include, WCDMA concepts, Multi-User Detection, Antenna Array techniques, MIMO, high speed packet access, long term evolution, radio resource management, packet scheduling, core network evolution. Multimedia: Image and video representation and transmission. Competing technologies: WiFi, WiMAX, FttX. Emerging techniques: may include MANET, cognitive radio. Other topics contemporary and emerging wide area data technologies, Emerging research areas in telecommunications, and the interaction between commercial interests and technology standards.

DCIT 428: Wireless Systems & Networks
This course introduces students to the fundamental principles underlying wireless data communications. Topics include wireless transmission basics, radio propagation issues, antennas, digital modulation, spread spectrum techniques and their applications, and popular standards: WiFi, WiMAX and Bluetooth. Also presents practical knowledge to enable the design, testing, deployment, debugging and commissioning of WiFi, WiMAX networks and point-to-point microwave systems. Discussions on cellular network technologies are also included.

INFORMATION TECHNOLOGY
PROGRAMME STRUCTURE

LEVEL 200

SEMESTER I

Code	Title	Credit
CBAS 210	Academic Writing II	3
DCIT 201	Programming I	3
DCIT 203	Digital and Logic Systems Design	3
DCIT 205	Multimedia and Web Design	3
DCIT 207	Computer Organization and Architecture	3
DCIT 209	E-Business Architectures	3
Total Credits		**18**

SEMESTER II

Code	Title	Credits
Core		
UGRC 220	Introduction to African Studies	3
DCIT 200	Internship	1
DCIT 202	Mobile Application Development	3
DCIT 204	Data Structures & Algorithm I	3
DCIT 206	Systems Administration	3
DCIT 208	Software Engineering	3
DCIT 214	Information Modelling and Specification	3
Total Credits		**19**

LEVEL 300
SEMESTER I

Code	Title	Credits
Core		
DCIT 301	Operating Systems	3
DCIT 303	Computer Networks	3
DCIT 305	Database Fundamentals	3
DCIT 307	Mini-Project	1
DCIT 313	Introduction to Artificial Intelligence	3
DCIT 317	IT Project Management	3
Total		**16**
Electives: Select 3 Credits		
DCIT 315	Principles of 3D Environment	3
DCIT 321	Software Evolution	3
Total Credits (+1 Electives)		**16+(3) = 19**

SEMESTER II

Code	Title	Credits
Core		
DCIT 302	Human Computer Interaction	3
DCIT 304	Research Methods	3
DCIT 306	Cloud Computing	3
DCIT 312	Information Security Management	3
DCIT 318	Programming II	3
	Total	15

Electives: Select 3-6 credits		
DCIT 308	Data Structures and Algorithms II	3
DCIT 314	Game Engine Architecture	3
DCIT 322	Database Management Administration	3
Total Credits (+2 Electives)		**15+(3/6) = 18/21**

LEVEL 400
SEMESTER I

Code	**Title**	**Credits**
Core		
DCIT 400	Project	3
DCIT 401	Social, Legal, Ethical and Professional Issues	3
DCIT 409	Digital Forensics	3
	Total	09
Electives: Select 3-9 Credits		
DCIT 413	Play and Games	3
DCIT 415	Advanced Software Engineering	3
DCIT 419	Agile Methods	3
DCIT 421	Persuasive Systems Development	3
Total Credits (+2 or +3 Electives)		**9+(6/9) = 15/18**

SEMESTER II

Code	**Title**	**Credits**
Core		
DCIT 400	Project	3
DCIT 402	Management Principles in Computing	3
DCIT 418	Systems and Network Security	3
DCIT 428	Wireless Systems and Networks	3
Total		12
Electives: Select 3-6 Credits		
DCIT 404	Advanced Databases	3
DCIT 406	Advanced Computer Networks	3
DCIT 408	Compilers	3
DCIT 412	Computer Vision	3
DCIT 414	Data Mining and Warehousing	3
DCIT 416	Digital Signal Processing	3
DCIT 422	Information Visualization	3
DCIT 426	Telecommunication Systems	3
Total Credits (+1 or +3 Electives)		**12+(3/6) = 15/18**

INFORMATION TECHNOLOGY

Course Descriptions

DCIT 200: Internship

This internship is designed to give students opportunity to work in a cooperate environment to explore career alternatives, integrate theory and practice, develop communication, interpersonal skills and other critical skills for job success. The internship also creates an environment for students to improve their practical skills and gain industrial

experience. Student internship provides students with the opportunity to gain practical insight into the working world. Students will be encouraged to seek internship opportunities with companies. The idea is to help them come up with practical ideas for their project work and to have the experience of working with corporate organizations.

DCIT 201: Programming I
This course is designed to give students an understanding of object-oriented methodology, and the approach to modular and reusable software systems. Object orientation will be discussed from ground up, pointing out and explaining key concepts of object orientation, its justification and how it is applied in Software Engineering. Principles and concepts from four programming languages - Java, C#, Python and PHP will be discussed. Topics include: overview of Methods, Classes and Objects, Object Design and Programming – Encapsulation, Abstraction, Inheritance, Polymorphism, Composition, Aggregation, Method overloading, Interfaces, Exception Handling, Collections, etc.

DCIT 202: Mobile Application Development
This course deals with 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. Topics include an introduction to Objective-C, XCode IDE and will focus on designing, implementing and running of applications using the simulator for the various Apple devices. Students will leverage on their object-oriented programming skills for concepts like classes, objects, inheritance, exception handling, and graphical user interface design.

DCIT 203: Digital and Logic Systems Design
This course will provide students with an overview of principles and Techniques of modern digital systems. Topics Include: Introduction to number systems and codes, logic circuits, combinational and sequential logic, storage elements, digital arithmetic, integrated circuit logic families. An Overview of Technologies and Application of wide array of digital components used within state-of-the-art IT Systems. An understanding of the applications of such digital devices embedded within telecommunications systems, storage systems, computing systems, multimedia systems, digital electronic technologies and computer networks will enable students to meet the growing needs of industry.

DCIT 204: Data Structures and Algorithms I
This course introduces students to the fundamentals of computer algorithms, with emphasizes on methods useful in practice. Topic includes the Big-O notation, algorithms and their efficiency, basic algorithm strategies and approaches to problem solving. Approaches such as Sorting and searching algorithms, divide and conquer method, dynamic programming, greedy programming paradigms, graph theory and graph algorithms will be discussed.

DCIT 205: Multimedia and Web Design
This course delivers sound training in the latest web technologies that are relevant to build modern and feature-rich web applications. It provides insight into state-of-the-art web design practice and introduces emerging topics in web development such as package management and version control. Topics include: Introduction to HTML, CSS and JavaScript, understanding frameworks and tools for modern web development, exploring CSS frameworks – bootstrap and foundation, exploring JavaScript frameworks – VueJS, AngularJS, ReactJS, NodeJS, package management with npm and a gentle introduction to version control using github.

DCIT 207 Computer Organization and Architecture
This course introduces students to understand and appreciate computer system's functional components, their characteristics, performance, interactions and in particular, the challenge of harnessing parallelism to sustain performance improvements now and into the future. Topics include CPU clock speed, cycles per instruction, memory size, and average memory access time, Organization of von Neumann machine, Instruction sets, format and types, Assembly/machine language programming, addressing modes, Subroutine call and return mechanisms, I/O and interrupts, Shared memory multiprocessors/multicore organization, Memory Organization and Architecture.

DCIT 208: Software Engineering
The course introduces students to concepts, techniques and principles of software engineering. The course covers software development process, from software characteristics to programming practices. Topics include the

characteristics of software, software environments, software engineering, software myths, software realities, product vs processes, risks, project lifecycles, software processes, project management, people management, software requirements, analysis and specification, design software requirements, system models, architectural and detailed design, user interface design, programming practices.

DCIT 209: E-Business Architectures
This course introduces students to concepts, vocabulary, and procedures associated with E-Commerce and the Internet. Topics include e-business, the evolution of the Internet and E-Commerce, features of Web sites and the tools used to build an E-Commerce web site, marketing issues, payment options, security issues, and customer service. Others include B2B, B2C, E-commerce, supply-chain, and emerging business models.

DCIT 212: Numerical and Computational Methods
This course introduces students to numerical and computational methods appropriate for performing iterative methods for solving nonlinear equations; direct and iterative methods for solving linear systems; approximations of functions, derivatives, integrals and error analysis. Topics include Solving Numerical Algebraic and Transcendental Equations, Bisection Methods, False Position Method, Newton Raphson Method, Successive Approximation Method, Simultaneous Linear Algebraic Equations, Gauss Elimination Method, and Jacobi Method. Students will be expected to implement a range of numerical methods with Matlab and/or Python.

DCIT 214: Information Modeling and Specification
The course introduces students to database systems, modeling issues and the translation of models into relational tables. Topics include analysis and design in the software engineering lifecycle, develop object-oriented designs by applying established design principles, develop use-case and scenario descriptions of the requirements, develop descriptions of design models using UML diagrams, understand the role and influence of design patterns and frameworks in software design.

DCIT 301: Operating Systems
This course introduces students to basic principles of operating systems. Topics include: 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. Other 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.

DCIT 302: Human-Computer Interaction (HCI)
This course introduces students to designing interactions between human activities and the computational systems that support them, and with constructing interfaces to afford those interactions in HCI. Topics Include: Principles of user interface design, development, and programming, User psychology and cognitive science, menu system design, command language design, icon and window design, graphical user interfaces, web-based user interfaces. Principles of user interface design. Others include; Concepts for objectively and quantitatively assessing the usability of software user interfaces, designing Interaction, Programming Interactive Systems, User-Centered Design and Testing, New Interactive Technologies, emerging technologies are discussed.

DCIT 303: Computer Networks
This course covers both the Introduction to Networks and Routing and Switching Essentials in CCNA. The principles of IP addressing, and the fundamentals of Ethernet concepts, media, and operations are introduced to provide a foundation for the curriculum. At the end of the course students will be able to build simple LANs, perform basic configurations for routers and switches, and implementing IP addressing schemes, configure and troubleshoot routers and switches and resolve common issues with RIPv1, RIPv2, single-area and multi-area OSPF, virtual LANs, and inter-VLAN routing in both IPv4 and IPv6 networks.

DCIT 304: Research Methods

This course focuses on developing students researching and writing skills in the computing sciences domain. Students investigate different methods applicable and suitable for their research problem. Topic include examining different methods of acquiring knowledge, role of economic research, identification of a research problem and stating of research questions and hypotheses. Other topics are review of literature, purpose and principles of research design and the measurement design, methods of data collection and analysis; descriptive and inferential statistics; interpretation of data and proposal, and research writing.

DCIT 305: Database Fundamentals
In this course, students will be introduced to relational database concepts, E/R diagrams, normalization, and structured query language (SQL). Students will write and execute queries and sub-queries, create database objects (tables. views, indexes, sequences, functions, triggers, stored procedures), and manipulate data in tables. Topics covered in this course will include: Database Concepts and Architecture, Database Modelling and Design, Entity-Relationship Model, Normalization, Data Manipulation Language (DML), Data Definition Language (DDL), Data Control Language (DCL), Sub-queries, Multiple Tables, Database Views, Database Triggers, Stored Procedures, Decision and Control Structures, PL/SQL, and Transaction Processing.

DCIT 306: Cloud Computing
This course provides a hands-on comprehensive study of Cloud concepts and capabilities across the various Cloud service models IaaS, PaaS, SaaS, and Business Process as a Service (BPaaS). Topics include the evolution of infrastructure migration approaches thus, VMWare/Xen/KVM virtualization, adaptive virtualization, and Cloud Computing/on-demand resources provisioning (IaaS). Mainstream Cloud infrastructure services and related vendor solutions are also covered in detail. PaaS topics cover a broad range of Cloud vendor platforms including AWS, Google App Engine, Microsoft Azure, Eucalyptus, OpenStack as well as storage services that leverage Google Storage, Amazon S3, Amazon Dynamo.

DCIT 307: Mini-Project
Students use information technology as a tool to redesign business processes so the enterprise can achieve its objectives. Student teams analyze the business processes of real organizations, quantify the negative impact caused by current process challenges, then develop and present a compelling Business Case for Change. Students develop skills critical for preparing and delivering effective verbal briefings and presentations.

DCIT 308: Data Structures and Algorithms II
This course introduces students to topics in data structures and relevant algorithms required for their implementation. Topics include analysis techniques (asymptotic worst case, expected time, amortized analysis, and reductions between problems), 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, and weighted graph algorithms.

DCIT 312: Information Security Management
This course introduces students to a range of concepts, approaches and techniques that are applicable in Information Security Management Principles. Topics include Knowledge of the concepts relating to information security management, understanding of current national legislation and regulations which impact upon information security management, Awareness of current national and international standards, frameworks and organizations which facilitate the management of information security.

DCIT 313: Introduction to Artificial Intelligence
This course introduces students to 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. Topics include 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. Other topics are state space search, logic, and resolution theorem proving. Application areas may include expert systems, natural language understanding, planning, machine learning, or machine perception.

DCIT 314: Game Engine Architecture

This course provides students with an introduction to the theory and practice of video game programming. Topics would include real-time programming and the game loop, human interface devices, 3D rendering, collision detection, skeletal animation, rigid body dynamics, game object models, event-driven programming, game scripting languages. Students will participate real game development, design and build functional game using an existing game engine (e.g. XNA) and design and implement engine subsystems and integrat 3rd party components.

DCIT 315: Principles of 3D Environment
This course introduces students to 3D concepts for game play, modeling, and programming with a view on current and future technologies for electronic game design. Topics include graphics, game scripting, game engines, motion control, narrative in games, game interfaces, artificial intelligence, music and sound, "Serious Games" and social and interface issues of game development. Students will explore game engine software framework to design and implement games, animation techniques, physics simulation, user controls, graphical methods, and intelligent behaviors, Game Studio for control of objects and interactions in 2D and 3D game worlds.

DCIT 317: IT Project Management
This course is designed to equip students develop project management skills needed to better manage IT projects. Topics include IT project management lifecycle, IT project management concepts such as initiating, planning, controlling, executing, and closing projects. Other topics will focus on how IT projects should be managed, from inception to post-implementation review. The audience who take this course will likely improve their management skills and abilities to define the project scope, create a workable project plan, and manage within the budget and schedule.

DCIT 318: Programming II
The course introduces students to advanced application software development using Microsoft application development platform. It teaches students how to design desktop and web based application software using the design tools available in Microsoft Visual Studio. Topics to be covered in this course include introduction to C# Syntax, Methods, Classes and Inheritance, Exceptions handling and Monitoring, UI design using windows forms, controls, menus, and toolbar, Reading and writing files on to local disk and Accessing a Database using ADO.Net, LINQ and Entity Data Models, Accessing Remote Data using the types in the System.Net namespace, and WCF Data Services, UI design using XAML.

DCIT 321: Software Evolution
This course introduces students to the state-of-the-art methods, tools, and techniques for evolving software based on the current software engineering research literature. Students will be expected to read current literature on software evolution since the course will be discussion based. Software evolution plays a key role in software development. In most cases, programmers do not build software from scratch but rather modify existing software to provide new features to customers and fix defects in existing software. Evolving software systems is often a time-consuming and error-prone process.

DCIT 322: Database Management Administration
The course introduces students to database management administration concepts and practices. This course will cover 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 Normalization 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.

DCIT 400: Project
The project work provides students with experience in carrying out a significant computer science project from conception to completion with minimal supervision and assistance. It comprises of the design, implementation and documentation of a significant software or hardware system, but theoretical investigations are equally valid. Other project ideas which do not fall into any of these categories are also possible. A faculty member and the student will agree on a topic and appropriate scope of work before the project begins. All project work must be done independently by individual students.

DCIT 401: Social, Legal, Ethical and Professional Issues
This course introduces students to legal, social, and ethical issues surrounding software development and computer use. The course is designed to raise students' awareness about ethics in Information Technology and in research. Topics include Professional conduct, social responsibility and rigorous standards for software testing and reliability will be stressed. Issues such as Cyberspace Privacy Laws and Issues, Cyberspace Free Speech Laws and Issues, liability, intellectual property laws and issues, security and crime will be examined in the context of computer use, Professionalism and Workplace issues in the IT field, Contracts and Leadership.

DCIT 402: Management Principles in Computing
This course provides an understanding of the nature and importance of managing and of management as a developed and important science. Topics include 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.

DCIT 404: Advanced Databases
This course introduces students to the skills necessary to become a Database administrators. Topics covered in this course will includes Database Architecture, installation configuration of the Oracle Network Environment, Managing Database Storage Structures, Administering User and Database Security, Oracle object management, Managing Concurrency & Locks, Undo Data, Network environment: oracle shared servers, performance monitoring & management, etc. Other topics include creation of an operational database and management of the structures in an effective and efficient manner, including performance monitoring, database security, user management, performance tuning, and backup/recovery techniques.

DCIT 406: Advanced Computer Networks
This course introduces students to Scaling Networks and Connecting Networks in CCNA. Topics include Scaling Networks architecture, components, and operations of routers and switches, Connecting Network WAN technologies and network services, configuration of routers and switches for advanced functionality, configuration and troubleshooting network devices and resolve common issues with data link protocols, implementing IPSec and virtual private network operations in complex networks.

DCIT 409: Digital Forensics
This course introduces students to range of topics related to computer crime, relevant laws, agencies, and standards. The course covers auditing, logging, forensics, and related software, legal principles such as chain of evidence, electronic document discovery, eavesdropping, and entrapment. Topics Include: The legal and technical aspects of computer forensics. Applicable laws and the roles of legal authorities. How to obtain and handle digital evidence and will have been exposed to a range of freeware forensic tools.

DCIT 412: Computer Vision
This course introduces students to the essentials of computer vision. Topics include basic principles of image formation, image processing algorithms and different algorithms for 3D reconstruction and recognition from single or multiple images (video). Other topics are applications to 3D modelling, video analysis, video surveillance, object recognition and vision-based control.

DCIT 413: Play and Games
This course introduces students to the underlying principles of video games. The course examines the concept of "play" using methods from literary criticism, cultural anthropology, poststructuralism, and cinema studies. Topics include the philosophy of action, ludology, and theories of machinic and gamic visuality, social realism, and war games. Other topics include what is "Play"?, formal criticism, Poststructuralism: Narrative, Authorship and Play, Counter-Gaming: The Politics of Play and artist game mods, Ideology and War, and Gamic Vision.

DCIT 414: Data Mining and Warehousing
This course introduces students to the basic concepts and skills associated with decision-making and the modelling of business decisions using data. The covers introduction to data mining and its motivating challenges, types of data,

measures of similarity and distance, data exploration and warehousing, supervised learning, bias and variance. Topics include Classification techniques and their evaluation, Clustering, Association and sequence rule mining.

DCIT 415: Advanced Software Engineering
The course introduces students to the discipline of software engineering (gained in the earlier Software Engineering course). The course will also provide an on-going project clinic to directly support a group project work. Topics that will be covered include verification and validation, Testing and inspection, Reliability, software evolution, advanced design topics such as system architecture design, object-oriented design and functional-oriented design, and finally, the Business aspect of software engineering. Although the emphasis will be on modern approaches some more traditional software engineering techniques will also be discussed.

DCIT 416: Digital Signal Processing
This course provides an introduction to digital signal processing. Topics include introduction to digital signal processing operations including sampling/reconstruction of continuous time signals, Fourier and Z-transforms (the Fourier and Z-transforms will be used to analyze the stability of systems, and to find the system transfer function). Other topics include discrete Fourier transform (DFT) and fast Fourier transform (FFT), etc.

DCIT 418: Systems and Network Security
This course provides a comprehensive study of security principles and practices in computer and network systems. Topics include computer security concepts, attack techniques, security policies, basic cryptographic tools, authentication, access control, network intrusion detection, software security, operating system security, network security, legal and ethical issues in computer security.

DCIT 419: Agile Methods
This course introduces students to agile methods, how they are implemented and their impact on software engineering. Topics include agile methods, Scrum and Extreme Programming, Issues associated with planning and controlling agile projects, implications of empowered teams on the customer-supplier dynamic and how the agile practices are realized. Other topics include enterprise agility, team dynamics, collaboration, software quality, and metrics for reporting progress.

DCIT 421: Persuasive Systems and Design
In this course students will be introduced to the philosophy underpinning human computer persuasion. They will explore the latest research results, best practices and guidelines for the use of persuasive applications. In this course, student will work on real-world projects to design and implement persuasive technology applications. In addition, the course will host several expert guest speakers from industry and higher education institutions who will share their latest findings. Topics include, persuasive technologies, modeling human attitude behavior change, persuasive system features, technology, design perspectives, methods for designing persuasive systems, ethical issues and unexpected effects of persuasive technologies and disruptive technologies.

DCIT 422: Information Visualization
This course introduces to students 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).

DCIT 426: Telecommunication Systems
This course introduces students to the latest mobile systems. Topics to be covered include, WCDMA concepts, Multi-User Detection, Antenna Array techniques, MIMO, high speed packet access, long term evolution, radio resource management, packet scheduling, core network evolution. Multimedia: Image and video representation and transmission. Competing technologies: WiFi, WiMAX, FttX. Emerging techniques: may include MANET, cognitive radio. Other topics contemporary and emerging wide area data technologies, Emerging research areas in telecommunications, and the interaction between commercial interests and technology standards.

