National Council For Higher Education

Minimum Standards for Courses of Study in

Basic Sciences

Undergraduate Programmes

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PREFACE

Section 5(i) of Universities and Other Tertiary Institutions Act 2001, requires the National Council for Higher Education "to ensure minimum standards for courses of study." In arriving at minimum standards for courses of study, Council worked with lecturers and professors from universities who recommend to Council what they thought was the minimum body of knowledge for which a degree in a particular programme can be awarded. The operative word is "minimum" and it is at this level that Council has set the standards for these courses of study.

This is done in compliance with the section of the Act quoted above but also fully aware of the objects of the Universities and Other Tertiary Institutions Act 2001, Section 3

> *"The objects of this Act are to establish and develop a system governing institutions of higher education in order to equate qualifications of the same or similar courses offered by different institutions of higher education while at the same time respecting the autonomy and academic freedom"*

Council holds institutional autonomy and academic freedom for universities as sacrosanct. The standards prescribe the body of knowledge below which universities must not teach. The standards leave the universities with the freedom to design their courses based on the minimum standards. The universities are free to add to these minimum course contents to meet their vision, mission and individual uniqueness. When this has been done, universities can then bring their courses and programmes to Council for accreditation. Again the law requires that all courses must be accredited by Council.

Council is grateful to lecturers and professors who have helped in the process of establishing the minimum standards for courses of study.

A.B.K Kasozi
EXECUTIVE DIRECTOR

SUMMARY OF COURSES OFFERED UNDER BASIC SCIENCES PROGRAMME

No.	Course name	CU
1. BIOCHEMISTRY		
YEAR ONE		
1.	Physical Biochemistry	2
2.	Metabolism and Metabolic Regulation	5
3.	Principles and Applications of Biochemical Methods Not reviewed)	
YEAR TWO		
1.	Tissue Structure and Function (Not yet reviewed)	
2.	Cell Biology	4
3.	Biomolecules: Structure and Function	3
4.	Enzymology	2
5.	Endocrinology	2
6.	Microbial Biochemistry and Genetics	4
7.	Molecular Biology	4
YEAR THREE		
1,	Industrial Biochemistry	5
2.	Food Science and Nutrition	3
3.	Advanced Immunology/Immunochemistry	3
4.	Advanced Molecular Biology and Biotechnology	4
5.	Animal Nutrition	2
6.	Industrial Biochemistry	3
7.	Research Project	5
8.	Clinical Chemistry and Disease Processes	3
9.	Comparative Biochemistry	2
10.	Pharmacology and Toxicology	2
2. BOTANY		
YEAR ONE		
1.	Forms, Structures and Classification for Kingdoms Protista, Monera, Fungi and Plantae	3
2.	Flowering Plant Growth and Development	3

3.	Elementary Genetics	3
4.	Cell Biology	3
5.	Introduction to Plant Functions	3
YEAR TWO		
1.	Applied Bacteriology and Virology	3
2.	Plant Diversity and Evolution-II: Lower plants – Algae, Mosses, Ferns, Lichens and Gymnosperms	3
3.	Plant Diversity and Evolution- III: Higher Plants-Angiosperms	
4.	Plant Diversity and Evolution- I: Viruses, Bacteria and Fungi	3
5.	Plant - Water Relations and Mineral Nutrition	3
YEAR THREE		
1.	Plant Biochemistry	3
2.	Energy Relations of Plant Communities	3
3.	Environmental Science for the Conservation of Nature and Natural Resources	3
4.	Weed Biology	3
5.	Crop Improvement Methods and Plant Biotechnology	4
6.	Advanced Plant Taxonomy *	4
7.	Genetics*	4
8.	Microbiology and Plant Pathology*	4
9.	Natural Resources Ecology*	4
10.	Plant Physiology*	4
3. CHEMISTRY		
YEAR ONE		
1.	Physical Chemistry I	3
2.	Inorganic/Physical Practicals I	2
3.	Organic Chemistry I	5
4.	Inorganic Chemistry II	3
YEAR TWO		
1.	Analytical Chemistry I	4
2.	Inorganic Practical II	2
3.	Organic Chemistry II	4

4.	Aromatic Chemistry I	2
5.	Sugar and Protein Chemistry*	2
6.	Physical Chemistry II	4
7.	Transition Metal Chemistry	2
8.	Spectroscopy*	2
9.	Environmental Chemistry	2
YEAR THREE		
1.	Quantum Chemistry	3
2.	Inorganic Chemistry II*	3
3.	Polymer Chemistry	2
4.	Colloid Science*	2
5.	Aromatic Chemistry II	2
6.	Insecticides Chemistry*	2
7.	Analytical Chemistry II	2
8.	Applications of Group Theory in Chemistry	2
9.	Organic Chemistry III*	2
10.	Divalent Species*	2
11.	Thermodynamics	3
	Colloid Chemistry	3
12.	Electrochemistry (Not reviewed)	
13.	Reaction Kinetics (Not reviewed)	
14.	Inorganic Synthesis (Not reviewed)*	
15	Structured Determinations (Not reviewed)	
16.	Advanced Physical Chemistry Practicals (Not reviewed)	
4. GEOLOGY		
YEAR ONE		
1.	External Processes	3
2.	Palaeontology	3
3.	Crystallography and Mineralogy	3
4.	Petrology	3

5.	Internal Earth Processes	3
6.	Regional Geology	2
YEAR TWO		
1.	Prospecting and Mining Geology	2
2.	Regional Geology II	2
3.	Engineering Geology	3
4.	Environmental Geology	2
5.	Stratigraphy	2
6.	Geochemistry	3
YEAR THREE		
1.	Igneous Petrology	3
2.	Field Geology and Surveying	2
3.	Optical Mineralogy	4
4.	Seminar	2
5.	Project	5
6.	Industrial Field Attachment	2
7.	Introduction to Computing and Geostatistics	2
8.	Ore Microscopy	2
9.	Photogeology and Remote Sensing	2
10.	Sedimentary Petrology	3
11.	Sedimentology	2
5. PHYSICS		
YEAR ONE		
1.	Properties of Matter	2
2.	Electricity	3
3.	Optics	3
4.	Physics Practicals I	2
5.	Electricity and Magnetism	3
6.	Heat and Thermodynamics	2
7	Classical Mechanics I (Not reviewed)	2
YEAR TWO		
1.	Physics Practicals II	2

2.	Classical Mechanics II	3
3.	Solid State Physics I	2
4.	Evolution of Physics	2
5.	Electromagnetism	3
6.	Elements of Astronomy and Astrophysics	2
7.	Elements of Environmental Physics	2
8.	Introduction to Computer Science	2
9.	Solar Energy	3
YEAR THREE		
1.	Physics Practicals III *	2
2.	Geophysics I *	2
3.	Fluid Dynamics	2
4.	Waves and Optics	2
5.	Quantum Mechanics I *	3
6.	Electronics/	3
7.	Acoustics	2
8.	Industrial Training	3
9.	Physics Practical IV	2
10.	Geophysics II	2
11.	Solid State Physics II	3
12.	Statistical Mechanics *	3
13.	Quantum Mechanics II	3
14.	Electronics and Instrumentation	3
15.	Agricultural Physics	3
16.	Physics Project	3
17.	Materials Science	3
18.	Microwave and Fibre Optics/	3
19.	Nuclear Physics/	3
20.	Computer Applications	3
21.	Elements of Industrial Physics/	3
ZOOLOGY		

YEAR ONE		
1.	Invertebrate I - Lower Invertebrates	**3**
2.	Invertebrate II - Higher Invertebrates	**3**
3.	Introductory Ecology	**3**
YEAR TWO		
1.	Vertebrates I	**3**
2.	Cell Biology	**3**
3.	Evolutionary Biology	**3**
4.	Parasitology	**3**
5.	Reproductive and Developmental Biology	**4**
6.	Vertebrates II	**4**
7.	Entomology	**3**
8.	Biogeography	**3**
9.	Histology	**2**
10.	Commercial Entomology*	**3**
11.	Integrated Pest and Vector Management*	**3**
12.	Fisheries Biology*	**3**
13.	Applied Ecology*	**3**
14.	Applied Entomology*	**3**
15.	Comparative Animal Physiology	**3**

* = Elective course

Table Contents

MINIMUM REQUIREMENTS FOR COURSES IN BIOCHEMISTRY

i) Course Name : PHYSICAL BIOCHEMISTRY

Course Level : Level 1

Course Credit : 2CU

Brief Course Description:

The course is divided into the following three major topics comprising: properties of biochemical media, pH and buffers and bioenergetics (Thermodynamics).