DCIT 428: Wireless Systems & Networks
This course introduces students to the fundamental principles underlying wireless data communications. Topics include wireless transmission basics, radio propagation issues, antennas, digital modulation, spread spectrum techniques and their applications, and popular standards: WiFi, WiMAX and Bluetooth. Also presents practical knowledge to enable the design, testing, deployment, debugging and commissioning of WiFi, WiMAX networks and point-to-point microwave systems. Discussions on cellular network technologies are also included.

INFORMATION TECHNOLOGY
PROGRAMME STRUCTURE

LEVEL 200
SEMESTER I

CODE	TITLE	CREDITS
UGRC210	Academic Writing II	3
CSIT 201	Professional, Legal, Moral and Ethical issues in Information Technology	3
CSIT 203	Computer Hardware Fundamentals	3
CSIT 205	Object Oriented Techniques for IT Problem Solving	3
CSIT 207	Database Fundamentals	3
UGBS 201	Microeconomics and Business	3
	Total Credits	**18**

SEMESTER II

CODE	TITLE	CREDITS
CSIT 202	Introduction to Computer and Networks	3
CSIT 204	Introduction to Information Security	3
UGRC 220-238	Introduction to African Studies	3
CSIT 206	Applied IT Programming	3
CSIT 208	Multimedia and Web Design	3
UGBS 204	Macroeconomics and Business	3
	Total Credits	**18**

LEVEL 300
SEMESTER I

CODE	TITLE	CREDITS
CSIT 301	Mobile Development	3
CSIT 303	Human Computer Interaction	3
CSIT 305	Operating Systems Fundamentals	3
CSIT 321	Principles of Accounting	3

Electives (6 Credits): Select from your Concentration
Network and Telecommunications

CSIT 307	Digital and Logic Systems Design	3
CSIT 309	Data Network Security I	3

Information Security

CSIT 309	Data Network Security I	3
CSIT 311	Information Security Principles	3

Database Technology and Programming

CSIT 313	Programme Design and Data Structures	3
CSIT 315	Event-Driven Programming	3

Web Development and Multimedia

CSIT 317	Web Development I	3
CSIT 319	Web Site Administration	3

Total Credits **18**

SEMESTER II

CODE	TITLE	CREDITS
CSIT 302	Data Communications	3
CSIT 304	IT in the Global Economy	3
CSIT 306	IT Resources Planning	3
CSIT 308	Turning Ideas into Successful Companies	3
CSIT 310	Design Project I	3

ELECTIVES (3)
Select from your Concentration:
Network and Telecommunications

CSIT 312	Network Servers and Infrastructures Administration	3

Information Security

CSIT 312	Network Servers and Infrastructures Administration	3

Database Technology and Programming

CSIT 314	Database Management System Administration	3

Web Development and Multimedia

CSIT 316	Web Development using Content Management Systems	3

Total Credits **18**

LEVEL 400
SEMESTER I
ELECTIVES (15 CREDITS)
Select 12 credits from your concentration 3 credits from any other concentration

CODE	TITLE	CREDITS

Web Development and Multimedia

CSIT 401	Digital Media Editing	3
CSIT 403	Graphics & Information Visualization	3
CSIT 405	Web II: Advanced Web Development	3
CSIT 407	Applied Knowledge Technologies for the Semantic Web	3

Network and Telecommunications

CSIT 409	Cloud Computing	3
CSIT 411	Advanced Networking Principles	3
CSIT 413	Wireless Systems and Networks	3
CSIT 415	Applications of Digital Technologies	3

CODE	TITLE	CREDITS

Database Technology and Programming

CSIT 417	Information Storage and Management Technologies	3
CSIT 419	Advanced Database	3

CSIT 421	Information Retrieval and XML Data	3
CSIT 405	Web II Advance Web Development	3

Information Security

CSIT 411	Advanced Networking Principles	3
CSIT 425	Computer Crime, Forensics, and Auditing	3
CSIT 417	Information Storage and Management Technologies	3
CSIT 431	Data Network Security II	3

Total Credits 15

SEMESTER II

CORE

CODE	TITLE	CREDITS
CSIT 402	Concepts of Multimedia Processing and Transmission	3
CSIT 410	Design Project II	3

ELECTIVES (6) CREDITS)

SELECT FROM YOUR CONCENTRATION

Network and Telecommunications

CSIT 404	Voice Communications Technologies	3
CSIT 406	Fundamentals of Satellite Communications	3

Web Development and Multimedia

CSIT 408	Development – E-Business	3
CSIT 412	Advance Web Technologies- E-Commerce	3

Information Security (INFS)

CSIT 416	Information Defense Technologies	3
CSIT 418	Database and Distributed System Security Principles	3

Database Technology and Programming

CSIT 424	Parallel & Distributed Databases	3
CSIT 426	Data Mining & Data Warehousing	3

Total Credits

Course Descriptions

UGBS 201: Microeconomics and Business

This course will cover the principles of microeconomic analysis which will equip students to understand basic economic principles and help them make better economic decisions than they otherwise would. The course will focus on the working of markets and institutions in allocating economic resources. In this course, students will be introduced to basic economic theories such as Demand and Supply, Consumer Behaviour, the Theory of the Firm and Market Structures, the Theory of Production, Cost Theory and Market Structures.

UGBS 204: Macroeconomics and Business

This course deals with the interactions within the whole economy of economic variables and agents and their effect on economic activity. It will therefore look at the broad aggregate of economic behaviour and demand by households, firms and the government. The relevance of these interactions with respect to business will be emphasized. Topics will include National Income Accounting, National Income Determination, Aggregate Demand, Fiscal Policy and Foreign Trade, Money and Banking, Monetary and Fiscal Policies in a Closed Economy, Aggregate Demand, Aggregate Supply and Prices, Inflation and Unemployment, Exchange Rate and the Concept of Balance of Payments, International Trade and Economic Growth

CSIT 201: Professional, Legal, Moral and ethical issues in IT

Explores how IT changed nature of society and contributed to evolution of global economy. This course examines changing nature of work, education, and communication, and ethical issues such as intellectual property rights, computer-related crime, privacy concerns, and public policy issues. It also includes intensive introduction to legal,

social, and ethical issues surrounding software development and computer use. Again, it stresses professional conduct, social responsibility, and rigorous standards for software testing and reliability.

CSIT 202: Introduction to Computer Networks
This course is 50 percent lab work of configuration of routers and network design, implementation, and testing. Topics Include: Focus on the primary aspects of data communications networking, including a study of the Open Systems Interconnection (OSI) and Internet models. Students will start at Layer 1 with the study of various Layer 1 interface and cabling configurations. They will construct and test various cables with connectors. Moving up the OSI layers, students will focus on IP network addressing, network design, and enhanced hands-on router and port configurations. They will also learn security protocols and do static routing, EIGRP, RIPv2, and OSPF. Students will also develop Access Control Lists (ACLs) used in modern day networks as a prime method of controlling network security and implement the ACLs on laboratory networks.

CSIT 203: Computer Hardware Fundamentals
This course explains the basic principles of how computers work. It provides a comprehensive understanding of the essential components associated with computers with a focus on PCs. Topics include: The history of computers, the microprocessor, motherboard, memory, graphics and sound adapters, input and output devices, and storage media. An overview of operating systems and other software, as well as the various methods used to connect computers to each other and the Internet, are presented. The course also addresses recent advances in computer architectures and computer hardware and how they affect computer performance. Presentations of actual hardware are included so that students can gain experience in identifying the various internal and external components of a PC.

CSIT 204: Introduction to Information Security
This course introduces concept of information security. Discusses the need for organizational policy to define required services such as confidentiality, authentication, integrity, nonrepudiation, access control, and availability, and mechanisms to implement those services. Topics Include: Cover different types of security including physical security, computer security, and network security; common threats to and attacks against information systems, including accidental damage, identity theft, malicious software, and “spam”; and defensive measures.

CSIT 205: Object Oriented Techniques for IT Problem Solving
Topics Include: Introduction to concepts of event-driven programming. Basic object-oriented (OO) programming concepts and principles; Apply basic object-oriented principles and techniques in the development of software systems using a specific programming language. Effectively develop software systems using both basic command line tools and sophisticated integrated development environments, and to understand the advantages and limitations of each. To successfully perform debugging operations and techniques. To perform software development in both individual and team environments. Programming-related references/resources available to software developers and the ability to use them effectively - both in ongoing projects and in the acquisition of new technical skills.

CSIT 206: Applied IT Programming
This course covers client and server side scripting languages and SQL database management
system. Students will use open source software tools to develop database-enabled web applications. Topics Include: Develop proficiency in some of the basic technologies used to implement applications with Web browser user interfaces, server-side processing, and data storage. Building on fundamentals of structured and object-oriented programming,

CSIT 207: Database Fundamentals
This course introduces relational database management systems and their applications. Students learn about types of databases, data modelling, designing relational databases, normalization and relationships, and recent trends in database management, including web applications. Students apply learned concepts using modern database application to create tables, forms and reports. Topics Include: Use modern techniques of data organization and access in a database environment. Describe the importance of database modelling and design. Understand and work with the relational database model and ERD. Design and create multiple tables, table relationships, and queries using SQL. Understand what transaction management and concurrency control are, have solid understanding of different types of databases

CSIT 208: Multimedia and Web Design

This course introduces multimedia and web computer graphics. It focuses on development of web-enabled multimedia applications from practical business perspective. Introduces and discusses technological aesthetic human factors. Topics Include: Understand fundamental Web design principles and technologies. Understand the detailed design plan required to create a successful Web site that considers audience needs, design features, and various technical issues. Understand the coverage of ownership, permissions, and copyright issues. Incorporate text, images, animation, sound, and video into Web pages. Create an accessible and full-feature Website with popular multimedia authoring tools, such as Adobe Dreamweaver, Flash, and Photoshop

CSIT 301: Mobile Development
The course will provide an overview of the various mobile platforms but will focus on developing applications for iPhone, iPod Touch and iPad. Topics Include: Studies the design and implementation of mobile applications for popular platforms like Blackberry, Android and Apple devices. 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.

CSIT 302: Data Communication
This course provides a comprehensive overview of the fundamental principles of telecommunications. Topics Include: Protocol Architecture, Data transmission, channel impairments, channel capacity, Guided and wireless transmission, signal encoding techniques, digital data communication techniques, Data link control, multiplexing, spread spectrum, circuit and Packet switching, Asynchronous Transfer Mode, Routing in Switched networks, congestion control, Communications architecture and protocols.

CSIT 303: Human Computer Interaction
This course illustrates the principles of user interface design, development, and programming. Topics Include: User psychology and cognitive science, menu system design, command language design, icon and window design, graphical user interfaces, web-based user interfaces. Principles of user interface design. Concepts for objectively and quantitatively assessing the usability of software user interfaces. Outcomes include knowledge of quantitative engineering principles for designing usable software interfaces and an understanding that usability is more important than efficiency for almost all modern software projects, and often the primary factor that leads to product success.

CSIT 304: IT in the Global Economy
The course examines changing nature of work, education, and communication, and ethical issues such as intellectual property rights, computer-related crime, privacy concerns, and public policy issues. Topics Include: Rapid rate of technological change and its impact on societies around the world. Role of IT and Communications Technology in the globalization of economies, crime, culture, and the shifts in global power. Role of ICT in the changing nature of work, governance, identity, communication, and loss of privacy. Role of IT and Communications Technology in creating a global civil society and facilitating the work of NGOs and consortia. Appreciation for the role of IT and Communications Technology in economic development and meeting UN millennium development goals.

CSIT 305: Operating Systems Fundamentals
This course studies practices and procedures for installing and configuring modern operating systems. Topics Include: User accounts, file, print, and terminal servers, mobile computing, and disaster recovery. Through practical lab sessions, students receive real-world experiences with multiple operating systems.

CSIT 306: IT Resources Planning
The course provides essential strategies and procedures for planning, organizing, staffing, monitoring, and controlling design, development, and production of system to meet stated IT-related need in effective and efficient manner. It fulfils writing-intensive requirement for BS in information technology.

CSIT 307: Digital and Logic Systems Design
This course will provide an overview of principles and Techniques of modern digital systems. The fundamental principles of digital systems will be explored. This course exposes individuals to a wide array of classic as well as state of the art digital electronics technology.
Topics Include: Introduction to numbers systems and codes, logics circuits, combinational logic, storage elements, digital arithmetic, integrated circuit logic families. An Overview of Technologies and Application of wide array of

digital components used within state of the art IT Systems. An understanding of the applications of such digital devices embedded within telecommunications systems, storage systems, computing systems, multimedia systems, and computer networks.

CSIT 308: Turning Ideas into Successful Companies
This is a practical course in entrepreneurship. Each class session will focus on specific topics associated with building a business: team creation, business planning, market research, product development, financial planning, funding, people and organizations, competitive strategies, operations, growth and exit strategies, and more. Students will have reading assignments and will participate in competitive team assignments.

CSIT 309: Data Network Security I
This course examines information security services and mechanisms in network context.
Topics include: The information network context, including common approaches to networking. The risks involved in transmitting information over networks and give examples of threats to and attacks against network security. The security services needed for information networks. Give examples of current applications of network security technologies. Symmetric and asymmetric cryptography; message authentication codes, hash functions and digital signatures; digital certificates and public key infrastructure; access control including hardware and biometrics; intrusion detection; and securing network-enabled applications including e-mail and web browsing.

CSIT 310: Design Project I
Students use information technology as a tool to redesign business processes so the enterprise can achieve its objectives. Student teams analyze the business processes of real organizations, quantify the negative impact caused by current process challenges, then develop and present a compelling Business Case for Change. Students develop skills critical for preparing and delivering effective verbal briefings and presentations.

CSIT 311: Information Security Principles
Studies security policies, models, and mechanisms for secrecy, integrity, availability, and usage controls. Topics include models and mechanisms for mandatory, discretionary, and role-based access controls; authentication technologies; control and prevention of viruses and other rogue programmes; common system vulnerabilities and countermeasures; privacy and security policies and risk analysis; intellectual property protection; and legal and social issues.

CSIT 312: Network Servers and Infrastructure Administration
Covers IP networking concepts and practices for using DHCP, DNS, secure communication, routing, remote address services, web servers, and network connectivity between operating systems. Students learn TCP/IP, routing architecture, and understand application-level services used in Internet. Through networking lab sessions, students focus on using switches and routers connected in LANs and WANs.

CSIT 313: Program Design and Data Structures
This course covers the fundamentals of data structures and analysis of algorithms. Large programmes written in a modern, high-level programming language. It stresses abstraction, modular design, code reuse, and correctness.

CSIT 314: Database Management Systems Administration
This course studies logical and physical characteristics of data and their organization in computer processing. Emphasizes data as resource in computer applications, and examines database management system (DBMS) software and design, implementation, and use.
Topics Include: Client/Server Databases and the Oracle 10*g* Relational Database; Creating and Modifying Database Tables; Using SQL Queries to Insert, Update, Delete, and View Data; Introduction to PL/SQL ; Introduction to Database Forms; Introduction to Database Reports; Advanced SQL and PL/SQL Topics; Advanced Topics in Oracle 11g; Database Administration

CSIT 315: Event-Driven Programming
Building on the programming concepts covered in IT 108, this course focuses on graphical user interfaces. Students will design, develop, and document event-driven programmes using an object-oriented language. Topics Include: Define event-driven programming. Write programmes using the event-driven programming paradigm; Write programmes with graphical user interfaces; Create well-designed layouts for graphical user interfaces; Write

programmes including multimedia elements such as graphics, sound, and animation; Develop programmes from requirements presented as text:

CSIT 316: Web Development using Content Management System
Through lectures and hands-on lab experience, presents web development techniques using content management systems (e.g. Joomla, Dot net nuke). Introduces characteristics of various types of websites (corporate portals, intranets and extranets; online magazines, newspapers, and publications; e-commerce and online reservations, government applications, small business websites). Presents methods, languages, tools related to web content management systems from an applied perspective.

CSIT 317: Web Development I
The course introduces the principles and techniques necessary for successful client-side web development. 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. Topics Include:
Understand advanced Web design principles and technologies. Create attractive Web interfaces with client-side technologies and popular Web authoring tools, such as Adobe Dreamweaver. Create Web pages with emerging and existing technologies, such as XHTML, CSS, JavaScript, DOM, XML, RSS, and AJAX. Design, create and publish advanced interactive websites with accessible, user-friendly interface design and features.

CSIT 319: Web Site Administration
Covers web server administration and web security, property sheets related to these sites and security features, hosting multiple web sites on same web server, associated performance issues, and application-level password security.

CSIT 321: Principles of Accounting
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.

CSIT 401: Digital Media Editing
Examines three areas of digital media editing- tools for editing, content and logic decision process, and information technology used by major corporations for development and distribution- through video examples from entertainment industry and corporate productions as well as hands-on editing experience. Topics Include: The technical foundations of digital media editing and presentation. Current issues surrounding the digital media industry, edit videos on multiple topics. Develop innovative ideas through creativity, and display the topic to a large audience.

CSIT 402: Concepts of Multimedia Processing and Transmission
This course covers fundamentals of audio and image processing and transmission. Technical topics include audio and video compression algorithms for efficient storage and transmission of multimedia content, streaming video, high definition video, multimedia storage technologies. Other issues discussed include legal aspects concerning distribution of multimedia content, multimedia standards, the entertainment industry as well as the future of multimedia processing and transmission.

CSIT 403: Graphics & Information Visualization
This course will provide students the opportunity to learn the principles and applied technologies in information visualization and explore the application of development protocols. Relevant topics will be chosen to enable students to create comprehensible
applied visualizations and may include fundamentals of information visualization; system functional requirements development; current important visualization applications: geographic information visualization and scientific visualization; advanced interactive visualization -- virtual reality; future trends in information visualization. Students will get hands on experience with the latest web-based widely-used visualization tools and software to include design and development of a rudimentary visualization application.

CSIT 404: Voice Communication Technologies
This course examines current and emerging technologies for transmission of voice signals over telecommunications systems. It highlights significant differences between the requirements for voice and other forms of data. Topics provide a balance between traditional voice technologies and those that use data networks. Real-world implementations are analyzed to determine reliability, quality, and cost effectiveness. Includes lab experiments with analog and digital technologies.

CSIT 405: Web II: Advanced Web Development
This course is a continuation of Web I. Rapid Application Development (RAD), client- and server-side scripting for user and database interaction. Students build skills in web application development using different technologies and frameworks. Topics such as session tracking/cookie management, privacy and integrity issues, and web services are also covered.

CSIT 406: Fundamentals of Satellite Communications
This course provides a comprehensive overview of the principles of satellite communications systems. Major topics include satellite orbits and constellations, the space segment, antennas, modulation, coding, satellite access methods and link analysis. Also covers satellite applications, with emphasis on recent developments in the satellite communications field. Hands-on design experience is gained through the use of readily available vendor software systems.

CSIT 407: Applied Knowledge Technologies for the Semantic Web
The course will integrate theory with case studies to illustrate the history, current state, and future direction of the semantic web. It will maintain an emphasis on real-world applications and examines the technical and practical issues related to the use of semantic technologies in intelligent information management. Topics Include: Fundamentals - reviewing ontology basics, ontology languages, and research related to ontology alignment, mediation, and mapping. it covers ontology engineering issues and presents a collaborative ontology engineering tool that is an extension of the Semantic MediaWiki. Unveiling a novel approach to data and knowledge engineering, introduces cutting-edge taxonomy-aware algorithms. Examines semantics-based service composition in transport logistics.

CSIT 408: Development - E-Business
This course covers management-related topics in electronic business. Conceptualizing and maintaining an e-business strategy. It also focuses on economic impact of e-business strategies and management practices, models of e-business, electronic payment systems, Internet security, ethics and privacy, and advanced e-business trends and issues.
Topics Include: The knowledge management life cycle model; Leadership in dynamic e-business environments; E-business models and networks; E-business modeling, ontologies and business rules; E-business security and reliability; E-business middleware, integration and protocols; XML, e-business processes, web services and semantic web services.

CSIT 409: Cloud Computing
Cloud Computing gives students hands-on experience creating programmes hosted on the Google cloud. The course teaches Python and its use. Students create a small business application-style programme using Python and App Engine-specific tools, following the Model-View-Controller-based paradigm, using HTML/Django I/O templates, with data storage on the Google Big Table.

CSIT 410: Design Project II
Students, in teams, complete projects demonstrating preparedness as an IT professional. This work includes ethical challenges, status reports and engineering notebooks evaluated during class. Team members develop detailed designs, build solutions up to Beta, present final written reports and final verbal presentations before review panels of business leaders.

CSIT 411: Advanced Networking Principles
This course focuses on Layer 2 and 3 of the OSI model and WAN technologies. Frame Relay and ISDN, complex router configurations of Variable Length Subnet Masking (VLSM), Classless Inter-Domain Routing (CIDR), Network Address Translation (NAT), Dynamic Host Configuration Protocol (DHCP), and study of Network Management

Systems available for Data Communications Networks. Layer 2 involves Ethernet-switching components, including detailed hands-on configuration covering all aspects of switches using the command-line interface method.

CSIT 412: Advanced Web Technologies
This course is also a continuation of Web I. Rapid Application Development (RAD), client- and server-side scripting for user and database interaction. Students build skills in web application development using different technologies and frameworks. Topics such as session tracking/cookie management, privacy and integrity issues, and web services are also covered.

CSIT 413: Wireless Systems and Networks
This course covers fundamental principles underlying wireless data communications. Topics include wireless transmission basics, radio propagation issues, antennas, digital modulation, spread spectrum techniques and their applications, and popular standards: WiFi, WiMAX and Bluetooth. Also presents practical knowledge to enable the design, testing, deployment, debugging and commissioning of WiFi, WiMAX networks and point-to-point microwave systems. Discussions on cellular network technologies are also included.

CSIT 415: Application of Digital Technologies
The course covers an overview of technologies and applications of a wide array of digital components used within state of the art IT systems. Topics include: Understand the technical foundations of digital technologies; Exposure to current issues surrounding the digital electronics industry. Perform research on a technical topic, develop innovative ideas through creativity, and present the topic to a large audience An understanding of the applications of such digital devices embedded within telecommunications systems, storage systems, computing systems, multimedia systems, and computer networks.

CSIT 416: Information Defense Technologies
This course will examine and assess the role of information technology as a tool of warfare and civil defense. Topics will be discussed from both defensive and offensive perspectives and will include asset tracking, asymmetric warfare, network centric warfare, physical attacks, cyber-terrorism, espionage, psyops, reconnaissance and surveillance, space assets, and applications of GPS and cryptographic technology. Understand the concept of asymmetric warfare and its implications for traditional defense organizations and systems. Understand the use of technology to enable attacks against information systems and other strategic assets, and the use of technology to defend against attacks on those assets. Be able to write rules of engagement for information warfare operations.

CSIT 417: Information Storage and Management Technologies
The course provides an introduction to principles of information storage and management technologies. This course covers Direct Attached Storage (DAS), networked storage models such as Network Attached Storage (NAS), Storage Area Network (SAN), and Content Addressed Storage (CAS); and applications in business continuity, replication, and disaster recovery. Includes exposure to real-world storage networking technologies.

CSIT 418: Database and Distributed System Security Principles
Introduces information and distributed system security fundamentals. Topics include notions of security, threats and attacks; legal and ethical issues; security evaluation; data models, concepts, and mechanisms for database and distributed system security; inference in statistical databases; basic issues in operating system, application and network security.

CSIT 419: Advanced Databases
Explores advanced concepts of database modelling using enterprise-level database management system. Topics include object-oriented database processing, data integrity, transactions, locks, concurrency control, backup, recovery, optimization, data mining, Internet databases, server programming, and security.

CSIT 421: Information Retrieval and XML data
Topics Include:
Outline of the general information retrieval problem, functional overview of information retrieval. Deterministic models of information retrieval systems; conventional Boolean, fuzzy set theory, p-norm, and vector space models. Probabilistic models. Text analysis and automatic indexing. Automatic query formulation. System-user adaptation

and learning mechanisms. Intelligent information retrieval. Retrieval evaluation. Review of new theories and future directions. Hands-on experience with a working experimental information retrieval system.

CSIT 424: Parallel & Distributed Databases
Topics include transaction management, concurrency control, deadlocks, replicated database management, query processing reliability, and surveys of commercial systems and research prototypes. Study of advanced database models and languages, database design theory, transaction processing, distributed database, and security and integrity.

CSIT 425: Computer Crime, Forensics, and Auditing
This course covers computer crime, relevant laws, agencies, and standards. It presents auditing,
logging, forensics, and related software. It also explores legal principles such as chain of evidence, electronic document discovery, eavesdropping, and entrapment. Students get hands-on experience with forensics tools.
Topics Include:
The legal and technical aspects of computer forensics. Applicable laws and the roles of legal authorities. How to obtain and handle digital evidence and will have been exposed to a range of freeware forensic tools.

CSIT 426: Data Mining & Data Warehousing
This course is an 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.

CSIT 431: Data Network Security II
Detailed study of certain symmetric and asymmetric cryptographic schemes; analysis of network data (including "packet sniffing"); security at different network layers (including IPSec, SSL/TLS and Kerberos); and secure e-commerce. The course teaches principles of designing and testing secure networks, including use of network partitioning, firewalls, intrusion detection systems, and vulnerability assessment tools.

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.

FACULTY

ACADEMIC STAFF

L. P. Chegbeleh *BSc (Ghana), PhD (Okayama)*	-	Associate Professor **(Head of Department)**
B. K. Banoeng-Yakubo* *BSc (Ghana), MSc (Ife), MPhil, PhD (Ghana)*	-	Professor
D. K. Asiedu* *BSc (Ghana), MSc, PhD (Okayama)*	-	Professor
P. M. Nude* *BSc, MPhil, PhD (Ghana)*	-	Professor
D. Atta-Peters* *BSc, MPhil, PhD (Ghana)*	-	Professor
S. M. Yidana *BSc (Ghana), PhD (Montclair)*	-	Professor
F. K. Nyame *BSc (Ghana), MSc, PhD (Okayama)*	-	Professor
P. A. Sakyi *BSc, MPhil (Ghana), MSc (DTU), PhD (Okayama)*	-	Professor
T. M. Akabzaa* *BSc, PhD (Ghana), MEng (McGill)*	-	Associate Professor
J. Manu* *BSc, MBA (Ghana), MSc PhD (Braunscheig)*	-	Associate Professor
C. Y. Anani* *BSc (Ghana), MSc (Shinshu), PhD (Niigata)*	-	Associate Professor
T. E. K. Armah* *BSc, MPhil, PhD (Ghana)*	-	Senior Lecturer
Yvonne S. A. Loh *BSc, MPhil, PhD (Ghana)*	-	Senior Lecturer
B. Fiebor* *BSc (Ghana), MS, PhD (Auburn)*	-	Visiting Scholar/Senior Lecturer
P. O. Amponsah *BSc, MPhil (Ghana), PhD (Toulouse)*	-	Senior Lecturer
D. Kwayisi *BSc, MPhil (Ghana), PhD (Johannesburg)*	-	Senior Lecturer
J. O. Thompson *BSc (Ghana), MSc (Lille), PhD (Rennes)*	-	Senior Lecturer
S. Nunoo *BSc, MPhil (Ghana), PhD (Johannesburg)*	-	Senior Lecturer
Marian S. Sapah *BSc (Ghana), PhD (ANU)*	-	Senior Lecturer
Elikplim A. Dzikunoo *BSc, MPhil, PhD (Ghana)*	-	Lecturer
E.K. Ackom *BSc, PhD (Kumasi), MSc 1, (Stuttgart), MSc 2, (Stuttgart), MBA (GIMPA)*	-	Lecturer
Naa A. Agra *BSc, MPhil (Ghana), PhD (Johannesburg)*	-	Lecturer
Abigail E. Ayikwei *BSc, MPhil (Ghana)*	-	Assistant Lecturer
Jennifer E. Agbetsoamedo** *BSc, MPhil (Ghana)*	-	Assistant Lecturer
S. B. Dampare *BSc, MPhil (Ghana), PhD (Okayama)*	-	Professor/ Part-Time
M. A. Akoto *BSc (Kumasi), MPhil (London)*	-	Senior Lecturer/Part-time

J. M. Kutu *BSc, MPhil, PhD (Ghana)*	-	Senior Lecturer/Part-time
F. Achampong *BSc (Kumasi), MASc (Windsor), PhD (Detroit)*	-	Senior Lecturer /Part-Time
Paulina E. Amponsah *BSc (Kumasi), MPhil, PhD (Ghana)*	-	Associate Professor/Part-Time
E. Apesegah *BSc (Ghana), MSc (Imperial College)*	-	Lecturer/Part-Time
M. N. A. Aryeetey *BSc (Ghana), MSc (NTNU, Norway)*	-	Lecturer/Part-Time
A. N. A. Ammah *BSc (Ghana), MSc (NTNU, Norway)*	-	Lecturer/Part-Time
C. K. James *Dip (London), Intl Dip (London), LLB (London), MSc (Australia)*	-	Lecturer/Part-Time
S. Ahulu *BSc (Kumasi), MPhil, PhD (Ghana)*	-	Lecturer/Part-Time
T. Davor *BSc (Ghana), MSc (Kumasi)*	-	Lecturer/Part-Time
M. Odainkey *BSc (Ghana), MSc (Edinburgh, UK)*	-	Lecturer/Part-Time

NON-ACADEMIC STAFF

Diana Abugah	-	Chief Administrative Assistant
Mary Klu	-	Administrative Assistant
Abraham Odame	-	Chief Library Assistant
Richard Mejida Adams**	-	Senior Research Assistant
Dora Mawuko	-	Senior Research Assistant
Solomon Abban	-	Assistant Technologist
Elizabeth Anima Adrah	-	Assistant Technologist
Humphrey Akanaba Nsobila	-	Senior Technician
Oscar Mensah	-	Driver Grade II
Samuel Otoo	-	Driver Grade I
George Acheampong	-	Artisan
Mark Atopo	-	Messenger Cleaner
Imoro Asikanda	-	Gardiner

*Post Retirement Contract
**Study Leave

SINGLE MAJOR EARTH SCIENCE DEGREE PROGRAMME

Successful candidates will be awarded a BSc degree in the following, depending on option selected at Level 400:

- BSc Earth Science (Geology)
- BSc Earth Science (Applied Geology)
- BSc Earth Science (Applied Geophysics)

LEVEL 200

FIRST SEMESTER

Code	Title	Credits	Pre-requisite
Core			
EASC 217	Optical Mineralogy	2	EASC 101
EASC 219	Practical Crystallography	1	EASC 101
EASC 220	Geological Field Exercises I	2	EASC 101 EASC 104
EASC 227	Geological Structures and Maps	2	EASC 101
EASC 229	Introduction to Stratigraphy and Sedimentation	2	EASC 101 EASC 104
UGRC	Academic Writing II	3	
Total		**12**	
Electives: Select 3 – 6 credits			
EASC 225	Quantitative Geology	2	
MATH 223	Calculus II	3	MATH 122
STAT 223	Elementary Statistical Methods	3	
CHEM 213	Physical Chemistry I	2	
CHEM 233	Organic Chemistry I	2	
CHEM 271	Analytical Chemistry I	2	
PHYS 241	Atomic Physics and Quantum Phenomena	2	
PHYS 245	Electromagnetism I	3	

SECOND SEMESTER

Code	Title	Credits	Pre-requisite
Core			
EASC 214	Principles of Geochemistry	2	
EASC 216	Fundamentals of Geophysics	2	
EASC 218	Introduction to Paleontology	2	
EASC 224	Petrography	3	EASC 101
UGRC 220-238	Introduction to African Studies	3	
Total		**12**	
Electives: Select 3 – 6 credits			
EASC 280	Internship in Earth Science I	1	
MATH 224	Introductory Abstract Algebra	3	MATH 126
MATH 220	Introductory Computational Mathematics	3	MATH 122
CHEM 234	Organic Chemistry II	2	
CHEM 252	Inorganic Chemistry I	2	
PHYS 242	Oscillations and Waves	2	
PHYS 244	Mathematical Methods I	3	
PHYS 256	Computational Methods in Physics I	2	

LEVEL 300

FIRST SEMESTER

Code	Title	Credits	Pre-requisite
Core			
EASC 320	Geological Field Exercises II	2	EASC 220
EASC 321	Introduction to Igneous and Metamorphic Petrology	3	EASC 224
EASC 341	Structural Geology	3	EASC 227
EASC 343	Sedimentology	2	EASC 229
Total		**10**	
Electives: Select 5 – 8 credits			
EASC 323	Soil Mechanics	3	
EASC 325	Fundamentals of Hydrogeology and Hydrology	2	
EASC 333	Environmental Impact Assessment	2	
EASC 339	Principles of Applied Geophysics	3	EASC 216
EASC 380	Internship in Earth Science II	1	
PHYS 345	Electromagnetism II	3	
PHYS 347	Electronics I	3	
EASC 317	Environmental Geochemistry	2	
MATH 358	Computational Mathematics I	3	MATH 220

SECOND SEMESTER

Code	Title	Credits	Pre-requisite
Core			
EASC 342	Geology of Ghana	3	EASC 320
EASC 326	Aerial Photo Interpretation	2	
EASC 354	Geological Resources	3	
EASC 352	Geological Field Methods	2	EASC 320
Total		**10**	
Electives: Select 5 – 8 credits			
EASC 332	Introduction to Petroleum Geology	2	
EASC 336	Mineral Economics	2	
EASC 338	Earthquake Seismology and Disaster Risk Reduction	3	
EASC 322	Environmental Pollution	2	
EASC 334	Organic Geochemistry	2	
CHEM 312	Thermodynamics I	2	
PHYS 356	Computational Methods in Physics II	3	
MATH 455	Computational Mathematics II	3	

LEVEL 400

OPTIONS (Select one option)

OPTION 1: GEOLOGY

FIRST SEMESTER

Code	Title	Credits	Pre-requisite
Core			
EASC 420	Project	3	
EASC 450	Geological Field Mapping	3	EASC 352

EASC 471	Remote Sensing and Geographic Information Systems	3	
Total		**9**	
Electives: Select 3 – 6 credits			
EASC 417	Mineralogy	3	EASC 217
EASC 419	Igneous and Metamorphic Petrology	3	EASC 321
EASC 437	Geochemistry and Cosmochemistry	2	
EASC 461	Basin Analysis	3	EASC 343
EASC 465	Micropaleontology	3	EASC 218
CHEM 473	X-ray Crystallography	2	

SECOND SEMESTER

Code	Title	Credits	Pre-requisite
Core			
EASC 404	Statistical Methods in Earth Science	2	
EASC 420	Project	3	
EASC 470	Communication and Entrepreneurship in the Earth Sciences	2	
EASC 480	Field Studies in Earth Science	1	
Total		**8**	
Electives: Select 4 – 7 credits			
EASC 446	Sedimentary Petrology	3	EASC 224
EASC 448	Geology of Africa	3	
EASC 454	Geochronology	2	
EASC 476	Geotectonics	2	EASC 341
EASC 478	Stratigraphy	2	EASC 229
EASC 482	Geology of Mineral Deposits	3	

OPTION 2: APPLIED GEOPHYSICS

Students who opt for Applied Geophysics must have taken and passed at least 9 credits of elective courses in Physics and/or Mathematics at Level 200.

FIRST SEMESTER

Code	Title	Credits	Pre-requisite
Core			
GPHY 400	Project	3	
GPHY 403	Geophysical Instrumentation and Techniques	3	
EASC 401	Remote Sensing and Geographic Information Systems	3	
EASC 470	Communication and Entrepreneurship in the Earth Sciences	2	
Total		**11**	
Electives: Select 4 – 7 credits			
EASC 405	Hydrogeology	3	EASC 325
EASC 431	Exploration Methods, Planning and Management	3	
EASC 457	Geology of Civil Engineering Projects	3	
EASC 467	Rock Mechanics	3	
PHYS 447	Electronics II	2	
PHYS 455	Energy Systems	2	
PHYS 461	Principles of Radioactive Dating	2	

SECOND SEMESTER

Code	Title	Credits	Pre-requisite
Core			
GPHY 400	Project	3	
EASC 442	Petroleum Reservoir Geophysics	3	EASC 339
EASC 458	Exploration Geophysics	3	EASC 339
EASC 480	Field Studies in Earth Science	1	
Total		**10**	
Electives: Select 5 – 8 credits			
EASC 452	Site Investigations	3	EASC 339
EASC 454	Geochronology	2	
EASC 468	Reservoir Engineering	2	
EASC 476	Geotectonics	2	EASC 341
OCNO 422	Marine Geophysics	2	

OPTION 3: APPLIED GEOLOGY (Hydrogeology, Engineering Geology, Mineral Exploration, Petroleum Geoscience)

FIRST SEMESTER

Code	Title	Credits	Pre-requisite
Core			
EASC 420	Project	3	
EASC 471	Remote Sensing and Geographic Information Systems	3	
EASC 480	Field Studies in Earth Science	1	
Total		**7**	
Electives: Select 8 – 11 credits			
EASC 401	Hydrology	3	EASC 325
EASC 405	Hydrogeology	3	EASC 325
EASC 407	Integrated Water Resources Management	2	EASC 325
EASC 439	Mineral Exploration Methods, Planning and Management	3	
EASC 447	Mineral Projects Feasibility Studies	2	
EASC 449	Geostatistical Ore Reserve Estimation	2	
EASC 457	Geology of Civil Engineering Projects	3	
EASC 459	Bearing Capacity and Slope Stability Analysis	3	
EASC 461	Basin Analysis	3	EASC 343
EASC 467	Rock Mechanics	3	

SECOND SEMESTER

Code	Title	Credits	Pre-requisite
Core			
EASC 420	Project	3	
EASC 404	Statistical Methods in Earth Science	2	
EASC 470	Communication and Entrepreneurship in the Earth Sciences	2	
Total		**7**	
Electives: Select 8 – 11 credits			
EASC 426	Rural Water Supply	2	EASC 325

EASC 438	Water Quality and Hydrochemistry	2	EASC 325
EASC 458	Exploration Geophysics	3	EASC 339
EASC 462	Exploration Geochemistry	3	
EASC 466	Petroleum Reservoir Geophysics	3	EASC 339
EASC 468	Reservoir Engineering	2	
EASC 472	Site Investigations	3	EASC 339
EASC 474	Rocks as Construction Materials	2	

MAJOR - MINOR DEGREE PROGRAMME

Students can major in Geology and minor in either Physics or Mathematics. After successful completion such students will be awarded BSc degree in any one of the following categories depending on second subject:

- Geology with Physics
- Geology with Mathematics

Students can also minor in Geology and major in either Physics or Mathematics. After successful completion such students will be awarded BSc degree in any one of the following categories depending on second subject:

- Physics with Geology
- Mathematics with Geology

LEVEL 200

FIRST SEMESTER

Code	Title	Credits	Pre-requisite
Core			
EASC 217	Optical Mineralogy	2	EASC 101
EASC 219	Practical Crystallography	1	EASC 101
EASC 220	Geological Field Exercises I	2	EASC 101 EASC 104
EASC 227	Geological Structures and Maps	2	EASC 101
EASC 229	Introduction to Stratigraphy and Sedimentation	2	EASC 101 EASC 104
UGRC 210	Academic Writing II	3	
Total		**12**	

SECOND SEMESTER

Code	Title	Credits	Pre-requisite
Core			
EASC 214	Principles of Geochemistry	2	
EASC 216	Fundamentals of Geophysics	2	
EASC 218	Introduction to Paleontology	2	
EASC 224	Petrography	3	EASC 101
UGRC 220-238	Introduction to African Studies	3	
Total		**12**	

LEVEL 300

Students shall take 18 – 21 credits per Semester (12 to 15 credits per Semester in major subject and 6 to 9 credits per Semester from the minor subject)

FIRST SEMESTER

Code	Title	Credits	Pre-Requisite
Core			
*EASC 320	Geological Field Exercises II	2	EASC 220
EASC 321	Introduction to Igneous and Metamorphic Petrology	3	EASC 224
*EASC 341	Structural Geology	3	EASC 227
EASC 343	Sedimentology	2	EASC 229
Total		**10**	
Electives			
EASC 323	Soil Mechanics	3	
EASC 325	Fundamentals of Hydrogeology and Hydrology	2	
EASC 333	Environmental Impact Assessment	2	
EASC 339	Principles of Applied Geophysics	3	EASC 216
EASC 380	Internship in Earth Science II	1	

*Core for students majoring in Geology

SECOND SEMESTER

Code	Title	Credits	Pre-Requisite
Core			
*EASC 342	Geology of Ghana	3	EASC 320
*EASC 326	Aerial Photo Interpretation	2	
EASC 352	Geological Field Methods	2	EASC 320
EASC 354	Earth Resources	3	
Total		**10**	
Electives			
EASC 322	Environmental Pollution	2	
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	

*Core for students majoring in Geology

LEVEL 400

The Level 400 courses are for students who opt for major in Geology. Students will take 18 – 21 credits per Semester. Students are advised to select 3 to 6 credits per Semester from the minor subject.
Student minoring in Geology shall take 3 to 6 credits of any of the under listed courses per Semester.

FIRST SEMESTER

Code	Title	Credits	Pre-Requisite
Core			
EASC 419	Igneous and Metamorphic Petrology	3	EASC 321
EASC 420	Project	3	
EASC 450	Geological Field Mapping	3	EASC 352
EASC 471	Remote Sensing and Geographic Information Systems	3	
Total		**12**	
Electives: Select 6 – 9 credits			

EASC 417	Mineralogy	3	EASC 217
EASC 437	Geochemistry and Cosmochemistry	2	
EASC 461	Basin Analysis	3	EASC 343
EASC 465	Micropaleontology	3	EASC 218

SECOND SEMESTER

Code	Title	Credits	Pre-Requisite
Core			
EASC 404	Statistical Methods in Earth Science	2	
EASC 420	Project	3	
EASC 446	Sedimentary Petrology	3	EASC 224
EASC 470	Communication and Entrepreneurship in the Earth Sciences	2	
EASC 480	Field Studies in Earth Science	1	
Total		**11**	
Electives: Select 7 – 10 credits			
EASC 448	Geology of Africa	3	
EASC 454	Geochronology	2	
EASC 476	Geotectonics	2	EASC 341
EASC 478	Stratigraphy	2	EASC 229
EASC 482	Geology of Mineral Deposits	3	

COURSE DESCRIPTION

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 and use of 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 identify the major rock-forming minerals in thin section. In order to accomplish this objective, students will learn about the underlying concepts related to mineral behaviour in transmitted/polarized light and the use of the petrographic microscope.