Course Objectives

At the end of this course students should be able to:

- define different units of concentration and practice in their application
- discuss buffers and their application
- discuss pH and its biochemical relevance
- use absorbance as a measure of concentration of solutions
- discuss systems in the universe, laws of thermodynamics and energy functions of state.

Detailed Course Description

Properties of biochemical media (3 hours)

- Use of units of international system of units
- Aqueous solution
- Units of concentration

pH and Buffers (6 hours)

- Acid/base theory and pH
- Henderson-Hasselbalch equation
- Buffers
- Polyprotic acids and Amphoteric salts
- pH Indicators
- Biochemical relevance of pH
- Regulation of pH in the body

Bioenergetics (6 hours)

- Terminologies
- Systems in the universe
- Laws of thermodynamics
- Energetic functions of state
- Equilibria
- Energy conservation and free energy
- Redox reactions and redox potentials
- Flow of electrons in the biological systems
- Theories of energy generation
- Substrate level and oxidative phosphorylation
- Action of ionophores and uncouplers
- Inhibitors of the electron transport chain system

Practical **(30 hours)**

Mode of delivery

The course will be taught using lectures and practicals

Assessment

Practical reports, test and final module examination. Their relative contributions to the final grade is shown below:

Requirements	Contribution
Practicals	20 %
Tests	20 %
Final Examination	60 %
Total	**100 %**

iii) Course Name : TISSUE STRUCTURE AND FUNCTION
Course Level : 1
Credit Unit :

iv) Course Name : METABOLISM AND METABOLIC REGULATION
Course Level : 1
Course Credit : 5 CU

Brief Course Description.

This course introduces students to cellular metabolism, energy transfer mechanisms as well as the basic tools and methods of biochemical investigations. It is divided into the following five major topics: Carbohydrate metabolism, Lipid metabolism, Amino acid metabolism, Porphyrin and Nucleotide metabolism and metabolic integration and regulation

Course Objectives

At the end of this course students should be able to:

- explain how chemical energy in form of ATP is derived from food consumed.
- explain the role of various pathways, their relationship and control.
- integrate metabolism in the context of the functions of different organs and the whole body.
- demonstrate a good understanding of the actions of hormones and hormonal interrelationship in the regulation of metabolism.

Detailed Course Description

Carbohydrate metabolism **(16 hours)**

Glycolysis, Krebs cycle, pentose phosphate pathway, Mitochondrial Electron transport and oxidative phosphorylation, gluconeogenesis, Glycogen metabolism mechanisms of action of insulin, regulation of metabolism in liver.

Lipid metabolism **(12 hours)**

Absorption of fats and activation of fatty acids, Beta-oxidation of unusual fatty acid, formation of ketone bodies, Biosynthesis of fatty acids, triyglycerols and phospholipids and cholesterol biosynthesis, transport of cholesterol and regulation of lipid metabolism.

Amino acid metabolism **(12 hours)**

Proteolysis, amino acid pool, metabolic flow of amino acid nitrogen, fate of carbon skeletons, biosynthesis of other amino acid-derived compounds, heme metabolism.

Nucleotide metabolism **(10 hours)**

Synthesis of purine and pymiridine nucleotides Degradation of purines and pyrimidines, inhibition of purine and pyrimidine metabolism, Deoxyribonucleotides

Metabolic integration and regulation **(10 hours)**

Organ specialization; the brain, muscle, adipose tissue, liver and kidney; inter-organ metabolic pathway, hormonal control (mechanism of action of steroid hormones); signal transduction(adenylate cyclase, protein phoshatase).

Practical **(30 hours)**

Mode of delivery

The course be taught using lectures, tutorials, assignments, praticals.

Assessment

Assignments reports, tests, practical reports and end of module examination. Their relative contributions to the final grade is shown below:

Requirements	**Contribution**
Tests	20%
Practical reports	20%
Final examinations	60%
Total	**100%**

ii) Course Name : BIOMOLECULES: Structure and Function

Course Level : 2

Course Credit : 3

vi) Course Name: PRINCIPLES AND APPLICATIONS OF BIOCHEMICAL METHODS

v) Course name : CELL BIOLOGY

Course level : 2

Course Credit : 4 CU

Brief description:

- Introduces the concept of a cell as a unit of life.
- Examines the cell structure, function and cell cycle.

Objectives:

At the end of this course students should be able to:

- explain the principles of microscopy (theory) and application
- describe the concept of a cell as a unit of life and the cell cycle
- describe the role of a cell in growth, inheritance and reproduction.
- describe the structure and functions of prokaryotic and eukaryotic cells
- describe the structure and function of the endomembrane system

Detailed course description

- Principles of microscopy (theoretical and practical aspects). Light microscopes and other types including electron microscope. Importance of microscope in contribution to cell knowledge. **(6 hours)**
- An overview of the cell/cell theory **(3 hours)**
- Generalised structure of prokaryotic and eukaryotic cells. **(3 hours)**
- Intra cellular endomembrane system (organelles)such as the nucleus golgi complex, lysosomes, peroxisomes, endoplasmic reticulum, ribosomes mitochondria/chloroplast in plant cells and the plasma membrane, their structure and function. **(12 hours)**
- Specialisation of cell membrane: microvillosites, the cell coat, the case of plant cells and prokaryotes. **(5 hours)**
- The nucleus of the cell; aspect during the inter-phase membrane, chromatin, interchromatin spaces, nucleus. The cell cycle (inter-phase, mitosis, chromosomes, meiosis) **(10 hours)**
- Cytoplasm, cytosol and cytoskelton: structure of microtubules, microfilament, their function of microtubules and microfilaments in

cell motility, cell division, movement of secretory vesicles and beating of flagella and cilia. **(6 hours)**

Mode of delivery:

The course will be taught by using lectures, assignments and practicals,

Assessment:

Practical reports, assignments, tests and module examination. Their relative contribution to the final grade is shown below:

Requirements	Contribution
Tests	20%
Practical reports	20%
Final examinations	60%
Total	**100%**

viii) Course Name : ENDOCRINOLOGY (30 hours)

Course Level : 2

Course Credit : 2 CU

ix) Course Name : MICROBIAL BIOCHEMISTRY AND GENETICS

Course Level : 2

Course Credit : 4 CU

Brief Course Description

This course introduces students to how microorganisms harness and utilize energy. This course requires students to have studied "Metabolism and Metabolic Regulation" course in level one. The course comprises of Microbial Growth and metabolic changes during growth, Bacterial Energy Transductions (diversity of metabolic pathways), Microbial genetics and Introduction to Virology.

Course Objectives

At the end of this course students should be able to:

- describe the biochemical changes during different phases of microbial growth
- isolate and culture microbes in the laboratory
- discuss diversity of metabolic pathways among microbes
- describe a microbial genome
- describe mutation, mutagenesis, mutants and mutation analysis
- discuss the applications of microorganisms in various fields such as medicine, agriculture, industry and environment

Detailed course descriptions

Microbial growth and metabolic changes during growth (8 hours)

Isolation of microbes, culture techniques (batch cultures, continuous cultures), growth kinetics, Biochemical changes (DNA, RNA and protein) levels during different phases (Lag phase, exponential phase and stationery phase) of microbial growth.

Bacterial energy transductions (14 hours)

Substrate – level – phosphorylation (SLP), Electron transport – coupled phosphorylation (aerobic and anaerobic respiration), and fermentation, diversity of metabolic pathways.

Microbial genome (14 hours)

Typical example of bacteria genome (haploid genome), transfer of genetic material among bacteria (F' factor), conjugation and resistance factor (R_f factor), mutations, mutants, mutagens and mutagenesis, vectors (plasmids, cosmids, phages and transposons) , transduction and transducing phages, recombination and complementation.