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 of geometric crystallography. 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 225: Quantitative Geology
This course is designed to improve students' quantitative and problem-solving skills applied to geological problems. Student will learn and practice various types of mathematical approaches used to quantify processes across a broad range of geoscience disciplines, including mineralogy, petrology, structural geology, hydrogeology, and geophysics. Topics to be covered include: mathematics as a tool for solving geological problems; common relationships between geological variables; equations and how to manipulate them; trigonometry; graphs; statistics; differential and integral calculus. Students will be given a project to design and solve a mathematically relevant problem in geology using any of the mathematical techniques discussed in class.

EASC 227: Geological Structures and Maps

This course discusses, from first principles, the morphology of the common types of geological structures, their elements and attitudes; classification of structures; and how structures manifest on geological maps. It covers the recognition and interpretation of geological structures from maps. The types of geological structures covered in class include: geometric forms and characteristics of rock bodies, horizontal and dipping strata, foliations, lineations, folds, faults, joints, cleavages, boudins, fractures, unconformities, and rock boundaries. Elements and attitudes of geological structures. Students shall learn about geological maps as records of geologic history, and how a map showing the distribution of rock types and their structures may yield information on geological history from relative ages of rocks and events, and on locations and distribution of economically valuable materials.

EASC 229: Introduction to Stratigraphy and Sedimentation
This course provides an overview of sedimentary processes and products, and the basic principles of stratigraphic analysis and correlation. Topics covered in class include weathering, erosion, transport, deposition; sediments; lithification, diagenesis; sedimentary rocks; common sedimentary structures, depositional environments; stratigraphic nomenclature and the stratigraphic column; basic principles of stratigraphy. Lab work involving application and interpretation of the sedimentary and stratigraphic principles to historical geology.

EASC 214: Principles of Geochemistry
This course is intended 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 216: Fundamentals of Geophysics
Introduction to basic principles of geophysics as applicable to the 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), the electrical methods, radioactivity and geochronology, and heat flow.

EASC 218: Introduction to Palaeontology
This course aims to provide a practical introduction to palaeontology - the study of ancient life forms preserved as fossils. It examines how fossils are preserved, the identification of fossils and explains how fossils are used in establishing geologic age of rocks, correlating strata, and reconstructing paleoenvironments. The contents are as follows: Study of Phyla: porifera, cnidarian, hemichordata, mollusca, brachiopoda; nature of the organism and geologic importance; important index fossils; environmental stratigraphy and environmental reconstruction. Identification and sketching of some specimens of the phyla of organisms indicated above.

EASC 220: Geological Field Exercises I
A practical field-based course consisting of two parts. Part I covers the most commonly used field equipment and outlines field safety procedures. It explores the general objectives of fieldwork, the use of a field notebook, and the necessary skills for the collection of paleontological and sedimentological data. Part II involves about six days 'live-in' field exercises in a sedimentary terrain (e.g., the Sekondian Group in the Sekondi/Takoradi area), providing 'hands-on' instructions on the recognition, identification, description and interpretations of geological features.

EASC 224: Petrography
This course has both lecture and practical components. The lecture component covers petrographic work on the origin, mode of formation, compositions, textures, fabric and classification of igneous, sedimentary and metamorphic rocks. The practical component covers the study of igneous, sedimentary and metamorphic rocks in hand specimen and in thin sections. Concepts are illustrated by rock suites from Ghana and elsewhere.

EASC 280: Internship in Earth Science I
Long vacation industrial attachment to a governmental or private sector geoscience or related institution/ company. Credit is contingent on submission of a final report by students and an assessment report by industry. This course offers an

opportunity forstudents with little or no experience to come into a professional working environment and work hands-on in their chosen field.

EASC 317: Environmental Geochemistry
The course will offer students the opportunity to learn how the principles of Geochemistry 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 321: Introduction to Igneous and Metamorphic Petrology
The introduction to the origin and evolution of magmatic systems, and metamorphic systems and processes. It gives students good preparation in the techniques of modern petrology; a clear and organized review of the classifications, textures, petrofabric and approach to petrologic study; and then applies these concepts to the real occurrences of the rocks themselves. Concepts are illustrated by rock suites from Ghana and elsewhere.

EASC 323: Soil Mechanics
This is an introductory course in soil properties and testing techniques. Topics covered include: 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; clay-silt-sand-gravel-loess- peat-fills-soil admixtures; total and effective stresses; shear strength tests; residual strength. Emphasis is placed on practical field applications. Laboratory exercises are included to compliment lecture topics.

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 333: Environmental Impact Assessment
This course provides knowledge on environmental impact assessment (EIA) as a vital tool for sound environmental management and decision-making. Topics covered in class include: evolution of 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; environmental management systems; land disturbance and reclamation; project decommissioning. The course mainly draws on case studies from Ghana, but also includes other EIA systems of other countries.

EASC 339: Principles of 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. It provides a comprehensive introduction to the methods of applied geophysics including seismic, gravity, magnetic, electrical methods and electromagnetics. The course covers the basic theories, field procedures, data acquisition, processing and interpretation of the above methods. The emphasis of the course is on basic principles (i.e., the physics and mathematics behind the methods) rather than on applications.

EASC 341: Structural Geology
Structural geology is the study of processes and products of rock formation and deformation. This course introduces the discipline and techniques of structural geology through a study of the mechanics of rock deformation and related structures, identification and interpretation of structures from the microscopic scale to the scale of mountain belts, a study of the features and geometries of rock bodies, faults and folds, and techniques of strain analysis. Class lectures are supplemented by lab exercises as well as field trips to local outcrops. The practical aspect enables a student to work to unravel the deformational history of the rocks.

EASC 343: Sedimentology

This course concerns the formation, accumulation, alteration, and preservation of sediments in the geological record. It focuses on the reconstruction and interpretation of ancient carbonate and siliciclastic paleoenvironments based on the analysis of lithology, geometry, sedimentary structures, modern depositional environments, stratigraphic successions, and fossils. The course will include a laboratory component and may include a field trip allowing for first-hand experience with describing and interpreting sedimentological units.

EASC 320: Geological Field Exercises II
This is a practical field-based course consisting of: (i) Lecture/practical sessions on the study of igneous and metamorphic rocks in the field, and construction and interpretation of geological maps and cross-sections, and (ii) About one week 'live-in' geological field mapping, with supervision, in an igneous/metamorphic terrain (e.g., the Dahomeyan/Togo/Buem Structural Units in the Volta Region of Ghana.

EASC 322: Environmental Pollution
The purpose of this course is to give students an overview of the environmental pollution associated with air, water and solid waste, and methods for prevention, control and management of the pollution. Topics to be covered include: major categories and sources of air and water pollution; dangers of some air and water pollutants; detecting pollution; control and monitoring of pollution; acid rain and deposition; measurement of air and water pollution; air and water pollutant standards index from EPA and WHO; status of air and water quality in developed and developing countries; groundwater problems and ways to protect this resource; human waste disposal.

EASC 326: Aerial Photo Interpretation
This course introduces students to the principles of visual interpretation, measurement taking, and mapping from aerial photographs and remotely sensed imagery for geological and environmental applications. The course is a mix of lecture and hands-on exercises. Topics covered include stereoscopic vision, scale, stereogram construction, optical distortions and the techniques of stereo viewing, how to identify features on vertical air photos, and the application of aerial photo interpretation in geological mapping, mineral exploration, petroleum geology, engineering geology, hydrogeological, and environmental studies. The applications are illustrated by detailed case studies and numerous photographic examples.

EASC 332: Introduction to Petroleum Geology
This course provides an overview of how petroleum is generated and how it 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. Unconventional oil (oil sands, oil shales etc) and gas (shale gas).

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 336: Mineral Economics
This course provides an understanding of the broad aspects of minerals as resources, 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
This course covers the physics of earthquakes and seismic energy propagation, and seismic methods to determine Earth structure. Lectures cover the following: earthquake seismology; earthquake mechanics; earth structure; instrumentation; interpretation of seismograms; focal mechanisms; faults; paleoseismology; seismotectonics; earthquake locations and magnitudes; earthquake hazard assessment. 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 342: Geology of Ghana
This course gives a general overview of the geology of Ghana. It covers the following topics: Introduction to the geology of the various geological units of Ghana: i.e., Birimian Supergroup, Tarkwaian Group, Voltaian Supergroup, coastal sedimentary basins (i.e., Sekondian Group, Tano Basin, Keta Basin), Togo, Buem, and the Dahomeyide Structural Units; Lithotectonic evolution of the geological units of Ghana; Metallogenesis; Theories on the evolution of the geology of Ghana.

EASC 352: Geological Field Methods
This course provides a comprehensive introduction to geological mapping in the field, and application of appropriate field techniques to support the generation of a geological map. Students will be taught how to collect, process and interpret field data and solve geological relationships at a variety of scales. Thus, the course will draw upon the principles of structural geology and combine them with an understanding of sedimentary, igneous and metamorphic rock systems. Students will also be taught how to write a field-based geological report. The course may include several one-day long trips to the field to practice concepts learned in class.

EASC 354: Earth Resources
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. This course is about the occurrence, availability, exploration, exploitation and sustainability of these essential resources. It also considers their origins, how to find and extract them, and the environmental consequences of their exploitation. The course may include several one-day long trips to the field to reinforce geological and environmental concepts learned in class.

EASC 380: Internship in Earth Science II
Long vacation industrial attachment to a governmental or private sector geoscience or related institution/ company. Credit is contingent on submission of a final report by student and an assessment report by industry. The course offers an opportunity to students to with little or no experience come into a professional working environment and work hands-on in their chosen field.

EASC 401: Hydrology
This 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 404: Statistical Methods in Earth Science
This course covers the 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 405: Hydrogeology
This course examines the exploration for groundwater resources (e.g., using geophysical methods), the development and evaluation of groundwater resources (well construction and hydraulic testing) in a variety of hydrogeological systems, and groundwater management approaches (sustainability, vulnerability). Course topics include 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, and well and pump maintenance and rehabilitation.

EASC 407: Integrated Water Resources Management

This course develops knowledge in climate dynamics, hydrology and surface water resources which actually links 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 417: 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 421: Igneous and Metamorphic Petrology
This course covers advanced concepts in the origin and evolution of magmatic and metamorphic systems. It builds on material taught in the course EASC 321: Introduction to Igneous and Metamorphic Petrology. The course presents a broad review of igneous and metamorphic rocks, emphasizing their tectonic associations, interrelationships and petrogenesis. Concepts are illustrated by rocks from Ghana and elsewhere.

EASC 437: Geochemistry and Cosmochemistry
This course discusses the Earth from geochemical perspective using the fundamental geochemical tools studied in EASC 214. It covers the following: Cosmochemistry: nucleosynthesis, meteorites, formation of the solar system and the planets; The Mantle and Core of the Earth: composition of the earth's mantle and core, the "primitive mantle", magma ocean and mantle differentiation, mantle geochemical reservoirs; The crust of the Earth: 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 439: Mineral Exploration Methods, Planning and Management
The course introduces mineral exploration and mining methods. It focuses on the exploration of mineral deposits from desk studies up to harnessing of the mineral deposit. The various methods of exploration are treated in detail. Project evaluation is also discussed. The course covers the following topics: exploration programme design, reconnaissance exploration, detailed or follow-up exploration, sampling and assaying techniques, drilling techniques, project evaluation.

EASC 447: Mineral Projects Feasibility Studies
A mining feasibility study is an evaluation of a proposed mining project to determine whether the mineral resource can be mined economically. This course deals with the basic concepts of feasibility studies, including important aspects and stages. *Course content*: The role of the feasibility study in the mine development decision process, organization 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 449: Geostatistical Ore Reserve Estimation
This course will present basic concepts of geostatistics and ore reserve estimation. It will treat the data requirements for optimal geospatial modelling, data distributions, and the univariate statistical tools that are applicable to the preliminary assessment of data prior to geospatial modelling. The course will treat the various sampling techniques that are commonly used to acquire data for modelling and discuss their weaknesses and strengths. The traditional estimation methods will then be treated with practical demonstrations of their strengths and weaknesses. The course will then proceed to treat spatial continuity modelling. The course will expend significant part of the session to discuss the relevance of spatial continuity modelling, the types of theoretical variogram models commonly used, and the concept of structural analysis. Ordinary kriging will be treated, along with the concepts of geological modelling, and resource estimation. Students will be introduced to multivariate kriging, and non-linear estimation techniques.

EASC 457: Geology of Civil Engineering Projects
The course will cover urban geology, engineering geology of dams and tunnels, building cracks evaluation, and ground treatment. It will also consider the 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., will also be covered. The course may include visits to mine sites.

EASC 459: 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. The course will also include a three-day field visit.

EASC 461: Basin Analysis
This course focuses on the different kinds of sedimentary basins, the processes that form these basins, the processes that bring about filling of basins, and the nature of the fills. The methods used to carry out basin analysis and the applications of basin analysis are also discussed. Topics to be discussed include physical state of lithosphere, mechanisms of sedimentary basin formation by stretching, strike-slip, flexure and compression, effects of mantle dynamics, basin infill mechanisms and depositional systems, subsidence and thermal history, basin mapping methods, and application to the petroleum system, leading towards the play concept.

EASC 465: Micropalaeontology
The course gives a presentation of the various microfossil groups by discussing their morphology, taxonomy, mode of life, environments and stratigraphic distribution. Emphasis is laid on groups of geological importance by elucidating their application for dating, correlation and facies interpretation of sedimentary successions. The microfossils covered in class include foraminifera, ostracods, conodonts, and diatoms. It will also cover pollen and spores, dinoflagellates, acritarchs. Some applications of palynology will also be discussed. Practical work will include the method of preparation of microfossil.

EASC 467: Rock Mechanics
Index properties of rocks; engineering characteristics of rocks. Shear strength of planar discontinuities; Shearing on an inclined plane; Surface roughness; Shear testing on discontinuities in rocks; Estimating joint compressive strength and friction angle; Shear strength of filled discontinuities and closely jointed rock masses; Residual Strength; Schmidt Hammer Test. Rock Mass Classification and their importance in engineering works; Rock Quality Designation; 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; Foundations; Free-draining materials; Roads and Highways; Earth dams; Canal works. Laboratory work.

EASC 471: Remote Sensing and Geographic Information Systems
This course is of two parts. Part I introduces the principles and concepts of Remote Sensing (RS). In this part, students are introduced to environmental issues of the 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). 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 420: Project
Students undertake an independent research work which is the culmination of the BSc degree programme. This provides students with the opportunity to consolidate their specialist knowledge in a particular area. The dissertation is undertaken under the supervision of faculty. The Project may commonly include a fieldwork component or may entirely consist of the analysis of raw data. The project will normally begin in the first semester. Students will present their project report at the end of the academic year.

EASC 426: 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 438: Water Quality and Hydrochemistry
This course deals with water quality studies and sources, behavior and transport of contaminants. There is particular focus on interactions between water and minerals and their significance for groundwater composition. Course content include: 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.

EASC 446: Sedimentary Petrology
This course gives a broad understanding of the petrology of sedimentary rocks. The course consists of two parts. Part I deals with siliciclastic sedimentary rocks by examining the characteristics features of sandstones, conglomerates, shales and mudrocks. The important topic of sediment provenance is discussed followed by discussion of diagenesis of siliciclastic sedimentary rocks. Part II deals with chemical/biochemical sedimentary rocks. It describes limestones, discusses dolomites and examines the diagenesis of these carbonate rocks. It then describes the characteristics of evaporites, cherts, phosphorites, and iron-rich sedimentary rocks and discusses some of the controversial aspects of their origin.

EASC 448: Geology of Africa
This course is designed to introduce the student to the regional geology of Africa, the major geological events that have shaped the continent, mineral resources of Africa as well as the evolutional history of Africa. The main focus of the course is a discussion on the major tectonic events that consolidated the continent and the timelines, the resulting mineralisation and the compositions of the different cratons in Africa. The course covers the following topics: Precambrian Geology of Africa, Proterozoic cratonic basins and mobile belts, Palaeozoic sedimentary basins in Africa, Mesozoic – Cenozoic basins in Africa, the Atlas Belt.

EASC 450: Geological Field Mapping
This course is designed to train students in field mapping techniques and related skills. Skills developed during field camp typically include: field surveying, collection of geological data, construction of measured sections, interpretation of geological structures and how to take data, samples, and notes in the field. Students spend 3-4 weeks in the field during the long vacation, to collect geological data, analyze and interpret the data, and prepare geological maps and cross sections. Students work in groups in the field but work independently on the data gathered. At the end of the course, students present a report on the geology of the studied area.

EASC 454: 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 458: Exploration Geophysics
This course builds on EASC 335 and deals with geophysical techniques applied to solving geoscience problems with focus on techniques relevant to the exploration for groundwater and mineral resources: seismic, electrical (resistivity, S.P. & I.P.), electromagnetic, gravity, and magnetic methods. The course is intended to be practical, hands-on, and field-oriented so applications are emphasized, and theory is kept to the minimum. Case studies are included to illustrate applications. Hands-on experience at working with data is provided through laboratory exercises and take-home assignments.

EASC 462: Exploration Geochemistry

The course focuses on the application of geochemistry to mineral exploration. Topics discussed include the following: geochemistry of the supergene environment; supergene mineralization; regolith geochemistry; geochemical survey methods (lithogeochemical, stream sediments, soil, hydrogeochemical, geobotanical, biogeochemical); statistical treatment of geochemical data; analytical methods. Modern developments in understanding geochemical and isotopic systems and techniques applied to mineral exploration will also be discussed.

EASC 466: 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 468: Reservoir Engineering
The course covers 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 470: 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 geoscience. Topics include discussion and review of different kinds of geological publications. Also included are oral presentation delivery, proposal development, and content organization. Part II teaches students the basic and foundational skills needed to start their own business in the geoscience industries. 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 or medium scale business.

EASC 472: Site Investigations
Covers site mapping, test pit excavations and logs, drilling methods and equipment, disturbed and undisturbed sampling, water sampling, in-situ tests, exploratory drifts and tunnels, and installation of piezometers. It also covers the application of geophysical surveys in site investigations, and the interpretation of geophysical survey results and implications on engineering geological problems. Students are also taught how to prepare site investigation reports. Case studies are discussed in class. The course may include field visits.

EASC 474: Rock as Construction Materials
The course deals with explorations for quarries and rock aggregates for concrete, roads and highways, runways and railways. It also considers explosives and blasting, physical properties and chemical reaction on aggregates in concrete mixes, sulphides and organic substances in concrete, and pozzolanic materials. The techniques in sampling and laboratory analyses of samples are also considered. The course includes field visits to quarries and construction sites.

EASC 476: Geotectonics
Covers the origin and history of major tectonic forms and features of the earth, and their interaction and evolution through time. It examines modern tectonic principles and fundamental tectonic forms and textures of the earth's lithosphere and crust - orogenic belts, cratons, island arcs, rift zones, continental margins, etc, and discusses geotectonic models emphasizing on modern plate tectonic concepts. A knowledge of structural geology is required.

EASC 478: Stratigraphy
This course involves the large scale vertical and lateral relationships between units of sedimentary rock that are defined on the basis of lithologic properties, paleontological characteristics, geophysical properties, age relationships, and geographic position and distribution. The course is divided into three parts. Part I deals with lithostratigaphy and considers vertical and lateral successions of strata and correlation of lithostatigraphic units. Part II deals with

fundamental principles, and methods and applications of sequence stratigraphy. Part III deals with biostratigraphy, the characterization and correlation of rock units on the basis of their fossil contents.

EASC 480: Field Studies in Earth Science
The course includes several one-day long and one week-long field trips to hydrogeological, engineering, geo-environmental 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 studies of geology, landforms, soil types and water quality.

EASC 482: Geology of Mineral Deposits
The course gives an overview of the main types of metallic and non-metallic mineral deposits, their geological environments, geochemistry, mineralogy, structural geology and genetic constraints. It also considers the chemical, petrological, structural, and sedimentological processes that contribute to ore formation. Contents include: Distribution of economic mineral deposits with respect to their plate tectonic setting, lithological-stratigraphical environments, mineralogy, geochemistry, morphology and structural features. Description of classic deposits representing individual deposit types. Review of exploration strategies. Laboratory classes consists of hand specimen study of host rock-ore mineral suites and reflected light microscopy.

DEPARTMENT OF MATHEMATICS

INTRODUCTION
Mathematics is a critical skill which enables scientific and technological innovation and iselemental 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 Level 100 there are three 3 credit coursesto progress to Level 200 Mathematics, candidates are required to pass these Level 100 courses.