Introduction to virology and application of microbes (9 hours)

Introduction to virology, application of microbes in medicine, agriculture, industry, research and in the environment.

Practical (30 hours)

Mode of delivery

This course will be taught by using lectures, practicals and assignments

Assessment

Assignments reports, tests, practical reports and end of module examination. Their relative contributions to the final grade is shown below:

Requirement	Contribution
Practical	20 %
Test	20 %
Final examination	60 %
Total	**100 %**

x) Course name : ENZYMOLOGY

Course Level : 2

Course Credit : 2 CU

Brief description:

This course builds on the knowledge acquired from the course; "Biomolecules: Structure and Function". It is divided into the following subdivisions: Derivation of steady state rate equation, Factors affecting enzyme reaction rates, Types of enzyme inhibitions, Orders in kinetic reactions (Zero, first, second orders), Mechanisms of enzyme reactions

Course objectives

At end of this course the students should be able to:

- derive steady state rate equation for enzyme-catalyzed reaction.
- demonstrate how different concentrations of substrate affect steady state rate equation.
- demonstrate how key factors affect enzyme reactions rates.
- define the types of enzyme inhibitions.
- demonstrate different mechanisms involved in enzyme reactions.

Detailed course description

i) Derivation of Michaelis-Menten equation **(6 hours)**

Steady state assumptions used in deriving the equation

ii) Diagramtic illustrations of how different concentrations of

substrate affect Michaelis- Menten equation. **(3 hours)**

iii) Factors that affect enzyme reaction rates **(6 hours)**

- Substrate concentration
- Enzyme concentration
- Temperature
- pH
- Allosteric effectors
- Cofactors
- Inhibitors

iv) Types of inhibitions **(6 hours)**

- Competitive inhibition
- Non competitive inhibition
- Un competitive inhibition

v) Enzyme mechanisms **(9 hours)**

- General acid base catalysis
- Covalent catalysis
- Metal ion catalysis

Illustrated with examples

Mode of delivery

Lectures and coursework

Ways of assessment

This will include assignments, tests, and end of module examination. Their relative contribution to the final grade is shown below:

Requirement	Contribution
Test	30 %
Final examination	70 %
Total	**100 %**

xi) Course Name : MOLECULAR BIOLOGY
Course Level : 2
Course Credit : 4 CU

Brief description

This course examines the flow of genetic information from DNA to RNA to protein (central dogma in molecular biology) through major process of transcription and translation (gene expression), Posttranslational protein modifications, protein targeting to different cellular localities and regulation of gene expression processes are also explored.

Course objectives

At the end of this course, students should be able to**:**

- describe DNA structure, melting and hybridization processes.
- describe transcription and translation processes
- discuss post translation protein modifications and protein targeting processes
- discuss the regulation of gene expression

Detailed Course description

Central Dogma of Molecular biology **(10 hours)**

The principle of flow of genetic information from DNA to RNA to Protein. General processes involved in DNA replication, transcription to RNA and translation to protein.

DNA **(5 hours)**

DNA Structure, hybridization, melting and annealing. Enzymology of DNA replication, DNA organization in the genome. DNA packing and repairing processes.

RNA **(2 hours)**

Structure of different types of RNA and their processing.

Gene Expression **(14 hours)**

Genetic code, general stages of transcription, in prokaryotes and eukaryotes, RNA polymerases and structure of promoters in prokaryotes and eukaryotes. Transcriptional factors in both types. General steps of translation processes, translation characters. Protein targeting and sorting both co-translation and post-translation modifications.

Regulation of Gene Expression **(14 hours)**

Gene regulation in prokaryotic and eukaryotic cells. Strategies of adaptive enzyme synthesis (catabolic pathway, anabolic pathway and effector molecules). Lactose (*lac*) system of E.coli and operon concept. Tryptophan (*trp*) operon concept as repressible operon. Control of transcription and initiation of translation . Attenuation mechanism

Practical **(30 hours)**

Mode of delivery

The course will be taught by using lectures, assignments and practicals

Assessment

Tests, practical reports and end of module examination. Their relative contribution to the final grade is shown below

Requirement	Contribution
Practical	20 %
Test	20 %
Final examination	60 %
Total	**100 %**

xii) Course Name : INDUSTRIAL TRAINING
Course Level : 2
Course Credit : 5 CU

xiii) Course Name : FOOD SCIENCE AND NUTRITION
Course Level : 2
Course Credit : 3 CU

Course Description

The course is divided into two major topics with sub-topics within each: Food science (Food composition, Food microbiology and spoilage, Food processing and preservation) and Nutrition (Dietary standards, Macronutrients, Micronutrients (of public health interest), Assessment of nutritional status, Nutrition and infection and Protein-energy malnutrition)

Course Objectives

At the end of the course students should be able to:

- describe the composition of major food groups
- explain the application of food composition tables and dietary standards
- describe food spoilage and the organisms involved
- outline major food processing and preservation methods and the effects on nutrients in food
- discuss macronutrients in the context of energy and nitrogen balance
- describe the major approaches in assessment of nutritional status
- discuss Vitamin A, iodine and iron and their deficiency disorders
- explain the relationship between nutrition and infection
- discuss the protein-energy malnutrition

Detailed course description

Food science

Food composition (6 hours)

Major food groups and the pattern of distribution of major nutrients: Cereals, roots, tubers, starchy foods, fruits and vegetables, legumes, nuts and seeds, milk and dairy products, animal products.

Food composition tables and their applications. Bioavailability of nutrients. (3 hours)

Food microbiology and spoilage (6 hours)

Bacterial agents of food poisoning and food borne infection. *Salmonella* spp., *Staphylococcus aureus*, *Clostridium perfringens*, *Clostridium botulinum*, *Brucella melitensi*. Food borne viruses: Hepatitis A and Norwalk-like viruses. Mycotoxin fungi: *Aspegillus*, *Penicullum*, *Fusarium*.

Food processing and preservation (6 hours)

Major methods and effects on nutrient composition: temperature control: sterilisation, pastuertisation, blanching, refridgeration, freezing. Dehydration. PH control. Use of chemical preservatives: cures, salt, nitrites, and additives. Use of gases, irradiation, antibiotics. Packaging: canning. Malting. Effect of processing on nutrients.

Nutrition

Dietary standards (3 hours)

Overview of how dietary standards are derived. Application of dietary standards.

In-class group exercise on the application of food composition tables and dietary standards

Macronutrients (6 hours)

Energy, sources of energy, Atwater factors, energy balance. Carbohydrates and dietary fibre. Proteins and nitrogen balance. Fats, essential fatty acids. Alcohol.

Micronutrients (of public health interest) (6 hours)

Sources of iodine; absorption and metabolism of iodine; thyroid hormones. Functions of thyroid hormones, thyroid hormone activity in pregnancy during iodine deficiency. Cretinism. Iodine deficiency disorders. Overview of assessment of iodine status. Control of IDD. Sources and absorption of iron. Iron exchanges in the body. Causes and types of anemia. Vitamin B_{12} and folate. Iron deficiency, anemia and IDA. Assessment of iron deficiency and IDA. Control of iron deficiency and anemia. Vitamin A: Retinol, retinal, retinoic acid and carotenoids: sources, absorption, bioavailability. Metabolism. Functions of retinal and of other retinoids. Assessment of Vitamin A status. Vitamin A deficiency. VAD and infection.

Assessment of nutritional status (2 hours)

Dietary assessment: retrospective and prospective methods. Food balance sheets. Anthropometry. Biochemical assessment. Clinical assessment. Advantages and disadvantages of each approach.

Nutrition and infection (1 hour)

Mechanisms through which infection leads to malnutrition and how malnutrition causes infection. Examples: PEM, Vitamin A, Zinc. Diarrhoea, malaria, H. pylori infection, HIV/AIDS, measles.

Protein-energy malnutrition (3 hours)

Classification of children with PEM. Types of PEM. Factors associated with stunting in Uganda. Evolution and biochemistry of marasmus. Characteristics of, and observations in kwashiorkor in relation to its evolution – infection, oxidative stress and malnutrition. Approaches in the management of severe PEM.