FACULTY
ACADEMIC STAFF

Benoit F Sehba *BSc,MSc (Douala),DEA (Yaounde 1) PhD (Glasgow)*	-	(Associate Professor) Head of Department
Ralph A Twum *BSc (Ghana), MS, PhD (Howard)*	-	Lecturer
Douglass Adu-Gyamfi *BSc (Ghana) DIC PhD (Lond)*	-	Senior Lecturer- Part-time
Joseph S. G. Jackson *BSc (London) MA (Cambridge)*	-	Senior Lecturer-Part-time
Edward Prempeh *BSc, MPhil, PhD (Ghana)*	-	Senior Lecturer-Part-time (kindly removed)
John De-Graft Mensah *BSc (UCC) MSc (Trondheim)*	-	Lecturer (appointment not renewed for the past two years)
Peter Acquaah *BA,Mphil PhD (Ghana*)	-	Lecturer (no longer member of the department)
Prince K. Osei *BSc,Mphil, PhD (Ghana)*	-	Lecturer (appointment not renewed for the past two years)
Thomas Katsekpor *BSc,Mphil (Ghana),PhD(Ghana)*	-	Lecturer
Eyram K.A.Schwinger *BA(Ghana) MSc(Bergen) PhD (Ghana)*	-	Lecturer

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B.Sc(Imo State), MSc, Mphil PhD (Ibadan)
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Vincent T. Teyekpiti
BSc, Mphil (Norway),PhD(Norway) Lecturer

NON-ACADEMIC STAFF

Mr. Sampson Mark Amegayie – Principal Library Assistant

Ms. Henrietta N. Totimeh – Senior Administrative Assistant

Mrs. Emelda Obuobi – Administrative Assistant

Mr. Alex Agyei – Technician

Mr. Sedric Barrigah – Cleaner

PROGRAMME STRUCTURE

SINGLE MAJOR IN MATHEMATICS

LEVEL 200
FIRST SEMESTER
Core

Code	Title	Prerequisite- Pass in	Credits
UGRC 210	Academic Writing II		3
MATH 223	Calculus II	MATH 122	3
MATH 225	Vectors and Mechanics	MATH 122	3
STAT 221	Introductory Probability I		3

	3-6 credits from one other department from 100 level		3-6
Total			**15-18**

SECOND SEMESTER

Core

Code	**Title**	**Prerequisite- Pass in**	**Credits**
UGRC 220	Liberal and African Studies		3
MATH 222	Vector Mechanics	MATH 225	3
MATH 224	Introductory Abstract Algebra	MATH 126	3
MATH 220	Introductory Computational Mathematics	MATH 122	3
STAT 224	Introductory Probability II		3
Total			**15**
Electives			
	3 credits from one other department from 100 level		
			15-18

LEVEL 300

FIRST SEMESTER

Core

Code	**Title**	**Prerequisite- Pass in**	**Credits**
MATH 351	Linear Algebra	MATH 224	3
MATH 353	Analysis I	MATH 223	3
MATH 355	Calculus of Several Variables	MATH 223	3
[i]MATH 350*	Differential Equations I	MATH 223	3
Total			**9-12**
Electives (Select 6-9 credits)			
MATH 359	Discrete Mathematics	MATH 224	3
MATH 361	Classical Mechanics	MATH 222	3
MATH 363	Introductory concepts of financial mathematics	MATH 223/STAT 221	3
STAT 331	Probability distributions	STAT 221,224	3

SECOND SEMESTER

Core

Code	**Title**	**Prerequisite- Pass in**	**Credits**
MATH 354	Abstract Algebra I	MATH 224	3
MATH 356	Analysis II	MATH 223	3
MATH 372	Topology	MATH 353	3
[i]MATH 350*	Differential Equations I	MATH 223	3
Total			**9-12**
Electives (Select 6-9 credits)			
MATH 366	Electromagnetic Theory I	MATH 222	3
MATH 362	Analytical Mechanics	MATH 222	3
MATH 358	Computational Mathematics I	MATH 220	3
MATH 368	Introductory number theory	MATH 224	3
STAT 332	Multivariate distributions	STAT 331	3

*Please note MATH 350 may be taken in either First or the Second Semester

LEVEL 400
FIRST SEMESTER
Core

Code	Title	Prerequisite- Pass in	Credits
[i]MATH 400	Project		3
MATH 441	Advanced Calculus	MATH 353 or MATH 351	3
MATH 440*	Abstract Algebra II	MATH 354	3
MATH 447	Complex Analysis	MATH 223	3
Total			**9-12**
Select at least 6 credits			
MATH 443	Differential Geometry	MATH 355	3
MATH 445	Introductory Functional Analysis	MATH 356	3
MATH 449	Electromagnetic Theory II	MATH 366	3
MATH 451	Introduction to Algebraic Field Theory	MATH 354	3
MATH 453	Introduction to Quantum Mechanics	MATH 362	3
MATH 455	Computational Mathematics II	MATH 358	3
MATH 457	Mathematical Biology I		3

Project may be replaced by two elective courses in mathematics
MATH 440 may be taken in either semester

SECOND SEMESTER
Core

Code	Title	Prerequisite- Pass in	Credits
MATH 400	Project		3
MATH 442	Integration Theory and Measure	MATH 356	3
MATH 440*	Abstract Algebra II	MATH 354	3
Total			**6-9**
Electives (Select a minimum of 9 credits)			
MATH 444	Calculus on Manifolds	MATH 441	3
MATH 446	Module Theory	MATH 440	3
MATH 448	Special Relativity	MATH 362	3
MATH 452	Introduction to Lie Groups and Lie Algebras	MATH 354	3
MATH 450	Differential Equations II	MATH 350	3
MATH 458	Mathematical Biology II	MATH 457	3
MATH 460	Fourier series and Fourier transforms	MATH 356	3

MAJOR – MINOR IN MATHEMATICS

LEVEL 200 **FIRST SEMESTER**
Core

Code	Title	Prerequisite- Pass in	Credits
UGRC 210	Academic Writing II		3
MATH 225	Vectors and Mechanics	MATH 122	3
MATH 223	Calculus II	MATH 122	3
Total			**9**
Electives (Select a minimum of 3 credits)			

MATH 220*	Introductory Computational Mathematics	MATH 122	3
STAT 221	Introductory Probability I		3

SECOND SEMESTER

Core

Code	**Title**		**Credits**
UGRC 220	Liberal and African Studies		3
MATH 224	Introductory Abstract Algebra	MATH 126	3
Total			**6**
Electives (Select a minimum of 3 credits)			
MATH 222	Vector Mechanics	MATH 225	3
MATH 220*	Introductory Computational Mathematics	MATH 122	3
STAT 224	Introductory Probability II		3

Students take 6 credits each semester from their minor department
MATH 220 may be taken in either semester

LEVEL 300

FIRST SEMESTER

Core

Code	**Title**	**Prerequisite- Pass in**	**Credits**
MATH 351	Linear Algebra	MATH 224	3
MATH 353	Analysis I	MATH 223	3
MATH 355	Calculus of Several Variables	MATH 223	3
Total			**9**

SECOND SEMESTER

Core

Code	**Title**	**Prerequisite- Pass in**	**Credits**
MATH 354	Abstract Algebra I	MATH 224	3
MATH 356	Analysis II	MATH 223	3
MATH 350	Differential Equations I	MATH 223	3
MATH 372	Topology	MATH 353	3
Total			**9-12**

Students take 6 credits each semester from their minor department.
Students may choose to add an elective from the single subject elective list.
MATH 372 Topology may be done in level 400.
Minor students choose any two courses each semester

LEVEL 400

FIRST SEMESTER

Core

Code	**Title**	**Prerequisite- Pass in**	**Credits**
[i]MATH 400	Project		3
MATH 441	Advanced Calculus	MATH 351 or MATH 353	3
MATH 447	Complex Analysis	MATH 223	3

Total			**9**
Electives (Select 6-9 credits)			
MATH 440	Abstract Algebra II	MATH 354	3
MATH 443	Differential Geometry	MATH 355	3
MATH 451	Introduction to Algebraic Field Theory	MATH 354	3
MATH 453	Introduction to Quantum Mechanics	MATH 362	3
MATH 455	Computational Mathematics II	MATH 358	3
MATH 445	Introductory Functional Analysis	MATH 353	3
MATH 457	Mathematical Biology I		3
MATH 449	Electromagnetic theory II	MATH 366	3

SECOND SEMESTER

Core

Code	**Title**	**Prerequisite- Pass in**	**Credits**
[i]MATH 400	Project		3
MATH 442	Integration Theory and Measure	MATH 356	3
Total			**3**
Electives (Select 12 credits)			
MATH 444	Calculus on Manifolds	MATH 441	3
MATH 446	Module Theory	MATH 440	3
MATH 448	Special Relativity	MATH 362	3
MATH 452	Introduction to Lie Groups and Lie Algebras	MATH 354	3
MATH 450	Differential Equations II	MATH 350	3
MATH 458	Mathematical Biology II	MATH 457	3
MATH 460	Fourier series and Fourier transforms	MATH 356	3

*Project may be replaced by two elective courses in mathematics

COMBINED MAJOR

LEVEL 200

FIRST SEMESTER

Core

Code	**Title**	**Prerequisite- Pass in**	**Credits**
UGRC 210	Academic Writing II		3
MATH 225	Vectors and Mechanics	MATH 122	3
MATH 223	Calculus II	MATH 122	3
Total			**9**

SECOND SEMESTER

Core

Code	**Title**	**Prerequisite- Pass in**	**Credits**
UGRC 220	Liberal and African Studies		3
MATH 224	Introductory Abstract Algebra	MATH 126	3
Total			**6**
Electives (Select a minimum of 3 credits)			
MATH 222	Vector Mechanics	MATH 225	3
MATH 220	Introductory Computational Mathematics	MATH 122	3

Students take 6-9 credits each semester from their other department

LEVEL 300
FIRST SEMESTER
Core

Code	Title	Prerequisite- Pass in	Credits
MATH 351	Linear Algebra	MATH 224	3
MATH 353	Analysis I	MATH 223	3
MATH 355	Calculus of Several Variables	MATH 223	3
Total			**9**

SECOND SEMESTER
Core

Code	Title	Prerequisite- Pass in	Credits
MATH 354	Abstract Algebra I	MATH 224	3
MATH 356	Analysis II	MATH 223	3
MATH 350	Differential Equations I	MATH 223	3
Total			**9**

Students take 9 credits each semester from their other department.

LEVEL 400
FIRST SEMESTER
Core

Code	Title	Prerequisite- Pass in	Credits
MATH 441	Advanced Calculus	MATH 351 or MATH 353	3
MATH 447	Complex Analysis	MATH 223	3
Total			**6**
Electives (Select 3-6 credits)			
MATH 440	Abstract Algebra II	MATH 354	3
MATH 443	Differential Geometry	MATH 355	3
MATH 451	Introduction to Algebraic Field Theory	MATH 354	3
MATH 453	Introduction to Quantum Mechanics	MATH 362	3
MATH 455	Computational Mathematics II	MATH 358	3
MATH 445	Introductory Functional Analysis	MATH 353	3
MATH 449	Electromagnetic theory II	MATH 366	3
MATH 457	Mathematical Biology I		3

SECOND SEMESTER
Core

Code	Title	Prerequisite- Pass in	Credits
MATH 442	Integration Theory and Measure	MATH 356	3
Electives (Select 6 credits)			
MATH 372	Topology	MATH 353	3
MATH 444	Calculus on Manifolds	MATH 441	3
MATH 446	Module Theory	MATH 440	3
MATH 448	Special Relativity	MATH 362	3
MATH 452	Introduction to Lie Groups and Lie Algebras	MATH 354	3
MATH 450	Differential Equations II	MATH 350	3
MATH 458	Mathematical Biology II	MATH 457	3
MATH 460	Fourier series and Fourier	MATH 356	3

	transforms		

Students take 9 credits each semester from their other department.

Course Descriptions

LEVEL200

MATH 223: Calculus II-Prerequisite pass in MATH 122

The first and the second derivatives of functions of a single variable and their applications. Integration as a sum; definite and indefinite integrals; improper integrals. The logarithmic and exponential functions, the hyperbolic functions and their inverses. Techniques of integration including integration by parts, recurrence relations among integrals, applications of integral calculus to curves: arc length, area of surface of revolution. Ordinary differential equations: first order and second order linear equations with constants coefficients. Applications of first order differential equations.

MATH 225: Vectors and Mechanics

This is a first course in the applications of differentiation and integration of vector functions of a scalar variable. Kinematics of a single particle in motion, displacement, velocity and acceleration. Relative motion. Concept of a force, line of action of a force, Newton's laws of motion. Motion in a straight line, motion in a plane, projectiles, circular motion. Work, energy, power. Impulse and linear momentum. Moment of a force and couple, conditions for equilibrium of rigid bodies.

MATH 222: Vector Mechanics

Vector functions of a scalar variable; further differentiation and integration; Serret-Frenet formulae; differential equations of a vector function. Motion of a particle; Kinematics, Newton's laws; concept of a force; work, energy and power; impulse and momentum, conservation laws of energy and linear momentum. Rectilinear motion, motion in a plane. The two-body problem, variable mass.

MATH 224: Introductory Abstract Algebra -Prerequisite pass in MATH 126

This is the first course in abstract algebra and as such it will be the students' first approach to an axiomatic presentation of mathematics. Among the topics to be discussed are notions of relations on sets, equivalence relations and equivalence classes as well as the concept of partial ordering. The system of real numbers and their properties will be discussed. The principle of induction will be reviewed. An introduction to number theory will be given as numbers are the most familiar mathematical objects. The course also seeks to introduce axiomatically defined systems such as groups, rings and fields, and vector spaces.

MATH 220: Introductory Programming for Computational Mathematics

This course isin two parts. The first part is an introduction to programming using the python programming language. This part of the course begins with the basics of python. Vectorization, and visualization in python are also treated. The second part is an introduction to solving mathematical problems numerically. These problems include finding the roots of nonlinear equations, solving large systems of linear equations and fitting polynomials to data. By the end of this course, students will be able to use python to solve basic mathematical problems.

MATH 350: Differential Equations I-Prerequisite MATH 223

Differential equations can be studied analytically, numerically and qualitatively. The focus of this course is to find solutions to differential equations using analytic techniques. 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 solutions. Ordinary and regular singular points. Orthogonal sets of functions. Partial differential equations.

MATH 351: Linear Algebra-Prerequisite MATH 224

We will develop a core material called linear algebra by introducing certain definitions, creating procedures for determining properties and proving theorems. Although the student will be doing some computations, the goal in most problems is not merely to get the "right"answer, but to understand and explain how to get the answer and then interpret the result. Topics to be discussed include: 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 353: Analysis I-Prerequisite MATH 223
This is the first rigorous analysis course. Topics to be discussed include: normed vector spaces, limits and continuity of maps between normed vector spaces. Students will be expected to produce proof to justify their claims. We study 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 354: Abstract Algebra I-Prerequisite MATH 224
The primary aim of Math 354 is to study groups and their properties. We shall develop the foundations of group theory and study some notable groups like cyclic groups, permutation groups, finite Abelian groups and their characterization. Other ideas include: 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 355: Calculus of Several Variables-Prerequisite MATH 223
The major goal for this course is to understand and apply the concepts of differentiation and integration to functions of several variables. Functions of several variables and 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 356: Analysis II-Prerequisite MATH 223
This is a continuation of MATH 353. We now consider vector spaces of functions and discuss convergence of sequences of functions; pointwise and uniform convergence. Other topics discussed include; power series, the contraction mapping theorem and applications. We examine the definition of the Riemann integral and conditions for integrability. We give a proof of the fundamental theorem of calculus and other major basic results involved in its proof. We finish with some point set topology in R.

MATH 358: Computational Mathematics I-Prerequisite MATH 220
This course is a sequel to MATH 220. In this course, we continue the solution of linear systems by treating matrices with special structures. We also continue with data fitting using polynomials. Several high order methods for discretizing the derivative and definite integral are also treated. The course ends with approximations of eigenvalues for large matrices. We explain the concept of the dominant eigenvalue and its eigenvector. We also look at simultaneous approximation of eigenvalues.

MATH 359: Discrete Mathematics-Prerequisite MATH 224
This course is a study of discrete rather than continuous mathematical structures. Topics include: asymptotic analysis and analysis of algorithms, recurrence relations and equations, Counting techniques (examples include: Inclusion-exclusion and pigeon-hole principles and applications, Multinomial theorem, generating functions), Elementary number theory and cryptography, Discrete probability theory and graph theory; including planarity, Euler circuits, shortest-path algorithm. Network flows. Modelling computation:languages and grammars, models, finite state machines, Turing machines.

MATH 361: Classical Mechanics -Prerequisite MATH 222
The methods of classical mechanics have evolved into a broad theory of dynamical systems and therefore there are many applications outside of Physics; for example to biological systems. Topics to be discussed will include 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 362: Analytical Mechanics- Prerequisite MATH 222
In this course the student is introduced to a collection of closely related alternative formulations of classical ***mechanics. It*** provides a detailed introduction to the key analytical techniques of classical mechanics. Topics discussed include 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 363: Introductory Concepts in Financial Mathematics-Prerequisite MATH 223, STAT 221
This course introduces the basic methods applied in financial mathematics. We will discuss probability functions, stochastic processes, random walks and martingales; Ito's lemma and stochastic calculus. Students will understand the stochastic differential equations for a geometric Brownian motion process. We will study mean reverting models such as the Ornstein- Uhlenbeck process, as well as stochastic volatility models such as the Heston Model. Stochastic models for stock pricing are also discussed; we study a binomial option pricing model, the Black-Scholes model and the capital asset pricing model.

MATH 366: Electromagnetic Theory I-Prerequisite MATH 222
This course develops the mathematical foundations for the application of the electromagnetic model to various problems. Mathematics discussed includes 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 368: Introductory Number Theory-Prerequisite MATH 224
This course builds on the elementary number theory introduced in MATH 224. Topics include: the Fundamental theorem of Arithmetic, Proof and Application: GCD, LCM. Asymptotic notations,Congruences, Residue systems and Euler Phi-function, linear congruence, Chinese Remainder theorem, Theorems of Euler, Fermat and Wilson. Arithmetic functions and Dirichlet multiplication: Mobius, Euler Phi and Mangoldt, Dirichlet's product and Mobius inversion formula, averages of arithmetic functions. Quadratic residues and quadratic reciprocity law. Legendre's symbol and its properties. The applications of the quadratic reciprocity law, the Jacobi symbol. Prime Number distribution.

MATH 372: Topology –Prerequisite MATH 353
This is a first course in point set topology. Students will be introduced to topological spaces and be able to identify open and closed sets with respect to the given topology. Other aspects to be discussed are basis for a topological space. Separation and countability properties. Limit points. Connectedness. Subspace topology. Homeomorphism. Continuity. Metrizability. Continuity via convergent sequences. Compactness.

MATH 440: Abstract Algebra II-Prerequisite MATH 354
This is a second course in group theory. Topics covered will include: finite groups, Sylow theorems and simple groups. Composition series. We state and prove the Zassenhaus Lemma, the Schreier theorem and the Jordan-Hölder 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.

MATH 441: Advanced Calculus-Prerequisite MATH 351 or MATH 353
Here we think of differentiation as a process of approximating the function f near a, by a linear map. This linear map is called the Frèchet derivative of f at a. The main aim of this course is to understand two of the most important theorems for modern analysis: the Inverse Map Theorem and the Implicit Function Theorem. Other ideas include: 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.

MATH 442: Integration Theory and Measure –Prerequisite MATH 356
Algebra of sets, measurable sets and functions, measures and their construction (in particular Lebesgue measure), measure spaces. Integration, convergence theorems for example: Fatou's Lemma, Monotone Convergence Theorem, Lebesgue Dominated Convergence Theorem. Lebesgue spaces, elementary inequalities, modes of convergence. Product measures and Fubini's theorem. 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.

MATH 443: Differential Geometry-Prerequisite MATH 355
The modern approach to differential geometry uses the language of manifolds. This provides a theory and a variable free notation which frees us from always having to consider the coordinate system. We want to be able to deal with the elements of calculus both invariantly (i.e. independently of the local coordinates) and intrinsically (i.e. independently of the way a geometric object is embedded in Euclidean space). But to appreciate the great contribution to differential geometry made by the theory of manifolds, we will first study classical differential geometry and then a little of the modern approach.

MATH 444: Calculus on Manifolds-Prerequisite MATH 441
This course aims to provide an introduction to Differentiable Manifolds and the tools for performing calculus on these objects; tangent vectors and differential forms. We will see how concepts like the derivative in R^n is extended to a smooth *n*-dimensional manifold. Topics include: manifolds and submanifolds, differentiability of maps between manifolds, the tangent space, the tangent bundle and the tangent functor. Vector bundles. 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 445: Introductory Functional Analysis-Prerequisite MATH 356
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, their special subspaces and the dual space. The completion of a normed vector space. Reflexive Banach spaces.

MATH 446: Module Theory-Prerequisite MATH 440
In this course we shall study the mathematical objects called modules. The use of modules was pioneered by one of the most prominent mathematicians, Emmy Noether (a German), who led the way in demonstrating the power and elegance of this structure. Topics include: 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 447: Complex Analysis-Prerequisite MATH 223
The objective of this course is to introduce students to complex numbers and functions of a complex variable. We introduce the notions of differentiability, analyticity and integrability for a function defined on the complex plane. We also look at ways in which one can integrate complex-valued functions. Elementary topology of the complex plane. Complex functions and mappings. The derivative and harmonic functions. Integrals. Maximum modulus, Cauchy-Gorsat and Cauchy theorems. Applications of the theorems. Taylor and Laurent series, zeros and poles of a complex function. Residue theorem and consequences. Conformal mapping, analytic continuation.

MATH 448: Special Relativity- Prerequisite MATH 362
By employing the mathematics of sets, mappings and relations we aim to develop an ability to think relativistically. Topics include: 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 449: Electromagnetic Theory II-Prerequisite MATH 366
This is a second course in the development of the mathematical foundations for the application of the electromagnetic model to various problems. Magnetostatics: steady currents, heating affect and magnetic field, magnetic vector potential, magnetic properties of matter, dipoles, induced magnetism, permanent magnetism. Time-varying fields: electromagnetic induction. Differential form of Faraday's law, energy in electromagnetic fields. Maxwell's equations and their consequences Poynting vector; electromagnetic potentials formation of electrodynamics.

MATH 450: Differential Equations II-Prerequisite MATH 350
This course introduces undergraduate students to the qualitative theory of Ordinary Differential Equations. We will

use the Picard-Lindelöf Theorem to analyze whether an ODE or a system of ODEs has a solution and the behavior of the solution as the parameter is varied (bifurcation). We will especially consider autonomous linear and nonlinear systems and investigate the stability of the solutions that result. We will also introduce the concept of a Lyapunov function. Other topics might include partial differential equations, the method of characteristics and classification.

MATH 451: Introduction to Algebraic Field Theory-Prerequisite MATH 354
The famous problems of squaring the circle, doubling the cube and trisecting an angle captured the imagination of both professional and amateur mathematicians for over two thousand years. Despite the enormous effort and ingenious attempts by these men and women, the problems would not yield to purely geometrical methods. It was only the development of abstract algebra in the nineteenth century which enabled mathematicians to arrive at the surprising conclusion that these problems are impossible. Topics include: algebraic numbers. Extending fields. Towers of fields. Irreducible polynomials. Constructible numbers and fields. Transcendence of π and e. Residue rings and fields.

MATH 452: Introduction to Lie Groups and Lie Algebras- Prerequisite MATH 354
This course will cover the basic theory of Lie groups and Lie algebras. Topics may include: topological groups and Haar measure, vector fields and groups of linear transformations. The exponential map. Linear groups and their Lie algebras. Structure of semi-simple Lie algebras, Cartan and Iwasawa decompositions. Manifolds, homogeneous spaces and Lie groups. Integration and representations.

MATH 453: Introduction to Quantum Mechanics-Prerequisite MATH 362
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 Schrödinger equation in one-dimension; free particles in a box, single step and square well potentials. Orbital angular momentum. The 3-dimensional Schrödinger 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 455: Computational Mathematics II-Prerequisite MATH 358
This course looks at methods of discretizing and solving differential equations. It begins with the solution of initial value problems for ordinary differential equations. We start with the Euler methods and systematically develop high order solutions for solving problems. The course then develops the concept of finite differences to solve boundary value problems. In addition, we look at the problem of discretizing partial differential equations in space and time both implicitly and explicitly.

MATH 457: Mathematical Biology I
In this course we focus on 3 types of biological phenomena to be modelled, namely single species population dynamics, interacting species and molecular dynamics. In single species population dynamics we will use difference equations, graphical analysis, fixed points and linear stability analysis. First order systems of ordinary differential equations: logistic equation, steady states, linearisation, and stability. We will examine applications to harvesting and fisheries. For interacting species we examine systems of difference equations (host-parasitoid systems) and systems of ordinary differential equations (predator-prey and competition models). Finally, we will consider biochemical kinetics, Michaelis-Menten kinetics and metabolic pathways, activation and inhibition.

MATH 458: Mathematical Biology II- Prerequisite MATH 457
The detail of this course may be informed by the student choice(s) of project topic and could include: (i) modelling of biological systems using partial differential equations. Derivation of conservation equations. Different models for movement (e.g. diffusion, convection, directed movement). Connection between diffusion and probability. (ii) Linear reaction-diffusion equations. Fundamental solution for linear diffusion equations. Speed of a wave of invasion. Non-linear reaction-diffusion equations. Travelling wave solutions for monostable equations (e.g. Fisher equation). Travelling wave solutions for bistable equations. (iii) Systems of reaction-diffusion equations. Travelling wave solutions for systems of reaction-diffusion equations. Pattern formations in systems of reaction-diffusion equations. Pattern formations in chemotaxis equations. (iv) Mathematical modelling of infection diseases (SIR). Derivation of a simple SIR model. Travelling wave solutions for the simple SIR model. Generalisation of the simple SIR model. Stochastic SIR model.

MATH 460: Fourier Series and Fourier Transforms-Prerequisite MATH 356
The objective of this course is to introduce the theory of Fourier series and Fourier transforms on the real line. Topics

include: convolutions, summability kernels, convergence of Césaro means. Mean-square convergence, pointwise convergence. Fourier transform on the real line, inversion formula, Plancherel formula, Weierstrass approximation theorem. Applications to partial differential equations, Poisson summation formula. The Heisenberg uncertainty principle.

DEPARTMENT OF PHYSICS

INTRODUCTION

The Department of Physics offers degree programmes leading to a BSc Major in Physics, and a BSc Major in Physics and another subject, as well as a BSc Major in another subject and a Minor in Physics. The Department also offers a BSc in Geophysics. 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, Minor combinations of 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

ACADEMIC STAFF

Martin N. Y. H. Egblewogbe - Senior Lecturer (**Head of Department)**
BSc MSc.,PhD (Ghana)

Josef K. A. Amuzu - Emeritus Professor
MSc (Ghana) PhD (Camb)

Nana Ama Browne Klutse - Associate Professor
BSc (Cape Coast) PhD (Cape Town)

George K Nkrumah Buandoh - Senior Lecturer
-BSc MPhil PhD (Ghana) ICTP Dip. (Trieste)

Amos Kuditcher - Senior Lecturer
BSc (Kumasi) MSc PhD (Ann Arbor)

Samuel Akoto Bamford - Senior Lecturer/ Part-Time
BSc (Kumasi) MSc PhD (Ghana)

Gebremedhn G. Hagoss - Senior Lecturer
BSc. MSc. (Addis Ababa) PhD (Hanover)

Allison F. Hughes - Senior Lecturer
BSc MSc PhD (Ghana)

Alfred A. Yankson *Dip Ed, BSc (Cape Coast) MSc, PhD (Ghana)*	-	Senior Lecturer
Samuel A. Atarah *BSc (Cape Coast) MSc (Helsinki)* *PhD (Leicester - DMU)*	-	Senior Lecturer
Hubert A. Koffi *BSc., MSc., (Abidjan) PhD (Ghana)*	-	Senior Lecturer
Joseph Asare *BSc. (Cape Coast), MSc (Abuja)., PhD (Abuja)*	-	Senior Lecturer
Godfred B. Hagan *BSc., MPhil., PhD (Ghana)*	-	Lecturer
Joana A. M. Hodasi *BSc. MSc. (Cape Coast)*	-	Lecturer
Abraham Amankwah *Dip Ed BSc (Cape Coast) MSc (Bremen)* *PhD (Ghana)*	-	Lecturer
George Kusi-Appiah *BSc (Kumasi) MSc (Tromso) MPhil (Leeds)*	-	Lecturer/ Study Leave
Kofi Ampomah Benefo *BSc. (Cape Coast), MPhil PhD (Ghana)*	-	Lecturer/ Part-time
Eric Dominic Forson *BSc (Kumasi) MPhil (Kumasi) PGDE (Winneba) PhD (Ghana)*	-	Lecturer
Rodney N. Abugre *BSc. MSc. (Ghana)*	-	Assistant Lecturer / Study Leave
Daniel Sekyi-Arthur	-	Assistant Lecturer *BSc. MPhil., PhD (Cape Coast)*

NON-ACADEMIC STAFF

Rev. Seth Ofosu Asamani	–	Chief Library Assistant
Francis Mensah Essel	–	Senior Library Assistant
Esther Amenyo	–	Senior Administrative Assistant
Grace Nyarko	–	Administrative Assistant
Beatrice Agyapomah	–	Senior Laboratory Technologist
Elena Oti-Padmore	–	Senior Laboratory Assistant
Vicentia Osei-Agyapong	–	Assistant Technologist

Daniel C. Nkansah	–	Principal Technician
Evans Adabla	–	Principal Technician
Sampson Edem Adanuti	–	Senior Technician
Frederick K. Tattah	–	Technician
Richard Nkansah	–	Technician
Emmanuel Akplehey	–	Technician
Bernard Segbedzi	–	Cleaner
Joseph Gyimah	–	Cleaner
Kwame Abukari	–	Cleaner
Bawa Aturtue	–	Cleaner
Robert Mensah	–	Foreman

PROGRAMMME STRUCTURE
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	Vectors and Mechanics	3
Total		**15**

SECOND SEMESTER
Core

Course Code	Course Title	Credits
UGRC 220-238	Introduction to 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 220-238	Introduction to 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 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 361: 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 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, caliper 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 365: 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 STATISTICS AND ACTUARIAL SCIENCE

INTRODUCTION

The Department of Statistics runs three undergraduate programmes in Statistics and two in Actuarial Science. They are: Single Major in Statistics, Major- Minor in Statistics and Combined Major in Statistics. The other two new programmes in Actuarial Science are: Single Major in Actuarial Science and Combined Major Actuarial Science and Mathematics.

STATISTICS

The basic qualification for admission into Level 200-400 programmes in Statistics 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 Probability I and STAT 112: Introduction to Statistics and Probability II. 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: Introduction to Statistics and Probability II, 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.

ACTUARIAL SCIENCE

The basic qualification into Level 200 – 400 programmes in Actuarial Science is a pass in Level 100 courses in Mathematics and Actuarial Science, that is, in MATH 121: Algebra and Trigonometry MATH 122: Calculus I, STAT 111: Introduction to Statistics and Probability I, STAT 112: Introduction to Statistics and Probability II, ECON 101: Introduction to Economics I and ECON 102: Introduction to Economics II.

There will be two offerings: (i) SINGLE MAJOR in ACTUARIAL SCIENCE and

(ii) COMBINED MAJOR ACTUARIAL SCIENCE and MATHEMATICS

FACULTY

ACADEMIC STAFF

Louis Asiedu *BSc MPhil (Ghana) PhD (KNUST)*	-	Senior Lecturer *(Head of Department)*
Kwabena Doku-Amponsah *BA (Ghana) MSc (Kaisershlautern) PhD (Bath)*	-	Associate Professor *(Sabbatical Leave)*
Felix O. Mettle *BA MPhil PhD (Ghana)*	-	Senior Lecturer

Ezekiel N. N. Nortey - Senior Lecturer
BA, MPhil, PhD (Ghana)

Isaac Baidoo - Senior Lecturer
BSc (Massachusetts)MS PhD(Arizona)

Anani Lotsi - Senior Lecturer
BSc. (Ghana) MSc (Kaiserslautern)
PhD (Netherlands)

Samuel Iddi - Senior Lecturer
BSc (Ghana), MSc (Hasselt), PhD (Leuven)

Richard Minkah - Senior Lecturer
BSc (Ghana), MSc (Uppsala) PhD (Ghana)

Perpetual A. Boiquaye - Senior Lecturer
BSc(UDS), MSc(AIMS, Ghana) MPhil (KNUST) PhD (KNUST)

Benedict Mbeah-Baiden - Assistant Lecturer
BA, MPhil (Ghana)

Gabriel Kallah-Dagadu - Lecturer
BA, MPhil (Ghana) PhD (Ghana) *(Study Leave)*

Dennis Arku - Lecturer
BA MPhil (Ghana) PhD (Ghana)

Eric Nyarko - Lecturer
BSc. (UDS) MPhil (Ghana) PhD (Magdeburg)

Charlotte Chapman-Wardy - Lecturer
BA (Ghana) MSc (London) PhD (Ghana)

Eric Ocran - Lecturer
BA MPhil (Ghana) PhD (Ghana)

Edward Acheampong - Lecturer
BSc (KNUST),MS (Hasselt) PhD(Nottingham)

Godwin Debrah - Lecturer
BA MA (Central Michigan) PhD (Michigan State)

Winnie O. Onsongo - Lecturer
BSc (Kenya) MSc (PAUISTI) PhD (PAUISTI)

Issah Seidu - Assistant Lecturer
BA MPhil (Ghana)

Enoch Sakyi-Yeboah - Assistant Lecturer
*BSc. MPhil (Ghana)***Marjorie Danso-Manu** - Part-Time Lecturer
BA (Ghana) MSc (London) PhD (Ghana)

S. A. Yeboah - Part-Time Lecturer
BSc (Ghana) MSc (London)

E. Amartey-Vondee - Part-Time Lecturer
BSc (Ghana) MS (London)

E. Okyere - Part-Time Lecturer

BSc (Ghana) MSc, PhD (Bonn)

NON- ACADEMIC STAFF

Doreen Ami-Narh	-	Senior Administrative Assistant
Elizabeth Okantah Ntsiful	-	Senior Library Assistant
Emmanuel Kofi Bukari	-	Senior Library Assistant
Stephanie Elorm Mensah	-	Administrative Assistant
Doris Abalo-Kwadjo	-	Senior Clerk
Braimah Abdulai	-	Conservancy Labourer
Moses Banibapane Sadungo	-	Cleaner

PROGRAMME STRUCTURE FOR ACTUARIAL SCIENCE

SINGLE MAJOR IN ACTUARIAL SCIENCE

LEVEL 200

First Semester

Course Code	*Course Title*	*Credits*	*Pre-requisite(s)*
Core			
UGRC 210	Academic Writing II	3	
STAT 221	Introductory Probability I	3	MATH 121, STAT 122
ACTU 203	Introduction to Financial Mathematics I	3	
MATH 223	Calculus II	3	
STAT 223	Elementary Statistical Methods	3	
Total		15	

Electives (Select 3 – 6 Credits)			
*STAT 240	Introduction Statistical Computing	3	
ECON 201	Elements of Economics I	3	
STAT 220	Introduction to Actuarial Sciences	1	

Second Semester

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
Core			
UGRC 220-238	Introduction to African Studies	3	
ACTU 204	Introduction to Financial Mathematics II	3	
STAT 224	Introductory Probability II	3	STAT 221
MATH 224	Introductory Abstract Algebra	3	
MATH 220	Introductory Computational Mathematics	3	MATH 122
Total		15	
Electives (Select 3 – 6 Credits)			
ECON 202	Elements of Economics II	3	
DCIT 204	Database Fundamentals	3	
MATH 225	Vector Mechanics	3	MATH 122
STAT 230	Data Mining	3	

LEVEL 300

First Semester

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
Core			
STAT 331	Probability Distributions	3	STAT 224

MATH 351/STAT 339	Linear Algebra/Methods of Linear Algebra	3	MATH 224/ MATH 126
ACTU 301	Life Contingencies I	3	ACTU 204
FINC 301	Introduction to Business Finance	3	
MATH 355	Calculus of Several Variables	3	MATH 223
Total		15	
Electives (Select 3-4 Credits)			
STAT 333	Statistical Inference I	3	
MATH 359	Discrete Mathematics	3	
STAT 335	Sample Survey Methods	3	
MATH 353	Analysis I	3	MATH 223
MATH 358	Computational Mathematics I	3	MATH 220
ACTU 320	Internship in Actuarial Science (either 1st or 2nd Semester) **	1	
ACTU 335	Microeconomic Theory for Actuaries I	3	
ACTU 359	Risk Management and Insurance	3	

*** To be taken during vacation*

Second Semester

Course Code	*Course Title*	*Credits*	*Pre-requisite(s)*
Core			
STAT 332	Multivariate Distributions	3	STAT 331, MATH 331
ACTU 304	Life Contingencies II	3	
MATH 350	Differential Equations I*	3	MATH 223
ACTU 302	Introduction to Actuarial Computing	3	
MATH 356	Analysis II	3	MATH 223

Electives (Select 3 – 6 Credit)			
CSCD 314	Operations Research	3	
MATH 354	Abstract Algebra I**	3	MATH 224
STAT 334	Statistical Inference II	3	
ACTU 334	Microeconomic Theory for Actuaries II	3	
FINC 352	Principle and Practice of Insurance	3	
STAT 338	Decision Theory	3	
STAT 356	Life Insurance and Retirement Security	3	

**Please note MATH 350 is offered either in the first or second semester by the Dept. of Mathematics. BSC Actuarial Science Major students will take the course in the second semester.*

*** Not to be taken by Mathematics Students*

LEVEL 400
First Semester

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
Core			
ACTU 410	Project	3	
ACTU 405	Fundamentals of Financial Accounting I	3	
ACTU 409	Loss Distributions & Actuarial Risk Measures	3	
ACTU 453	Introduction to Non-Life Insurance Mathematics I	3	
ACTU 407	Financial Economics I	3	
Total		**15**	
Electives (Select 3 – 6 credits)			
STAT 457	Economic and Social Statistics II	3	

STAT 445	Advanced Regression Analysis	3	STAT 334, MATH 335
ACTU 445	Macroeconomic Theory for Actuaries I	3	
STAT 443	Population Statistics	3	
STAT 451	Random Processes	3	STAT 331
MATH 441	Advanced Calculus	3	MATH 351 or MATH 353
MATH 445	Introductory Functional Analysis	3	MATH 356
ACTU 441	Econometrics for Actuaries I	3	
MATH 447	Complex Analysis	3	MATH 223
STAT 459	Statistical Quality Control	3	
STAT 440	Business Statistics	3	

Second Semester

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
Core			
ACTU 410	Project	3	
ACTU 412	Fundamental Financial Accounting II	3	
ACTU 454	Introduction to Non-life Insurance Mathematics II	3	
ACTU 408	Financial Economics II	3	ACTU204,STAT 331,STAT332
ACTU 404	Pensions and Social Security	3	
Total		**15**	
Electives (Select 3 – 6 Credits)			
MATH 450	Differential Equations II	3	
ACTU 448	Macroeconomic Theory for Actuaries II	3	
FINC 458	Health Insurance	3	

STAT 458	Economic and Social Statistics II	3	
ACTU 442	Econometrics for Actuaries II	3	
FINC 452	Property and Pecuniary Insurance	3	

BSc/BA. ACTUARIAL SCIENCE AND MATHEMATICS
LEVEL 200 (ENTRY REQUIREMENT*: MATH 121, MATH 126, STAT 111, STAT 112, MATH 12*2)

First Semester

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
Core			
UGRC 210	Academic Writing II	3	
STAT 201	Introductory Probability I	3	MATH
ACTU 203	Introduction to Financial Mathematics I	3	
MATH 223	Calculus II	3	
Total		12	
Electives (Select 3 – 6 Credits)			
STAT 223	Elementary Statistical Methods	3	
STAT 227	Introduction Statistical Computing	3	
ECON 201	Elements of Economics I	3	

Second Semester

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
Core			
UGRC 220-238	Introduction to African Studies	3	
ACTU 204	Introduction to Financial Mathematics II	3	ACTU 203
STAT 224	Introductory Probability II	3	STAT 221
MATH 224	Introductory Abstract Algebra	3	

MATH 220	Introductory Computational Mathematics	3	MATH 122
Total		**15**	
Electives (Select 3 – 6 Credits)			
ECON 202	Elements of Economics II	3	
DCIT 204	Database Fundamentals	3	
STAT 222	Introduction to Regression and Time Series	3	
STAT 230	Data Mining	3	

LEVEL 300
First Semester

Course Code	*Course Title*	*Credits*	*Pre-requisite(s)*
Core			
STAT 331	Probability Distributions	3	STAT 221, 224
MATH 351	Linear Algebra	3	MATH 224
ACTU 301	Life Contingencies I	3	ACTU 204
FINC 301	Introduction to Business Finance	3	
MATH 355	Calculus of Several Variables	3	MATH 223
Total		**15**	
Electives (Select 1-3 Credits)			
STAT 333	Statistical Inference I	3	STAT 223
MATH 359	Discrete Mathematics	3	
STAT 335	Sample Survey Methods	3	
ACTU 320	Internship in Actuarial Science (either 1st or 2nd Semester) **	1	
ACTU 335	Microeconomic Theory for Actuaries I	3	
ACTU 359	Risk Management and Insurance	3	

**** To be taken during vacation**

Second Semester

Course Code	*Course Title*	*Credits*	*Pre-requisite(s)*
Core			
STAT 332	Multivariate Distributions	3	STAT 331, MATH 331
ACTU 304	Life Contingencies II	3	
MATH 350	Differential Equations I*	3	MATH 223
ACTU 302	Introduction to Actuarial Computing	3	
MATH 356	Analysis II	3	MATH 223
Total		**15**	
Electives (Select 0 – 3 Credit)			
DCIT 314	Operations Research	3	
STAT 334	Statistical Inference II	3	
ACTU 334	Microeconomic Theory for Actuaries II	3	
FINC 352	Principle and Practice of Insurance	3	
STAT 338	Decision Theory	3	
STAT 356	Life Insurance and Retirement Security	3	
MATH 358	Computational Mathematics I	3	MATH 220