Mode of delivery

This course will be taught by using lectures and assignment

Assessment

Test and final examination. Their relative contribution to the final grade is shown below:

Requirements	Contribution
Test	30%
Final Examination	70%
Total	100%

xiv) Course Name : ADVANCED IMMUNOLOGY/ IMMUNOCHEMISTRY

Course Level : 2

Course Credit : 3

Brief description:

This course explores the vertebrate immune system, its components and mechanisms of immune responses, with specific reference to the human immune system. Practical application of elements of the immune system (antigen and antibodies) as reagents in various fields (immunochemistry) is also explored.

Course Objectives:

At the end of this course the student should be able to:

- Define immunology, immunochemistry, and name major organs of the immune system.
- Describe the development of elements of the specific immune system (B/T-lymphocytes).
- Discuss the specific and non-specific immune responses and their inter-play
- Describe mechanism of immunological memory and the generation antibody diversity.
- Classify immunoglobulins and describe the biological/physiological functions
- Describe antigen recognition by B/T cells and antigen processing and presentation
- Define auto-immunity and explain origin of autoimmune diseases
- Describe MHC proteins and their role in tissue/graft rejection
- Define allergy/hypersensitivity and differentiate the different types of hypersensitivity reactions.
- Explain the basic principles of immunological methods and state their application in different fields (Immunochemistry).
- Explain the principles of vaccine development/immunizations.

Detailed Course description

The generalized immune system **(5 hours)**

The general IS, organs of IS, immune responses and importance of IS, Non-specific vs specific immune system and types of cells involved.

Specific immune system (10 hours)

Lymphocytes (B/T lymphocytes), origin and development. Antigen recognition by B/T lymphocytes, antigen processing and presentation, antigen presenting cells (APCs). Cell surface differentiation clusters or CDs; Immunogens, antigens and haptens, characteristics of good antigen/immunogens. Antigenic determinants epitopes (linear and conformational epitopes). Immunoglobulin (Ig) classes and subclasses, Ig-superfamily, structure of Ig molecule, biological/physiological functions of antibodies, Ig-genes, generation and antibody diversity.

Non-specific immunity, Hypersensitivity and Autoimmunity (8 hours)

Elements of non-specific immunity (phagocytic macrophages, monocytes and polymorphs, interferons and their role in viral infections, physical barriers such as the skin and mucous membranes etc), the complement system. Major histocompatibility complex (MHC) proteins (MHCI & II) and class restrictions, role in tissue transplantation. Allergy/Hypersensitivity: types of hypersensitivity reactions. Autoimmunity and origins of autoimmune diseases.

Immunological methods and immunochemistry (7 hours)

Antigen-antibody interactions and immunoassays, production of monoclonal antibodies, development of and application of vaccines /vaccination. Immunochemical assay principles and techniques and application.

Practical (30 hours)

Mode of delivery

This course will be taught by using lectures, practicals and assignments

Assessment

Assignments, tests, practical reports and examination. Their relative contributions to the final grade is shown below:

Requirement	Contribution
Practical	20%
Test	20%
Final examination	60%
Total	**100%**

xv) Course Name : ADVANCED MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Course Level : 2

Course Credit : 4 CU

Brief description

This course builds on an earlier course: "Molecular Biology". It explores the application of molecular biology and biological systems as a whole to solve some existing civic problems. The course is

divided into two major parts: Genetic engineering (principles) and the practical application of genetic engineering (recombinant DNA technology).

Course Objectives

At the end of this course the student should be able to:

- define cloning and discuss the principles involved in the process
- explain how vectors are constructed
- describe the *in vitro* process of DNA amplification by the polymerase chain reaction (PCR)
- describe the construction of genomic and cDNA libraries and their screening for the desired gene(s)
- describe the processes of transformation and recombination
- discuss the application of recombinant gene technology in various fields such as medicine, agriculture, industry, the environment and research.

Detailed course description

Molecular cloning **(15 hours)**

Cloning vectors (plasmids, cosmids, bacteriophages), host cells (e.g. *E. coli, B. subtilis*), expression vectors and their construction, enzymes involved in cloning (restriction endonucleases, ligases, ribonucleases, DNases etc), preparation of genomic DNA and cDNA, construction of genomic and cDNA libraries.

Transformation and gene expression **(15 hours)**

Principles underlying transformation process, screening the libraries for positive transformant(s) (recombinant), amplification of the recombinant, DNA sequencing, expression of the desired gene product using expression vectors, use of in vitro site-directed mutagenesis (rational design) to study the structure/ function relation of the recombinant proteins, use of directed evolution through gene-shuffling to improve properties of recombinant proteins.

Practical application of genetic engineering **(15 hours)**

Production of mammalian products (such as insulin, human growth hormone, and vaccines) by genetically engineered microorganisms, use of genetically modified microorganisms in production of commercial enzymes, pharmaceuticals, and environmental remediation (bioremediation), transgenic plants and animals' development.

Practical **(30 hours)**

Mode of delivery

This course will be taught by using lectures, practicals and assignments

Assessment

Practical and assignment reports, test and module examination. Their relative contribution to the final grade is shown below

Requirements	Contribution
Practical and assignments	20
Tests	20%
Final examination	60%
Total	100%

xvi) Course Name : ANIMAL NUTRITION
Course Code : Level 2
Course Credit : 2 CU

Brief description

This course explores the animals (monogastric and ruminant) feedstuff with regard to nutrient composition. Digestion and metabolism of feedstuff by livestock and other animal species as well as nutrient properties and requirements, feed evaluation and ration formulation are explored. The nutritional roles of carbohydrates, proteins, lipids, minerals vitamins and water are examined.

Course objectives

At the end of this course the student should be able to:

- describe the digestive physiology of ruminants and monogastric animals as related to the animals' ability to convert feeds into various high value products such as milk
- describe the factors that affect the processes of feed indigestion, propulsion, and digestion, and how these factors determine end product release
- describe and integrate the absorption and metabolism of proteins, lipids, minerals, and vitamins in productive ruminants.
- evaluate and compare diets for domestic ruminants.

Detailed course description

Introduction to animal nutrition **(5 hours)**

Animal feedstuff and their nutrient composition (carbohydrates, proteins, lipids, vitamins and minerals), nutrient composition determination

Digestion and metabolism **(15 hours)**

Digestion in monogastrics and ruminants, metabolism in monogastrics and ruminants (carbohydrates, proteins, lipids).

Feeding standards **(5 hours)**

Feeding standards for maintenance and growth, feed ration formulation in relation to nutrient requirements, nutrition needs evaluation, mammary gland and synthesis of milk constituents

Metabolic diseases in animals **(5 hours)**

Mode of delivery

This course will be taught by using lectures and assignment

Assessment

Test and examination. Their relative contribution to the final grade is shown below:

Requirement	Contribution
Tests	30 %
Final examination	70 %
Total	**100 %**

xvii) Course Name : INDUSTRIAL BIOCHEMISTRY

Course Level : 2

Course Credit : 3 CU

Brief description

This module introduces students to the industrial exploitation of biochemical systems (microorganisms and their associated processes) to make products with commercial value. The course is divided into four major topics: Industrial microbiology/Biocatalysis, Microbiology of food processing, Production and extraction of biochemical substances, and Biochemical basis of waste management and pollution control.

Course Objectives

At the end of this course the students should be able to:

- describe the biochemical systems and processes necessary for production of novel products with commercial value.
- describe the techniques of extracting biochemical substances from biological material and to add value to these substances
- apply the principles in the production of bioactive compounds
- discuss the role of biochemistry in waste management

Detailed course description

Industrial microbiology/Biocatalysis (8 hours)

This section will provide an introduction to industrial microorganisms and products, growth and product formation in biocatalysis, characteristics of large-scale fermentations, fermentation scale-up, energy production (ethanol, biogas etc), conversion of sunlight into biomass (bioreactors and biophotolysis), bioextractive metallurgy (microbial leaching, metal accumulation and complexation).

Microbiology of food processing (8 hours)

The food and beverages industry: dairy products, cereal products, brewing, food additives, fruits and beverages, ripening, meat processing, spoilage and pest control.