***Please note MATH 350 is offered either in first or second semester by the Dept. of Mathematics. BSC Actuarial Science Major students will take the course in the second semester. ** Not to be taken by Mathematics Students**

LEVEL 400
First Semester

Course Code	*Course Title*	*Credits*	*Pre-requisite(s)*
Core			
ACTU 403	Introduction to Non-Life Insurance Mathematics I	3	
ACTU 405	Fundamentals of Financial Accounting I	3	

ACTU 407	Financial Economics I	3	
ACTU 409	Loss Distributions & Actuarial Risk Measures	3	
MATH 441	Advanced Calculus	3	
Total		15	
Electives (Select 3 – 6 credits)			
MATH 445	Introductory Functional Analysis	3	
STAT 440	Business Statistics	3	
STAT 451	Random Processes	3	STAT 331
ACTU 443	Econometrics for Actuaries I	3	
STAT 443	Population Statistics	3	
STAT 445	Advanced Regression Analysis	3	STAT 334,MATH 335
ACTU 445	Macroeconomic Theory for Actuaries I	3	
MATH 447	Complex Analysis	3	
STAT 457	Economic and Social Statistics I	3	
STAT 459	Statistical Quality Control	3	

Second Semester

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
Core			
ACTU 404	Pensions and Social Security	3	
ACTU 412	Fundamental Financial Accounting II	3	
MATH 442	Integration and Measure Theory	3	MATH 356
ACTU 444	Introduction Non-life Insurance Mathematics II	3	ACTU 443
Total		12	

Electives (Select 0 – 3 Credits)			
ACTU 408	Financial Economics II	3	ACTU204, STAT 331, STAT332
ACTU 442	Econometrics for Actuaries II	3	
ACTU 448	Macroeconomic Theory for Actuaries II	3	
MATH 450	Differential Equations II	3	MATH 350
FINC 452	Property and Pecuniary Insurance	3	
FINC 458	Health Insurance	3	
STAT 458	Economic and Social Statistics II	3	STAT 457

PROGRAMME STRUCTURE FOR STATISTICS

SINGLE MAJOR IN STATISTICS

ENTRY REQUIREMENT: *STAT 111, STAT 112, MATH 121, MATH 122, MATH 126*

LEVEL 200

FIRST SEMESTER

Core

Course Code	*Course Title*	*Credits*	*Pre-requisite(s)*
UGRC210/ UGRC 220	Academic Writing II/ Introduction to African Studies	3	
STAT 221	Introductory Probability I	3	MATH121, 122, 126
STAT 223	Elementary Statistical Methods	3	
MATH 223	Calculus II	3	MATH 122
*STAT 240	Introduction to Statistical Computing	3	
Total		**15**	

Electives (Select 3-6 Credits)

ACTU 203	Introduction to Financial Mathematics I	3	
*STAT 220	Introduction to Actuarial Science	1	
*STAT 230	Data Mining	3	

SECOND SEMESTER

Core

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
UGRC 210/UGRC 220	Academic Writing II/ Introduction to African Studies	3	
STAT 222	Introduction to Regression and Time Series Analysis	2	
STAT 224	Introductory Probability II	3	STAT 221
STAT 226	Official Statistics	2	

Electives (Select 3-6 Credits)

ACTU 204	Introduction to Financial Mathematics II	3	ACTU 203
*STAT 220	Introduction to Actuarial Sciences	1	
MATH 224	Introduction to Abstract Algebra	3	MATH 126
STAT 228	Introduction to Non-Parametric Statistics	**3**	STAT 223
*STAT 230	Data Mining	3	STAT 121, 122

**STAT 220, STAT 230 and STAT 240 could be taken in the first semester or the second semester.*

LEVEL 300

FIRST SEMESTER

Core

Course Code	*Course Title*	*Credits*	*Pre-requisite(s)*
STAT 331	Probability Distributions	3	STAT 221, 224
STAT 333	Statistical Inference I	3	STAT 224
STAT 335	Sampling Survey Methods	3	
MATH351/STAT 339	Linear Algebra/Methods of Linear Algebra	3	MATH 224/ MATH 126
Total		**12**	

Electives (Select 3-6 Credits)

ACTU 301	Life Contingency I	3	ACTU 204
STAT 337	Introduction to Operations Research	3	
MATH 353	Analysis I	3	MATH 223
MATH 355	Calculus of Several Variables	3	
MATH 359	Discrete Mathematics	3	MATH 224

SECOND SEMESTER

Core

Course Code	*Course Title*	*Credits*	*Pre-requisite(s)*
STAT 332	Multivariate Distributions	3	STAT 331
STAT 334	Statistical Inference II	3	STAT 333
STAT 336	Design of Experiments	3	STAT 223
MATH 350	Differential Equations I	3	MATH 122, 223
Total		**12**	

Electives (Select 3-6 Credits)			
DCIT 308	Data Structures and Algorithms	3	
ACTU 332	Life Contingency II	3	ACTU 301
STAT 338	Decision Theory	3	
MATH 356	Analysis II	3	MATH 223

LEVEL 400

FIRST SEMESTER

Core

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
STAT 443	Theory of Sampling	3	STAT 335
STAT 445	Advanced Regression Analysis	3	STAT 334
STAT 450	Project	3	
STAT 461	Bayesian Statistics	3	STAT 224
Total		**12**	
Electives (Select 3-6 Credits)			
STAT 440	Business Statistics	3	STAT 222,203
STAT 447	Non –Parametric Statistics	3	STAT 228
STAT 451	Random Processes	3	STAT 331
STAT 453	Population Statistics	3	
STAT 459	Statistical Quality Control	3	
STAT 455	Actuarial Statistics I	3	STAT 331
STAT 457	Economic and Social Statistics I	3	STAT 226

MATH 441	Advanced Calculus	3	MATH 353
MATH 445	Introductory Functional Analysis	3	MATH 356

SECOND SEMESTER

Core

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
STAT 444	Survey Organization and Management	3	STAT 335
STAT 466	Discrete Data Analysis	3	
STAT 450	Project	3	
Total		**9**	

Electives (Select 3-6 Credits)

STAT 442	Applied Times Series Analysis	3	
MATH 442	Integration Theory and Measure	3	MATH 356
STAT 446	Multivariate Methods	3	STAT 332
STAT 448	Analysis of Experimental Design	3	STAT 335
MATH 450	Differential Equations II	3	MATH 350
STAT 464	Statistical Computing with R	3	STAT 240
STAT 454	Biometrics	3	STAT 331
STAT 456	Actuarial Statistics II	3	STAT 455, 453
STAT 458	Economic and Social Statistics II	3	STAT 457
STAT 462	Biostatistics	3	

MAJOR- MINOR IN STATISTICS

LEVEL 200

FIRST SEMESTER

Core

Course Code	*Course Title*	*Credits*	*Pre-requisite(s)*
*UGRC 210	Academic Writing II	3	
*UGRC 220	Introduction to African Studies	3	
STAT 221	Introductory Probability I	3	MATH 121, STAT 122
STAT 223	Elementary Statistical Methods	3	
STAT 230	Data Mining	3	STAT 121, 122
MATH 223	Calculus II	3	MATH 121
Total		**15**	

SECOND SEMESTER

Core

Course Code	*Course Title*	*Credits*	*Pre-requisite(s)*
UGRC210/ UGRC 220	Academic Writing II/ Introduction to African Studies	3	
STAT 222	Introduction to Regression and Time Series Analysis	2	
STAT 224	Introductory Probability II	3	STAT 221
STAT 226	Official Statistics	2	
Total		**13**	

Electives (Select 0-4 Credits)

STAT 220	Introduction to Actuarial Science	1	
STAT 228	Introduction to Non-Parametric Statistics	3	STAT 223
STAT 240	Statistical Computing	3	

MATH 224	Introduction to Abstract Algebra	3	**MATH 126**

*STAT 220, STAT 230 and STAT 240 could be taken in the first semester or the second semester.

LEVEL 300

FIRST SEMESTER

Core

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
STAT 331	Probability Distributions	3	STAT 221, 224
STAT 333	Statistical Inference I	3	STAT 224
STAT 335	Sample Survey Methods	3	
MATH351/ STAT339	Linear Algebra/Methods of Linear Algebra	3	**MATH 224/** **MATH 126**
Total		**12**	

SECOND SEMESTER

Core

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
STAT 332	Multivariate Distributions	3	STAT 331
STAT 334	Statistical Inference II	3	STAT 333
STAT 336	Design of Experiments	3	STAT 223
Total		**9**	
Elective (Select 0-3Credits)			
ACTU 302	Introduction to Actuarial Computing	3	

LEVEL 400

FIRST SEMESTER

Core

Course Code	*Course Title*	*Credits*	*Pre-requisite(s)*
STAT 443	Theory of Sampling	3	STAT 335
STAT 461	Bayesian Statistics Methods	3	STAT 224
STAT 445	Advanced Regression Analysis	3	STAT 334
STAT 450	Project	3	
Total		**12**	
Electives (Select 3-6 Credits)			
STAT 440	Business Statistics	3	STAT 222,203
STAT 447	Non –Parametric Statistics	3	
STAT 451	Random Processes	3	STAT 331
STAT 453	Population Statistics	3	STAT 453
STAT 455	Actuarial Statistics I	3	STAT 331
STAT 457	Economic and Social Statistics I	3	STAT 226
STAT 459	Statistical Quality Control	3	

SECOND SEMESTER

Core

Course Code	*Course Title*	*Credits*	*Pre-requisite(s)*
STAT 444	Survey Organization and Management	3	

STAT 466	Discrete Data Analysis	3	
STAT 450	Project	3	
Total		**9**	
Electives (Select 6 Credits)			
STAT 442	Applied Time Series Analysis	3	
MATH 442	Integration Theory and Measure	3	MATH 356
STAT 446	Multivariate Methods	3	STAT 332
MATH 450	Differential Equations II	3	
STAT 454	Biometrics	3	STAT 331
STAT 456	Actuarial Statistics II	3	STAT 455, 453
STAT 458	Economic and Social Statistics II	3	STAT 447
STAT 462	Biostatistics	3	
STAT 464	Statistical Computing with R	3	STAT 240

COMBINED MAJOR IN STATISTICS

LEVEL 200

FIRST SEMESTER

Core

Course Code	*Course Title*	*Credits*	*Pre-requisite(s)*
UGRC210/ UGRC 220	Academic Writing II/ Introduction to African Studies	3	
STAT 221	Introductory Probability I	3	MATH 121, MATH 122
STAT 223	Elementary Statistical Methods	3	
MATH 223	Calculus II	3	MATH 121

Total		**12**	

SECOND SEMESTER

Core

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
UGRC210/ UGRC 220	Academic Writing II/ Introduction to African Studies	3	
STAT 222	Introduction to Regression and Time series	2	
STAT 224	Introductory Probability II	3	STAT 221, MATH 223
STAT 226	Official Statistics	2	
STAT 230	Data Mining	3	STAT 111, STAT 112
Total		**13**	

LEVEL 300

FIRST SEMESTER

Core

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
STAT 331	Probability Distributions	3	STAT 221, 204
STAT 333	Statistical Inference I	3	STAT 224
STAT 335	Sample Survey Methods	3	
MATH351/STAT339	Linear Algebra/Methods of Linear Algebra	3	MATH 224/ MATH 126
Total		**12**	

SECOND SEMESTER ***Core***			
Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
STAT 332	Multivariate Distributions	3	STAT 331
STAT 334	Statistical Inference II	3	STAT 333
STAT 336	Design of Experiments	3	STAT 223
Total		**9**	
Elective (Select 0-3 Credit)			
ACTU 302	Introduction to Actuarial Computing	3	

LEVEL 400

FIRST SEMESTER

Core

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
STAT 443	Theory of Sampling	3	STAT 335
STAT 445	Advanced Regression Analysis	3	STAT 334
Total		**6**	
Electives (Select 3-6 Credits)			
STAT 440	Business Statistics	3	STAT 222,203
STAT 447	Non-Parametric Statistics	3	STAT 333, 304
STAT 450	Project	3	
STAT 451	Random Processes	3	STAT 331
STAT 453	Population Statistics	3	
STAT 455	Actuarial Statistics I	3	STAT 331

STAT 457	Economic and Social Statistics I	3	STAT 226
STAT 459	Statistical Quality Control	3	STAT 459
STAT 461	Bayesian Statistics Methods	3	STAT 224
	SECOND SEMESTER		
Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
STAT 444	Survey Organization and Management	3	STAT 335
Total		**3**	
Electives (Select 3-6 Credits)			
STAT 446	Multivariate Methods	3	STAT 332
STAT 448	Analysis of Experimental design	3	STAT336
STAT 450	Project	3	
STAT 454	Biometrics	3	STAT 331
STAT 456	Actuarial Statistics II	3	STAT 455, 453
STAT 458	Economic and Social Statistics II	3	STAT 447
STAT 464	Statistical Computing with R	3	STAT 222, 233
STAT 466	Discrete Data Analysis	3	

MINOR IN STATISTICS

LEVEL 200

FIRST SEMESTER

Core

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
*UGRC 210	Academic Writing II	3	

*UGRC 220	Introduction to African Studies	3	
STAT 221	Introductory Probability I	3	MATH 121, 122
STAT 223	Elementary Statistical Methods	3	
Total		**12**	

SECOND SEMESTER

Core

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
*UGRC 210	Academic Writing II	3	
*UGRC 220	Introduction to African Studies	3	
STAT 222	Introduction to Regression and Time Series Analysis	2	
STAT 224	Introductory Probability II	3	**STAT 221**
STAT 226	Official Statistics	2	
Total		**13**	

LEVEL 300

FIRST SEMESTER

Core

Course Code	***Course Title***	***Credits***	***Pre-requisite(s)***
STAT 333	Statistical Inference I	3	**STAT 224**
STAT 335	Sample Survey Methods	3	
Total		**6**	

Electives (Select 0-3 Credits)

STAT 337	Introduction to Operation Research	3	

SECOND SEMESTER

Core

Course Code	*Course Title*	*Credits*	*Pre-requisite(s)*
STAT 334	Statistical Inference II	3	STAT 333
STAT 336	Design of Experiments	3	STAT 223
Total		**6**	
Elective (Select 0-3 Credits)			
ACTU 302	Introduction to Actuarial Computing	3	
Total		**6**	

Course Descriptions

Statistics and Actuarial Science

ACTU 202: Data Analysis and Statistical Computing
To acquaint students with elementary modern computing methods appropriate to the work of an actuary. This course is largely practical and involves analyzing large data sets. Students will be introduced to modeling and statistical simulations using modern statistical software such as R. Exploratory Data Analysis and Confirmatory Data Analysis of both univariate and bivariate cases will be explored. Applications will be tailored to meet requirements of the Actuarial profession with hands-on training sessions with large data sets. No 'new' statistical methods should be presented but interesting data can be analyzed using known methods on the chosen package. Topics should include graphics, descriptive statistics, representations of multivariate data, simple hypothesis tests, analysis of variance, and linear regression.

ACTU 203: Introduction to Financial Mathematics I
This course is aim at introducing students to some basic concepts of mathematical finance. Course content includes foundational concepts of financial mathematics, with applications in calculating present and accumulated values for varied streams of cash flows as a basis for future use in actuarial reserving, valuation, pricing, duration calculation, asset/liability management, investment Introduction to optimal portfolio theory; mean–variance approach, markovitz solution for two assets. Introduction to option pricing; definition and types of options. One period binomial and trinomial models for option pricing. A basic knowledge of calculus and an introductory knowledge of probability is assumed for students taking this course.

ACTU 204: Introduction to Financial Mathematics II
This course is aim at building on the foundation of mathematical finance that has been laid in the course ACTU 203. Topics to be cover include: Introduction to option pricing; definition and types of options. One period binomial and trinomial models for option pricing. Conditional expectation, utility functions, examples of stochastic process. Introduction to interest theory; coupon rate, swap rate, forward rate, simple rate, LIBOR rate. Financial market; some complete market models, some incomplete market models, arbitrage opportunities.

STAT 220: Introduction to Actuarial Science (Continuously assessed)
Topics to cover the first foundations of actuarial practice module, role of the actuary etc. what an actuary is and does, external forces that influence actuarial work, and framework and processes actuaries use to perform actuarial work using Microsoft excel. One hour a week seminar by Members of Actuarial Society of Ghana. Students would be divided into working groups and each group would be assessed at the end of the Lecture series

STAT 221: Introductory Probability I (Pre-Req. MATH 121, 122)
The course builds on concepts introduced in STAT 112. Topics to be covered includes: Further concepts of Probability, Random Events and Random Variables. The Probability Calculus, Univariate Probability Distributions. Univariate Moment Generating Functions; their properties and uses. Introduction to Bivariate Discrete Distributions; conditional discrete distribution, expectation. Introduction to conditional expectation. Some Probability Modelling is based on discrete distributions.

STAT 222: Introduction to Regression and Time Series Analysis
The course is to provide the student with a basic knowledge of Regression and Time Series. Topics include Regression analysis; Simple linear regression: The model and its assumption; Least Square Estimation. Analysis of variance; sums of squares and their interpretation. Coefficient of determination and the correlation coefficient. Examining the Model Assumptions: Graphical Examination of residual. Test of Randomness of residuals, for constancy of variance, for normality. Forecasting; Time Series methods and Models; some financial/actuarial application of time series. Use of statistical computing packages in forecasting.

STAT 223: Elementary Statistical Methods
This course introduces students to some basic concepts of statistical methods. Topics to be covered are Bivariate Data analysis, Elements of Statistical inference. Hypothesis testing – One-sample case (test for mean, proportion, power, sample size, test for variance, Confidence intervals) Hypothesis testing – Two-sample case (two-sample test for paired and unpaired means and proportions, power, sample size, equality of variance test, CI).
ANOVA (one- and two-way), Simple Linear Regression and Correlation Analysis.

STAT 224: Introductory Probability II (Pre-Req. STAT 221)
This course aims to introduce students to the concepts of multivariate distributions. Topics to be discussed include the following: Bivariate Distributions, Bivariate Moment Generating Functions; their properties and uses. Sampling distributions. Distribution associated with samples from a normal population. The laws of Large Numbers, and the Central Limit Theorem and its Applications. Statistical Inequalities. Some Statistical Applications of Probability; likelihood functions and estimation. Some financial and Actuarial Applications of Probability.

STAT 226: Official Statistics
In this course students are introduced to economic, social and demographic statistics. Purposes and scope of the course includes the structure and work of the National Statistical System; Ghana Statistical Service. Organizational, Methods and Practices of Data Collection and Dissemination. Population Census Methods, Health Information Systems. Environmental Statistics and Introduction to Categorical Data Analysis.

STAT 230: Data Mining
The course will introduce students to introductory data mining. Topics to be covered include: data warehousing, data mining process (data preparation/cleansing, task identification), Association rules (mining and different algorithm types), Classification/Prediction, Classification (tree-based approaches, Neural Networks, etc), Clustering (statistical vs neural-net and other approaches), Model evaluation and visualization techniques. The course will help students make better sense of large chunks of data which will be incredibly useful in understanding big data.

STAT 240: Introduction to Statistical Computing

The course aims to build on the skills of computing students acquired in the course STAT 111 and STAT 112. Topics to be covered include: Reviews of some basic concepts in probability and classical statistical inference; triangular distribution, sampling distribution, point estimation, interval estimation, and hypothesis testing. Writing simple codes in R to perform inferences, simulation of random variables from probability distributions; geometric, negative binomial, hyper-geometric, exponential, normal distributions, the visualization of bivariate data.

STAT 228: Introduction to Non-Parametric Statistics

In this course students are introduced to the basic concepts of non-parametric statistics. Topics to be discussed include: Single Sample problems; the problem of location, the Sign Test, Wilcoxon Sign Rank Test. Introduction to Chi-square tests for Homogeneity, Chi-square tests for Independence, The Median Test, Mann-Whitney-Wilcoxon Tests all under two-sample tests. Some applications to data in the field of medicine and biological sciences will be discussed in class.

ACTU 301: Life Contingency I

This course introduces students to mathematics of life contingencies. Being probabilistic in nature, the course seeks to develop theoretical basis for modelling future lifetime status with emphasis on insurance. Topics to be covered include brief review of probability theory, international actuarial notations, actuarial survival models, life table format, life statuses, survival distributions, concept of dependence (common shock models, copulas etc), multiple lives and multiple decrement theory and multiple-state models. The course is designed to set the pace towards ensuring the student's adequate preparation for the MLC/3L exam of the Society of Actuaries or Canadian Institute of Actuaries respectively.

ACTU 302: Introduction to Actuarial Computing

This course provides foundation of knowledge concerning fundamental building blocks of actuarial practice. It is meant to present students with a transition from understanding the mathematical underpinnings of actuarial science to putting them into practice. The course focuses on two areas of actuarial practice: investment management and life insurance. All mathematical computations will be computer program assisted. Students will be able to construct and use life tables in simulation studies, portfolio management theory and design basic individual life. Concepts will apply the concepts within an actuarial problem statement. Recommended software include excel, R and MATLAB.