Production and extraction of biochemical substances (7 hours)

Production of biomolecules: insulin, interferon, viral antigens, growth hormones, rennin, antibiotics, biopolymers, pharmaceutical products, enzymes etc. Extraction of enzymes, dyes, perfumes, detergents, and medicinal products

Biochemical basis of waste management and pollution control (7 hours)

Types of waste, sewage and wastewater microbiology, conventional biological wastewater treatment technologies (activated sludge, fluidized bed reactor processes etc), wetland processes, resource recovery (biogas, biofertilisers).

Practical (30 hours)

Mode of delivery

This course will be taught by lectures, practicals and assignments

Assessment

Practicals, assignments and test and final examination. Their relative contribution to the final grade is shown below:

Requirements	Contribution
Practical	20 %
Tests	20 %
Final examination	60 %
Total	100%

xviii) Course Name : RESEARCH PROJECT

Course Level : 2

Course Credit : 5 CU

xix) Course Name : CLINICAL CHEMISTRY AND DISEASE PROCESSES

Course Level : 2

Course Credit : 3 CU

Brief description

This course explores biochemical basis of inborn errors of metabolism. Clinical and laboratory investigations as well as their management are also covered.

Course Objectives

At the end of this course students should be able to:

- use the population reference values and markers in laboratory diagnosis and patient care.
- explain the underlying physiology and clinical manifestations and sequelae of dysfunction of the vital organs.
- describe the molecular basis of metabolic disorders and the rationale for their management.
- explain the principle of developing and use of markers in neoplastic and immunologic disease

Detailed course description

- **Laboratory investigations. (4 hours)**

An understanding of population reference values. The predictive values of specific tests and their use in screening and diagnosis and patient care.

- **Homeostasis. (6 hours)**

Composition of plasma protein and their functions. Renal and pulmonary function in the regulation of electrolyte and water in body fluids, acid-base balance and respiration.

- **The endocrine functions (7 hours)**

Of the hypothalamic-pituitary axis and the thyroid gland in homeostasis, metabolic regulation and developmental physiology. The endocrine diseases and endocrine effects of cancer and tumour markers. Calcium regulation and bone disease.

- **Clinical manifestations and biochemical lesions (12 hours)**

In metabolic disorders of the biomolecules; distributing hours equally between:

i) In-born errors of metabolism, with examples of phenylketonuria, dissachride intolerance,

ii) Porphyrin biosynthesis and metabolic lesions underlying the distinct presentations of porphyria,

iii) Heme degradation with emphasis on neonate complications

- **Liver function (4 hours)**

Investigations and diseases affecting them.

- **Genetic disease and neoplasias as well as the common hemoglobinopathies (4 hours)**

- **Diseases of the immune system, Immunodefficiency, autoimmunity and inflammatory sequelae. (8 hours)**

Mode of delivery

This course will be taught by using lectures and assignments

Assessment

Test and final examination. Their relative contribution to the final grade is shown below:

Requirements	Contribution
Tests	30 %
Final examination	70 %
Total	**100%**

xx) Course : COMPARATIVE BIOCHEMISTRY

Course Level : 2

Course Credit : 2 CU

Brief description

The course gives a comparative analysis of biochemical diversity and adaptive molecular evolution in living organisms in the areas of: Protein and Nitrogen metabolism, Respiratory pigments, Invertebrate biochemistry, Aerobic/anaerobic adaptive mechanisms; and Sterol/steroid functional and structural diversity in eukaryotic cells.

Course Objectives

At the end of the course the student should be able to:

- identify species – specific structural variations of common proteins/enzymes
- discuss the modes of nitrogenous end-product metabolism in the animal kingdom.
- identify and give the functional properties of oxygen – binding pigments in vertebrates and invertebrates.
- compare the intermediary metabolism of vertebrates with that of terrestrial and marine-based invertebrates.
- identify the kinetic components of the control mechanisms in obligate and facultative anaerobes.
- identify the structural and functional differences of sterols and steroids of vertebrates, invertebrates, plants and fungi.

Detailed course description

i. Collagens; Albumen proteins, Caseins. Cuticular proteins; Chorion proteins, silk proteins; Esterases; phosphatases phospholipases; Nucleases. Ureotelic, uricotelic and ammoniotelic modes of nitrogen metabolism. **(8 hours)**

ii. Myoglobins, Haemoglobins, Haemocyanins, Haememerythrins. **(4 hours)**

iii. Carbohydrate and amino acid metabolism in insects, nematodes, crustaceans, mollusks. **(6 hours)**

iv. PEPCK in aerobic/anaerobic metabolism, succinate/propionate diversion. Pyruvate/lactate dead-end. **(6hours)**

v. Sterols of vertebrates, insects, crustaceans, mollusks, porifera, protozoa, plants, fungi, steroid hormones, Ecdysteroids. **(6 hours)**

Mode of delivery

Lectures and coursework

Ways of assessment

Test and module examination. Their relative contribution to the final grade is shown below:

Requirements	**Contribution**
Test	30 %
Examination	70 %
Total	**100 %**

xxi) Course Name : PHARMACOLOGY AND TOXICOLOGY

Course Level : 2

Course Credit : 2CU

Course Description

The course explores the principles of pharmacology and toxicology. Pharmacokinetics and it variation with pH, the major classes of drugs and their modes of action and toxicology are discussed. The biochemical aspects such as biotransformation of drugs and the biochemical basis of toxicity are emphasized

Course Objectives

At the end of the course students should be able to:

- describe the pharmacokinetics of a drug and the factors that influence it.
- explain the criteria used to define a neurotransmitter
- describe the major neurotransmitters of the peripheral nervous system
- describe neuropeptides, and the mode of action of antibiotics
- describe the mode of action of non-steroidal anti-inflammatory drugs
- define toxicology and describe the biochemical basis of toxicity
- outline dose-response relationships and explain their application
- discuss the factors that influence toxicity
- discuss the biotransformation of foreign compounds

Detailed course description

Pharmacology **(4 hours)**

Pharmacokinetics: definition of pharmacokinetics. Absorption: different sites of absorption, pH-partitioning, factors that affect absorption. Distribution: Plasma-protein binding and other factors that affect distribution. Entry of drugs into special tissues: the brain and the foetus. Elimination of drugs: introduction to metabolism of drugs. Excretion in urine: glomerular filtration, tubular reabsorption, tubular secretion. Other routes of elimination.

Pharmacodynamics (10 hours)

Receptors. Neurotransmitters. The adrenergic and cholinergic nervous systems; agonists and antagonists Serotonin, histamine, agonists and antagonists of each of these neurotransmitters. Neuropeptides. Antibiotics. Non-steroidal anti-inflammatory drugs.

Toxicology (4 hours)

The basics: Definition. Nature of toxic effects: inflammation, necrosis, enzyme inhibition; biochemical uncoupling and redox cycling; lethal synthesis; lipid peroxidation; covalent binding; receptor interaction; immune-mediated hypersensitivity interactions; immunosuppression; neoplasia; heritable changes; developmental and reproductive toxicity; receptor-mediated events; disturbance of function of excitable membranes; altered Ca2+ homeostasis. Factors influencing toxicity: species and strain; age; nutritional status; time of dosing; environmental factors; exposure characteristics; formulation and presentation. Factors influencing systemic toxicity: absorption, distribution, metabolism, elimination.

Dose-response relationships (2 hours)

ED50 and LD 50. Therapeutic index and margin of safety. Interpretation and application of dose-response curves. Routes of exposure: peroral, percutaneous, inhalation.

Biotransformation of xenobiotics (10 hours)

Phase I reactions: Oxidation: cytochrome P450 monooxygenase system. Microsomal FAD-containing monooxygenase. Alcohol dehydrogenase. Monoamine oxidases. Peroxidases. Reduction reactions. Hydrolysis. Hydration. Phase II (conjugation) reactions: type I and type II. Sulphation, glucuronidation, glutathione conjugation, acetylation, amino acid conjugation, methylation. Factors affecting metabolism: Species; sex; genetic factors; environmental factors; pathological state; age; diet. Intoxication vs detoxication. Tissue specificity of toxicity.

Mode of delivery

This course will be taught by using lectures and assignments

Assessment

Test and examinations. Their relative contribution to the final grade is shown below:

Requirements	**Contribution**
Test	30 %
Final Examination	70 %
Total	**100%**

MINIMUM REQUIREMENTS FOR COURSES IN BOTANY

i) Course Name :FORMS, STRUCTURES AND CLASSIFICATION FOR KINGDOMS PROTISTA, MONERA, FUNGI AND PLANTAE

Course Level :1

Course Credit:3 CU

Brief Course Description:

General structure, characteristics, occurrence and economic importance of the above four kingdoms.

Course Objectives:

(i) To impart knowledge about evolutionary relationships and nutritional characteristics of the group
(ii) To appreciate the structures and life history of the representative groups.
(iii) To enlighten students on the economic importance of all the members of this group.

Detailed Course Description:

General characteristics, classification, occurrence and economic importance of:

- **Protista general morphological diversity (4hours)**
- **Algae - Chlorophyta, Bacillariophyta, Euglenophyta and Phaeophyta (8 hours)**
- Fungi - Phycomycetes, Ascomycetes, Fungi imperfect, Bacidiomycetes and **Zygomycetes (9 hours)**
- Plantae - Bryophytes, Pteridophytes, Gymnosperms and Angiosperms, Emphasis will be put on general structural characteristics and evolution of reproductive **structures, and stems across the groups. (9 hours)**
- **Practicals (30 hours)**

Mode of delivery:

This course will consist of lectures, assignments and practicals

Assessment:

Examinations (60%) and course work (tests, assignments and practicals) (40%)

ii) Course Name : FLOWERING PLANT GROWTH AND DEVELOPMENT

Course Level : 1

Course Credit : 3 CU

Brief Course Description:

Seed germination, structure, and conditions for germination and growth; factors affecting seed germination.

Course Objectives:

(i) By the end of the course students should understand how the seed is formed
(ii) Composition of the seed (chemical composition)
(iii) Conditions suitable for germination
(iv) Grasp techniques of measuring growth
(v) To know the factors that influence the flowering of plants.

Detailed Course Description:

- Process of seed formation **(1 hour)**
- Seed structure **(1 hour)**
- Chemical composition of seeds **(1 hour)**
- Definition of seed germination; types of seed germination **(1 hour)**
- Longevity and viability, concept of seed dormancy **(1 hour)**
- Different types of seed dormancy **(3 hours)**
- Plant growth (general and development aspect); parameters of growth (measurable quantities) **(7 hours)**
- Theories to explain patterns of growth **(3 hours)**
- Hormonal control of plant growth and development **(4 hours)**
- Application of hormones in agricultural production **(4 hours)**
- Environment factors and their effect on plant growth **(4 hours)**
- Practicals **(30 hours)**

Mode of delivery:

Lectures and practicals will be used but in addition assignments and tutorials

Assessment method:

Coursework and practicals will constitute 40% while the final examinations will contribute 60% to the final grade.

iii) Course Name : ELEMENTARY GENETICS

Course Level : 1

Course Credit : 3 CU

Brief Course Description

The course introduces students to the basic principles of classical genetics and inheritance as espoused by Mendel. It helps to build the foundations that will enable students to understand and apply genetic principles in advanced undergraduate and postgraduate studies. The course content logically builds on the biological foundation acquired from "A" Level.

Course Objectives

The objectives of the course are:

At the end of the course, students should be able to:

- Compare and contrast Pre-Mendelian and Mendelian theories of inheritance and apply Mendel's first and second laws of inheritance to solve related genetic problems
- Explain the different factors that can cause deviations from expected patterns of Mendelian Inheritance
- Map genes on chromosomes basing on recombination frequencies between them
- Discuss the different factors that are responsible for sex determination in plants and animals and differentiate between the different patterns of inheritance related to sex
- Explain causes of sex abnormalities in man and enumerate symptoms associated with each abnormality
- Discuss the different types, causes and consequences of Mutations

Detailed Course Description

Pre-Mendelian genetics **(1 hour)**

- Pre-Mendelian theories of inheritance
- strengths and weaknesses of the different theories

Introduction to Mendelian genetics **(3 hours)**

- Brief biography of Gregor Mendel
- Survey of characteristics of a good genetic organism
- Advantages of garden peas over other species as genetic organisms
- Reasons for Mendel's success in breeding genetics
- Outline if Mendel's classic breeding experiments and his results
- Mendel's Monohybrid crosses and formulation of his first law of inheritance
- Reciprocal and test crosses

Modifications of Mendelian monohybrid ratios **(2 hours)**

- Incomplete dominance
- Co-dominance
- Lethal genes
- Multiple alleles
- Cytoplasmic inheritance
- Pleiotropy

Dihybrid inheritance **(3 hours)**

- Definition of dihybrid inheritance
- Description of Mendel's dihybrid crosses
- Introduction to probability concepts as they relate to predicting outcomes of dihybrid crosses
- The Punnett square method
- The concept of Independent assortment
- Mendel's second law of inheritance
- The dihybrid test cross

Modifications of Mendelian dihybrid genotypic and phenotypic ratios **(3 hours)**

- Incomplete dominance
- Co-dominance
- Lethal genes
- Epistasis
- Reciprocal gene interaction

Multiple Allelic inheritance **(3 hours)**

- Coat colour inheritance in Rabbits
- ABO blood groups in man
- Practical applications of blood group typing
- Rhesus factor inheritance and its implications
- ABO blood group system and disease susceptibility
- Inheritance of self-incompatibility alleles in plants

Gene linkage **(2 hours)**

- concept of linkage
- Types of linkage
- Crossing over: detection, advantages and disadvantages

Gene mapping **(3 hours)**

- Recombination frequencies/Cross over values
- Triangulation method of determining gene order
- Factors affecting recombination frequencies between genes

Sex determination in Plants and animals **(3 hours)**

- Environmental sex determination
- Disadvantages of environmental sex determination
- Genetic sex determination
- Abnormalities of sex determination and their symptoms
- Chromosomal non-disjunction

Inheritance related to sex **(3 hours)**

- Sex influenced characteristics
- Sex limited characteristics
- Holandric characteristics
- Sex linked characteristics
- Pedigree analysis

Mutations **(4 hours)**

- Definition and classification of Mutations
- Causes of Mutations
- Types of mutagens
- Gene Mutations
- Frame shift and non-frame shift mutations
- Chromosome mutations
- Aneuploidy and Euploidy

- **Practicals:** **(30 hours)**

Method Delivery:

Lectures, assignments, tutorials and practicals

Assessment:

Examination (60%), practicals and tests (40%)

iv) Course name : CELL BIOLOGY

Course level : 1

Course Credit : 3 CU

Brief Course Description:

Introduces the concept of a cell as a unit of life. Examines the cell structure, function and cell cycle.

Course Objectives:

At the end of this course students should be able to:

- Explain the principles of microscopy (theory) and application
- Describe the concept of a cell as a unit of life and the cell cycle
- Describe the role of a cell in growth, inheritance and reproduction.
- Describe the structure and functions of prokaryotic and eukaryotic cells
- Describe the structure and function of the endomembrane system

Detailed course description

- Principles of microscopy (theoretical and practical aspects). Light microscopes and other types including electron microscope. Importance of microscope in contribution to cell knowledge. **(4 hours)**
- An overview of the cell/cell theory **(3 hours)**
- Generalised structure of prokaryotic and eukaryotic cells. **(3 hours)**

- Intra cellular endomembrane system (organelles)such as the nucleus golgi complex, lysosomes, peroxisomes, endoplasmic reticulum, ribosomes mitochondria/chloroplast in plant cells and the plasma membrane, their structure and function. **(6 hours)**
- Specialisation of cell membrane: microvillosites, the cell coat, the case of plant cells and prokaryotes. **(5 hours)**
- The nucleus of the cell; aspect during the inter-phase membrane, chromatin, interchromatin spaces, nucleus. The cell cycle (inter-phase, mitosis, chromosomes, meiosis) **(5 hours)**
- Cytoplasm, cytosol and cytoskeleton: structure of microtubules, microfilament, their function of microtubules and microfilaments in cell motility, cell division, movement of secretory vesicles and beating of flagella and cilia. **(4 hours)**
- Practicals **(30 hours)**

Mode of delivery:

The course will be taught by using lectures, assignments and practicals,

Assessment:

Tests, practicals, and assignments (40%) and examination (60%)

v) Course Name : INTRODUCTION TO PLANT FUNCTIONS

Course Level : 1

Course Credit : 3 CU

Brief Course Description

This course is intended to introduce the students to major physiological functions in plants. This is in preparation for more advanced courses in plant Physiology.