ACTU 304: Life Contingency II (Pre-requisites: ACTU 301)

This course builds on Life contingency I. It is designed to develop theoretical basis for pricing and supporting life-contingency products. Topics treated includes economics of insurance, general insurances, annuities, premiums (level and non-level benefits and premiums) and expense (incorporating expenses in insurance models) analysis, analysis of reserves, Hattendorf theorem, probability models: Poisson Processes. The course is designed to set the pace towards ensuring the student's adequate preparation for the MLC/3L exam of the Society of Actuaries or Canadian Institute of Actuaries respectively.

ACTU 320: Internship in Actuarial Science

Aim: The core aim of this course is to introduce students to the Actuarial practices in jobs that they find themselves in. This in turn will bridge the gap between theory and practice. The course is offered in both semesters to students to seek practical applications of actuarial principles in insurance companies, financial institutions, pension consulting firms, and other related fields. The course requires students to participate in an internship program within the industry. Students need to submit monthly progress reports and a final semester report to the Head, Department of Statistics, University of Ghana, Legon.

ACTU 333: Microeconomics for Actuaries I

The course is designed to introduce actuarial science students to a thorough understanding of the fundamentals of economic analysis of individual, business and industry choices in market economies as it applies to actuarial practice. Topics to be covered include basic economic concepts, nature and function of product markets, price mechanism,

supply and demand, optimizing economic behaviour, cost and revenue, market structures, factor markets, income distribution, market failure and government intervention. Introduction to Economic model-building, comparative static and dynamic models.

ACTU 334: Microeconomics for Actuaries II
Introduction to Economic model-building, comparative static and dynamic models. Consumer Behaviour and Demand theory, law of diminishing marginal utility, ordinary utility approach, Demand function, income elasticity of demand, short-run cost; fixed, variable, total, average and marginal cost, production function, perfect competition; the firm, market, product homogeneity, perfect knowledge, profit maximization, free entry, short-run equilibrium of firm and industry, constant and increasing cost.

ACTU 359: Risk Management and Insurance
This course focuses on the core principles of risk management and insurance in actuarial science. Topics covered include types of risk identification and analysis, risk modelling concepts, risk quantification, approaches for managing risks (how business entities makes decisions about risk management techniques). The further sections of the course will delve into the concept of economic capital, risk measures in capital assessment and techniques to allocate cost of risk within business units. Topics also cover life and health insurance, property and liability insurance, value-based enterprise risk management for corporations, pensions and employee benefits and risk aggregation techniques.

STAT 331: Probability Distributions (Pre-Req. STAT 221, 204)
This course is aimed at introducing students to Elementary Distribution Theory. Topics to be covered includes: Generating Functions and Applications; moment generating functions, probability generating function, factorial moment generating function and characteristic function, moments and limiting distributions. Sequences of random variables; modes of convergences, the Central Limit Theorem and its Applications. Concentration inequalities. Introduction to large deviation theory; large deviation probabilities, method of types.

STAT 332: Multivariate Distributions (Pre-Req. STAT 331)
This course is aimed at introducing students to multivariate distribution theory. Topics to be covered include: Introduction to Vector Random Variables; vector of means, dispersion matrix, matrix of co-variances. Distribution Concepts for several random variables; exponential-type distribution, multivariate moment generating function. Transformation of Random Vectors; gamma distribution, beta distribution, chi-square distribution t-distribution, f-distribution. Order Statistics; joint distribution of order statistics. Multivariate Normal Distributions.

STAT 333: Statistical Inference I (Pre-Req. STAT 204)
The first part of the two-semester course provides 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. Introduction to Bayesian Statistics. Introduction to statistical modelling with R. Some applications to data in the field of Pharmacy, Biology, Economics, Agriculture, Biology, Pharmacy, Medicine and Finance.

STAT 334: Statistical Inference II (Pre-Req. STAT 333)
This course is a sequel to STAT 333. It is aimed at building on the concepts of mathematical statistics acquired in STAT 333. Topics to be covered include: General principles and Procedures of Hypotheses Testing. Parametric and Non- Parametric Test. Simple Linear Regression and Correlation Analysis. The Analysis of Frequency Data. Introduction to Categorical Analysis. Statistical modelling with R. Some applications to real-life data in the fields of Pharmacy, Biology, Economics, Agriculture, Biology, Pharmacy, Medicine and Finance.

STAT 335: Sample Survey Methods
This course is aimed at introducing students to the Theory of Sampling. Topics to be covered include: Basic Sample Survey Procedures and Sample Designs. Estimation of population of parameters. Sampling and Non-Sampling Errors, Sampling experiments, Estimation of population proportions and percentages. A proportion of simple sample estimation. Some applications to real-life data from the fields of Agriculture, Biology, Finance etc.

STAT 336: Design of Experiments (Pre-Req. STAT 223)
This course introduces students to the concept of Analysis of Experimental Design. Topics include: Single and multifactor experiments; analysis of variance; multiple comparisons; contrasts; diagnostics, fixed, random, and mixed effects models; designs with blocking and/or nesting; two-level factorials and fractions thereof; use of statistical computing packages. Some applications to data from the field of Agriculture, Biology, Pharmacy and Medicine.

STAT 337: Introduction to Operations Research
The course will introduce students to the use of mathematical and statistical techniques to solve a wide variety of organizational problems. Topics include linear programming, network analysis, queuing theory, decision analysis. Transport problem, dynamic programming, game theory, scheduling problem, Markov chains, decision trees, Optimization and inventory control and Introduction to Supply Chain Management.

STAT 338: Decision Theory
The course introduces the main concepts and tools of game theory with the aim of enabling students to read original game-theory literature and to prepare them to do research in the field. They will learn how to represent an economic situation as a game and how to analyze it using different equilibrium concepts proposed in the literature, the prominent one being the Nash equilibrium. Concentration will be on strategic interaction under incomplete information and modify the Nash equilibrium concept to include the uncertainty of the players about some of the parameters of the game.

STAT 339: Methods of Linear Algebra (Non-Mathematics Students Only)- (Pre-requisite MATH 126)
The emphasis is on the geometric and computational foundations of Linear Algebra with abstraction (and proof) kept to a minimum. We would examine matrices, linear systems of equations and their solutions. Basic properties of determinants, vectors in and a simple introduction to the idea of an arbitrary vector space. The pinnacle of the course is to be able to find eigenvalues and their corresponding eigenvectors for a given matrix and indeed for a linear map. We would carefully develop the diagonalization of symmetric matrices. For those who did the MATH 220 there would be applications using Python.

ACTU 403: Elements of Life Insurance
To instill the ability, in simple situations, to use judgment and apply the principles of actuarial planning and control needed for the operation on sound financial lines of providers of life insurance. Principal terms; The main contract types; The principles of life insurance markets; Data requirements and verification; Product pricing; Reserving; Surrender values; Policy alterations; Derivation of actuarial assumptions; Measurement and analysis of surplus; Methods of distributing surplus to policyholders; Principles of investment and asset-liability modeling; Principles of regulation and accounting; Risk and uncertainty in life insurance business; Principles of risk management including reinsurance; Life insurance regulations, including: Taxation, Accounting, Supervisory regulation; Experience rating; Future financial requirements including dynamic financial analysis; Value of a life company; Evaluation of the capital requirements of a life insurer for the purpose of determining the strategy for growth in business.

ACTU 404: Pensions and Social Security
To make students aware of the environment of effective social security system and pension and employee benefit schemes. The theory and practice of social security and state, occupational and personal pension plan funding. Features of the main employee benefit schemes, principles of financing, including asset and liability relationships. Legislative framework on retirement and various benefit schemes. Tax management, economic and demographic factors, accounting for pension cots, valuation data collection, analysing experience, valuing liabilities and assets, calculating contribution rates; choice and management of assets.

ACTU 405: Fundamentals of Financial Accounting I
The course is aimed at equipping students with some concepts of financial accounting. Topics include the following: principles of finance, structure of a joint stock company, and the different methods by which it may be financed,

financial instruments used by companies and the way they may be issued, capital structure and dividend policy, a company's cost of capital interacts with nature of the investment, major types of financial institutions operating in the financial markets.

ACTU 407: Survival Analysis and Modelling

To provide understanding of survival analyses and how to model concepts in practice in order to fix a trail for information. Topics that students will be exposed to include: Survival models, estimation of survival function and hazard function, estimation and fitting of survival model, parametric survival model, determining the optional parameters. Models for loss severity: parametric models, models for loss frequency, mixed Poisson models, compound Poisson models. Aggregate claims models, Classical ruin theory.

ACTU 409: Introduction to Actuarial Mathematics

To provide introductory preparation in Actuarial mathematics and their applications.
Deterministic theory of interest (i.e. traditional compound interest, cash-flow modelling; annuities certain, bond market theory), Introduction to contingent claims analysis (i.e. definition of derivative securities, no arbitrage principle); Stochastic calculus for finance (conditional expectation, introduction to martingales, stochastic integrals and differential equations, pricing and hedging of derivatives); Stochastic theory of interest; interest rate models (discrete and continuous time); derivatives on interest rates and bonds; Dynamic portfolio management (asset-liability modeling; introduction to stochastic optimal control); Introductory applications to insurance liabilities (embedded options in life insurance; valuation techniques for embedded options)

ACTU 410: Project

The project work is aimed at developing students' problem solving and written skills. It has one year duration. Students present a project on a relevant and topical issues pertaining to Actuarial Science while applying appropriate Statistical/Mathematical techniques and tools to problems or data emanating from Insurance, business, financial and banking sector, communication sector, agricultural sector, mining sector, construction sector etc.

ACTU 412: Fundamentals of Financial Accounting II

This course is a sequel to ACTU 405. Topics include: Basic construction of financial statements and the role and principal features of the financial statements of a company, accounts of a company or a group of companies; interpretation and limitations, structure, and content of insurance company accounts, basic principles of personal and corporate taxation.

ACTU 443: Econometrics for Actuaries I

The course is designed to introduce the student to the definition, scope, and branches of econometrics as they apply to actuarial science. Topics covered include methodology of econometrics research; partial correlation, limitations of the correlation theory. The simple linear regression model; ordinary least squares method (OLS), estimation of elasticity's from an estimated regression line. Statistical tests of the significance of the estimates, properties of the OLS estimates, extension of the linear regression model to nonlinear relationships, regression and analysis of variance. Introduction to Panel-data econometric models.

ACTU 444: Econometrics for Actuaries II (Pre-requisites: ACTU 443)

This course is designed to build on Econometrics I. Topics covered include: Test of assumptions of linear regression model; randomness, zero mean, constant variance and normality of the disturbance variable. Autocorrelation, multicollinearity, errors in variables, time as dummy variables, grouped data. Lagged variables and distributed-lag models, models of simultaneous relationships; simultaneous-equation models, identification, simultaneous-equation methods, the method of principal components, maximum likelihood methods, three-stage least squares, testing the forecasting power of an estimated model. Simulation models (Monte-Carlo etc.), Generalized linear models (GLM) and Generalized Estimating Equations (GEE). Recommended texts are left to
the discretion of the course instructor

ACTU 445: Macroeconomic Theory for Actuaries I (Prerequisites: ACTU 335, ACTU 334)

Building on the core economic principles of ECON 201 and ECON 202, this course is designed to introduce the actuarial student to behaviour of the economy from an aggregate perspective. Core topics include national income

calculation, measuring gross domestic product (GDP), unemployment, monetary policy and banking; inflation, interest rates, stagflation, and deflation. Fiscal Policy; exchange rate and balance of payment (BOP). Business cycle and exchange rate policy. Interest rate parity. A knowledge of calculus and ECON 201 and ECON 202 is assumed.

ACTU 448: Macroeconomic Theory for Actuaries II (Prerequisites: ACTU 445)
This is a sequel to ACTU 448. Topics covered include: Consumption demand, Absolute income, Life Cycle, permanent income and relative income hypothesis. The Keynesian Theory of Investment i.e. marginal efficiency of capital (MEC) and marginal efficiency of investment (MEI). Advanced topics in demand and supply of money. Modern Theory of Interest (The Hicks-Hansen analysis and synthesis).

ACTU 453: Introduction to Non-Life Insurance Mathematics I
This course aims to introduce students to the concept of non-life computations and analysis. Basic models and concepts; reserve process, risk process, Cramer-Lundberg model, homogeneous poisson process, compound Poisson model, Erlang's model. Common distributions for number of claims; Binomial distribution, negative binomial distribution, poisson distribution. Common distributions for claims size; Gamma distribution, lognormal distribution, some extreme risk distributions. Distribution of sum of claims; convolution theorem, generating functions, moment estimates.

ACTU 454: I ntroduction to Non-life Insurance Mathematics II
This course is a sequel to ACTU 453. Topics include: Premium; calculation and principles, notion of utility function; linear utility, exponential utility, properties of premium calculation principles. Introduction to experience rating; under writer A, B and C, Bayesian approach. Introduction to extreme value theory; limit behaviour of maximum.

STAT 440: Business Statistics
This course is designed to introduce students to the application of statistics business. Topics to be discussed include: Customer analytics, operation analytics, people analytics, accounting analytics and bus analytic capstone. Descriptive analytics; use to understand past and present data, predictive analytic; past performance, prescriptive analytic; uses of optimization techniques. Some applications to real-life data from the field of business.

STAT 442: Applied Time Series Analysis
The course is aimed at providing students with the working knowledge of Time Series. Topics include: General stationary, nonstationary models, auto-covariance autocorrelation functions; stationary, nonstationary autoregressive integrated moving average models; identification, estimation, forecasting in linear models; financial times series models, use of statistical computer packages. Some applications to financial and actuarial data will be discussed.

STAT 443: Theory of Sampling
This course is a sequel to STAT 335: Sample Survey Methods. It is aimed at exposing students to the theory of sampling. Topics to be covered include the following: Analysis and comparison of various sampling schemes, estimates of population means, totals, proportions, and their variances, Multi-stage and Multi-phase Designs, Ratio and Regression Estimation.

STAT 444: Survey Organization and Management (Pre-Req. STAT 334)
This course will expose students to multi-subject and specialized Socio-Economic surveys household surveys, Types of Surveys: by subject coverage, unit of enquiry, and mode of enquiry. Longitudinal and cross-sectional Studies. Other topics to be covered include: Single-purpose and Integrated surveys, Planning, Design and Organization. Error Control, Problems relating to Concepts, Definitions, Classification and Measurement.

STAT 445: Advanced Regression Analysis (Pre-Req. STAT 334)
The course aims to build on introductory regression knowledge gained in previous years. Advanced Regression analysis focuses on applications of basic statistical techniques; model formulation, checking/diagnostics, selection; interpretation and presentation of analysis results; simple and multiple linear regressions; logistic regression; ANOVA; hands-on data analysis with R computer software. Some applications to data from the field of Agriculture, Biology, Economics, Finance etc.

STAT 446: Multivariate Methods (Pre-Req. STAT 332)
This course is aimed at equipping students with a solid linear algebra background with further Statistical Inference Methods. Topics include: Introduction to theory and methods of Multivariate Data Analysis; Estimation and Tests of Hypotheses, Profile Analysis, Multivariate Structure, Discriminant Analysis. Use of statistical computer packages. Some applications to hand-on data will be discussed in class.

STAT 447: Non-Parametric Statistics (Pre-Req. STAT 333, 304)
The course aimed at building on the basic concepts of non-parametric statistics acquired in the course STAT 228. Topics to be covered include; Chi-square tests for Homogeneity, Chi-square tests for Independence, The Median Test, and Mann-Whitney-Wilcoxon Tests all under two-sample tests. Uses of Order Statistics Distribution under alternative Hypotheses. Introduction to nonparametric regression smoothing; basic ideal of smoothing, kernel smoothing, k-nearest neighbour estimates, orthogonal series estimators, spline smoothing. Use of statistical computer packages.

STAT 448: Analysis of Experimental Design
This course is a sequel to STAT 336: Design of Experiments. Topics to be covered include; Single-factor and multi-factor experiments, Analysis of Variance (ANOVA), Multiple Comparisons, Contrasts, Diagnostics, Fixed, Random and Mixed Effects models, Design with blocking and/or nesting, two level factorials and fractions thereof, Some Medical and Agricultural Applications. Use of Statistical Computing Packages.

STAT 450: Project
The project work is aimed at developing students' problem solving and written skills. It is one year duration. Students present a project on a relevant and topical issues pertaining to Statistics while applying appropriate Statistical techniques and tools to problems or data emanating from Insurance, business, financial and banking sector, communication sector, agricultural sector, mining sector, construction sector etc.

STAT 451: Random Processes (Pre-Req. STAT 331)
This course is to introduce students to stochastic models in the fields of natural and social sciences.
Topics to be covered include: Some discrete and continuous time processes; Markov Chains, Random Walks, Birth and Death Process, Random Trees; Galton-Watson Processes, Introduction to Brownian Process, Basic Theory and Applications in Demography/Population study, Insurance, Finance and Risk Management.

STAT 453: Population Statistics
The course is designed to broaden and deepen students' understanding of Demography and Population issues. Topics to be studied includes; Demographic Concepts and Measures. Collection and analysis of Demographic data. The Dynamics of population change. Mortality; Measures of Mortality, Construction of Mortality Tables, Construction of Mortality Tables from graduated data, Rate and Force of Mortality. Introduction to Survival Models and Reliability Models.

STAT 454: Biometrics (Pre-Req. STAT 331)
The course is aimed at introducing students to the application of experimental design and analysis in Biology and Agriculture. Topics to be discussed in class includes; Biological Assay, Analysis of Quantile responses. Agricultural and clinical trials. Sampling and Estimation of Biological Populations. Some applications to hand-on data using R computer package.

STAT 455: Actuarial Statistics I (Pre-Req. STAT 331)
The course is aimed at introducing students to basic concepts of financial statistics. Topics to be discussed includes the following: Principles of time value of money. Concepts of compound Interest and Discounting. Interest or Discounting Rates. Compound Interest Functions. Investment Project appraisals. Stochastic Interest Rate Models. Dynamic portfolio management, introductory applications to insurance liabilities.

STAT 456: Actuarial Statistics II (Pre-Req. STAT 453, 455)
This course introduces students to basic concepts of mathematics of life contingencies. 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 policy values. Survival Models and Reliability Models. to stochastic optimal control.

STAT 457: Economic and Social Statistics I (Pre-Req. STAT 226)
The course is designed to broaden and deepen student knowledge of Applied Statistics that concerns the collection, processing, compilation, dissemination, and analysis of social and economic data. Topics to be covered include: 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)
This course is aimed at building on the knowledge acquired by students in STAT 457. Topics to be discussed includes: review of statistical analysis of topics and problems in microeconomics, macroeconomics, business, finance, forecasting, data quality, and policy evaluation. Introduction to the System of National Accounts (SNA). The system, its Accounts and their corresponding economic activities. Input-Output Tables.

STAT 459: Statistical Quality Control
This course introduces students to techniques of statistical quality control. Topics to be discussed include: Development of control charts, acceptance sampling and process capability indices, reliability modelling, regression models for reliability data. Single and double acceptance sampling plans for attributes and variables. Some applications to real-life data will be discussed in class.

STAT 461: Bayesian Statistics Methods
This course is intended to equip students with concepts of Bayesian Statistical Analysis, with focus on applications; Bayesian and frequentist methods compared; Bayesian model specification, choice of priors, computational methods; hands-on Bayesian data analysis using appropriate software; interpretation and presentation of analysis results. Use of statistical computer packages. Some applications to data in the field of Pharmacy, Biology, Economics, Agriculture, Biology, Pharmacy, Medicine and Finance.

STAT462: Biostatistics
This course introduces concepts in design and analysis of medical studies, with emphasis on randomized controlled clinical trials. Primarily use data arising from biomedical and health sciences literature and analyzed using standard statistical computer packages. Design of clinical trials: bias elimination, treatment assignment, randomization and matching, precision, replication, repeated measures design, Prevalence and Incidence, Sensitivity and Specificity, ROC curves, Relative Risk, R x C tables, Cochran-Mantel-Haenszel test, Kappa statistics. Introduction to Survival data: Parametric and nonparametric methods, Kaplan-Meier survival curve estimator, Cox proportional hazards model.

STAT 464: Statistical Computing with R
This course is aimed at developing students programming and computational skills in the R package. Topics to be considered include: Simulation of random variables from probability distributions, the visualization of multivariate data, Monte Carlo integration and variance reduction methods, Monte Carlo methods in inference, bootstrap and jack-knife, permutation tests, Markov chain Monte Carlo (MCMC) methods, and density estimation. Selection of examples that illustrate the application of numerical methods using R functions.

STAT 466: Discrete Data Analysis
This course will focus on modelling categorical data. The basic aim of the course is to equip students with the basic skills in the analysis of discrete data. Contents include: contingency tables, general tests, binomial data, measures of

association, logistic regression, logit models for multinomial responses (nominal and ordinal), log-linear models for contingency tables, Poisson model, model building/selection, and diagnostics.