Course Objectives

By the end of this course unit the student should be able:

- Explain the developmental and scientific importance of the study of plant physiology
- Describe the process of nitrogen metabolism in plants
- Explain the importance of nitrogen metabolism to plants
- Describe the process of carbohydrate metabolism
- Explain the importance of carbohydrate metabolism to plants
- Describe the relationship between nitrogen metabolism, carbohydrate metabolism and nitrogen assimilation

Detailed Course Description

Nitrogen Metabolism

- The relations of nitrogen with other elements in the formation of organic compounds **(1 hour)**
- Sources of nitrogen available for utilization **(1 hour)**
  - Utilization of nitrogen in the formation of a diversity of organic compounds **(1 hour)**
  - The relationship between nitrogen compounds and other physiological functions in plants **(2 hours)**
  - Nitrogen compounds found in plants (1 hr)
- The influence of nitrogen on plant growth **(2 hours)**
- The influence of carbohydrate/nitrogen compound ratio on flowering behaviour of plants **(2 hours)**
  - Nitrogen fixation by symbionts and free-fixers (1 hr)
- Factors affecting the fixation of nitrogen by micro-organisms **(2 hours)**
  - Classification of micro-organisms in soils **(1 hour)** hr)
- Pathways of amino acids synthesis **(1 hour)**
  - Uses, general reactions and properties of amino acids (1 hr)
- Proteins, classification and their general properties **(1 hour)**

Carbohydrate metabolism

- Biosynthesis of carbohydrates: e.g. by glucogenosis and from carbon dioxide glucose, sucrose, cellulose and starch **(3 hours)**
- Photosynthesis, factors affecting photosynthesis, efficiency of photosynthesis **(3 hours)**
- Respiration, respiratory substrates and quotients and their significance **(2 hours)**
  - Intrinsic and environment factors controlling respiratory rates in plants **(3 hours)**
  - Practical aspects of respiratory factors with respect to storage of plant products **(2 hours)**
  - Practicals **(30 hours)**

Mode Delivery:

Lectures, assignments, tutorials practicals and field trips

Assessment:

Practicals, assignments and tests (40%) and Examination (60%) total 100%

vi) Course Name : PLANT - WATER RELATIONS AND MINERAL NUTRITION

Course Level : 2

Course Credit : 3 CU

Brief Course Description:

The course covers physical and chemical properties of water, its movement in biological and physical systems, uptake and transport within the plant, phloem transport, stomatal structure and movement, water stress and mineral nutrition.

Course Objectives

The objectives of the course are:

- To increase knowledge of how physiological factors affect growth of plants and plant communities.
- To demonstrate how the physical & chemical properties of water affect the physiological status of cells and tissues of plants.
- To increase the understanding of how environmental factors influence gases exchange and water uptake by plants and plant communities.
- To increase the knowledge of how plant distribution is affected by water content of the soil.
- To increase the understanding of the roles played by mineral nutrients in plant growth and development.

Detailed Course Description

- Physical & Chemical Properties of Water **(4 hours)**
- Water movement in physical and biological systems **(5 hours)**
- Water uptake by Plants **(1 hour)**
- The ascent of water in plants **(1 hour)**
- Phloem transport **(2 hours)**
- Stomatal structural & movements **(3 hours)**
- Transpiration & evapotransipiration **(3 hours)**
- Water Stress in plants **(3 hours)**
- Mineral nutrition plants **(8 hours)**
- Practicals **(30 hours)**

Mode of delivery:

Lectures, assignments, tutorials and practicals

Assessment:

Examination (60%), practicals, tests (40%)

vii) Course Name : APPLIED BACTERIOLOGY AND VIROLOGY

Course Level : 2

Course Credit : 3 CU

Brief Course Description

This course will cover viruses and prokaryotes and their influence on life processes of other organisms. Emphasis will be placed on their applications in genetics, evolution and biotechnology and host – parasite relationships.

Course Objectives

The objectives of the course are to:

(i) provide an improved understanding of bacteriology and virology
(ii) enable students understand the dynamics nature of the genetic material
(iii) equip the students with insights into the use of micro-organisms as biotechnological tools in plant, animal, human health and industry

Detailed Course Description

Virology: **(10 hours)**

Overview, definition, general characteristics, sizes and organization of viruses, chemical composition of viruses, physical characteristics, Reproduction of viruses, classification: Bacteriophages: morphology, multiplication, Phytophages; plant virus diseases, different symptoms of virus diseases of plants. Transmission of plant viruses. Control of virus diseases of plants. Zoophages, replication, host cellular alteration due to viral infections. Classification of zoophages with special reference to HIV virus. Application of bacteriology/virology.

Bacteriology: **(20 hours)**

Definition of bacteria, eukaryotic and prokaryotic cells, classification and nomenclature of bacteria. Why study bacteria? Morphology of bacteria cells; shapes, forms and groupings. Bacterial cytology; various structures of bacterial cells (Appendages, cell envelope, cytoplasm and its inclusions). Staining of bacteria, bacterial smears, different dyes and their actions on bacterial cells. Mechanism of staining bacterial cells, types of bacterial staining.

Growth of bacteria, the bacterial growth curve, factors affecting the growth of bacteria.

Nutrition of bacteria, different groups of bacteria based on their nutrition behaviour.

Identification of bacteria, principles on which bacterial isolates are categorized.

Biochemical activities; acid/gas from carbohydrates; oxidation-fermentation test, Reaction in litmus milk, production of indole. The methyl red test, Voges-ProsKauer test, oxidase test, urease production, hydrogen sulphide production, proteolytic activities, starch hydrolysis, catalase production, phosphatase test, nitrate reduction, Haemolysis.

Classification of bacteria; different bacterial groups and representative families; phototrophic bacteria, Gram negative facultatively anaerobic rods, Gram negative chemoautotrophic bacteria, Gram positive cocci, endospore-forming rods and cocci, Actinomycetales and related organisms. Examine bacteria of medical importance.

Practicals **(30 hours)**

Mode Delivery: Lectures, assignment, tutorials and practicals

Assessment: Practicals, assignment and tests (40%) and Examination (60%)

viii) Course name : PLANT DIVERSITY AND EVOLUTION I: Viruses, bacteria and fungi

Course Level : 2

Course Credit : 3 CU

Brief description:

The following groups of organisms will be covered: viruses, bacteria, fungi. Their structure, diversity, evolution and economic importance are covered.

Course objectives:

(i) Achieve a panoramic view of viruses, bacteria, fungi
(ii) To have a clear picture of interrelationships and increasing complexities within the different groups.

Detailed Course Description:

- Viruses **(1 hour)**
- Bacteria **(3 hours)**
- The domains of life namely: archbacteria, eubacteria and eukaryots **(1 hour)**
- Fungi **(5 hours)**
- Techniques of sterilisation, isolation and culture including diagnostic features of: viruses **(4hours)**

  bacteria **(6 hours)**
  and fungi **(6 hours)**
- Reproduction, survival and ecology **(4 hours)**
- Economic importance **(2 hours)**
- Practicals:

(3 0 hours)

Mode of Delivery:

Lectures, assignments, tutorials and practicals.

Assessment

Final examinations (60%) and coursework (practicals, homework and tests) (40%)

ix) Course Name : PLANT DIVERSITY AND EVOLUTION-II: Lower plants – Algae, Mosses, ferns, lichens and gymnosperms

Course Level : 2

Course Credit : 3 CU

Brief Course Description:

The course covers the following groups of organisms namely: lower plants. Their structure, diversity, evolution including their economic importance will be covered.

Course Objectives:

(i) To obtain a panoramic view of Algae, Mosses, ferns, lichens and gymnosperms
(ii) To have a clear picture of increasing complexities within the different groups.

Detailed Course Description

- Symbiotic relationships in these groups **(3 hours)**
- Occurrence of algae, lichens, mosses, ferns and gymnosperms **(3 hours)**
- Structure of these groups of plants **(4 hours)**
- Classification of the above groups **(2 hours)**
- Distribution of pigments and food reserves **(3 hours)**
- Range and types of reproduction and life cycles in the groups; alternation of generations in the different groups of plants (algae, lichens, mosses, ferns and gymnosperms) **(4 hours)**
- Ecological considerations of all these plant groups **(7 hours)**
- Economic importance of these plants **(4 hours)**
- Practicals: **(30 hours)**

Mode of Delivery:

Lectures, assignments, tutorials, and practicals.

Assessment:

Final examinations (60%) and coursework (tests, homework and practicals) (40%)

x) Course Name : PLANT DIVERSITY AND EVOLUTION- III: Higher plants- Angiosperms

Course Level : 2

Course Credit : 3 CU

Brief Course Description:

The course covers the following groups of organisms namely: higher plants -monocotyledons and dicotyledons. Their structure, diversity and evolution including their economic importance will be covered.

Course Objectives:

(i) To get a panoramic view of monocotyledons and dicotyledons
(ii) To have a clear picture of interrelationships and increasing complexities within the different groups.

Detailed Course Description:

- Basic principles of taxonomy, identification and classification of plants **(3 hours)**
- General characteristics of monocotyledons **(4 hours)**
- Genera characteristics of dicotyledons **(4 hours)**
- Vegetative and reproductive characteristics of monocotyledons **(3hours)**
- Vegetative and reproductive characteristics of dicotyledons **(3hours)**
- Modes of pollination and dispersal **(3 hours)**
- Dicotyledons – their variations traced from polypetalae through the apetalae to the gamopetalae **(4 hours)**
- Monocotyledons – variations traced from corofilae, calyciferae and glumiflorae **(3 hours)**
- Economic importance of plants **(2 hours)**
- Plant collection techniques for preservation **(1 hour)**
- Practicals: **(30 hours)**

Mode of Delivery:

Lectures, practicals, assignments and tutorials will be used.

Assessment:

Final examinations (60%) and coursework (tests, homework and practicals) (40%)

xi) Course Name : PLANT BIOCHEMISTRY

Course Level : 2

Course Credit : 3 CU

Brief Course Description:
This course is about energy relations in plants. Light as a source of energy relations in plants. Light as a source of energy for photosynthesis. Photosynthetic pigments electron transport systems. The path of carbon assimilation. Concept of limiting factors. Respiration ad photorespiration.

Course Objectives:

(i) To transform light energy into chemical energy
(ii) To foster the understanding of carbon assimilation
(iii) To promote the understanding of catabolic process in plants.

Detailed Course Description

- Nature of light and its measurement **(1 hour)**
- Solar energy and its modification by the earth's atmosphere **(2 hours)**
- Photosynthetic pigments; their absorption spectra and action spectra (PAR) **(6 hours)**
- Detailed structure of the chloroplasts an it semi genetics autonomy.
- Electron transport systems **(2 hours)**
- Photophosphorylation and production of reducing power **(2 hours)**
- The dark reaction (path of carbon assimilation); calvin cycle (C_3), Hatch – slack (C_4) – dicarboxylic acid pathway and crassulacean acid metabolisim (CAM) **(5 hours)**
- Adaptive significance of these pathways **(3 hours)**
- The physiology of photosynthesis – methods of investigating photosynthesis **(5 hours)**
- The principle of limiting factors **(2 hours)**
- Structural and physiological differences between C_3 and C_4 and CAM **(3 hours)**
- The concept of efficient and no-efficient plants **(3 hours)**
- Photorespiration **(2 hours)**
- Estimation of photorespiration and organelles in which it occurs
- Assimilation of photosynthesis; respiration – glycolysis, the Krebs cycle, the cytochrome system and the pentose phosphate pathway. **(6 hours)**
- Metabolic transformation in non-green tissues (glyoxylate) cycle, alpha and beta oxidation pathways) its significance in plant growth and development **(6 hours)**
- **Practicals:** **(30 hours)**

Mode of Delivery:

Lectures, tutorials, assignments and practicals,

Assessment:

Final examinations (60%) and coursework (tests, homework and practicals) (40%)

Mode of Delivery :

Lectures, assignments, tutorials and practicals

Assessment : Practicals, assignment and tests (40%) and examination (60%)

xii) Course Name : ENERGY RELATIONS OF PLANT COMMUNITIES
Course Level : 2
Course Credit : 3 CU

Brief course description:

This course is intended to introduce students to energy relations of plant populations, communities and ecosystems. Laws of energy conservation, the role of limiting factors in plant communities will be explained. Ecological field methods and techniques will be applied.

Course Objectives:

Students will be expected to:

- Explain the nature and characteristics of solar radiation in the outer earth atmospheres
- Explain the plant energy relations in primary productivity, energy flow efficiencies and balances
- Compare the global patterns of primary productivity, overall governing factors and food security
- Describe, explain and apply ecological methods and techniques in the assessment of plant community productivity

Detailed course description

General ecology of plant communities with regard to the following:

- Chief aspects of plant life and growth forms
- Environmental factors influencing community diversity

Radiation ecology and laws of thermodynamics:

- Radiation within the earth's atmosphere
- Attenuation of radiation in plants and water bodies
- Effect of radiation on plants and biogeochemical cycles
- Laws of thermodynamics in explaining energy absorption, conversions and transfers

Plant primary productivity and energy flow:

- Primary community, ecosystem productivity and energy flow
- Trophic levels, food webs, energy production and transfer efficiency in plants
- Factors affecting community primary productivity
- Energy production, conversion and transfer efficiencies in communities
- Determination of energy flow through an ecosystem
- Biomass, alcohol and the fuel wood issue
- The population, food intake and fertility

Ecological Field Methods and Techniques

- Rapid surveys and measurements of plant community productivity
- Students field course: Training, Research and Reporting

xiii) Course Name : ENVIRONMENTAL SCIENCE FOR THE CONSERVATION OF NATURE AND NATURAL RESOURCES

Course Level : 2

Course Credit : 3 CU

Brief course description:

Course Objectives:

- To introduce students to the vital aspects of environmental science and the global environmental debate
- To enable students analyze the environmental effects of global warming and the ozone layer depletion

Detailed course description

Introduction to environmental science

- Environmental science as a challenge to science
- Environmental science and environmental management
- Interdisciplinarity and multidisciplinarity
- Environmental ethics versa ecological ethics
- The precautionary principle in environmental science
- Sustainability concept in environmental science
- Environmental advertising, diplomacy and advocacy

Global environmental debate

- Environmental economics and management
- Environment, urbanization and the sustainable city
- Ecodevelopment and integrated rural development
- Environmental policy formulation and emerging issues in global environmental policy
- Environmental action plans
- Strategic environmental planning and management
- Environmental project design, implementation, perception and management
- Soils, soil erosion and land degradation
- Traditional and current impacts on environment
- Production science
- Ecological science and ecosystem science
- Environmental risk management
- Environmental health and planning
- Ecology, community and lifestyle
- The environment and international relations and politics
- Environmental negotiations
- Environmental law
- Global environmental strategies (NEAP, GEF,DNS etc)
- Environmental education for accountability
- Pollution, conservation and environmental management
- Bioclimatology and Holdridge life zone classification
- Biogeography and the biosphere reserve design
- Biodiversity and biodiversity prospecting

- Environmental effects of global warming and the ozone layer depletion
- Environmental scarcity, human rights and refugees
- Traditional knowledge in tropical environment
- Technological fundamentalism, biotechnology and environment
- Science and policy making
- Environmental knowledge and ecological methods and techniques
    - Modeling and dendrochronology
    - Environmental impact and social impact assessments
    - Remote sensing and mapping/aerial photography
    - Animal surveys and satellite imagery
    - Ecological land classification

Mode of Delivery:

Lectures, assignments, tutorials and practicals

Assessment:

Practicals, assignment and tests (30%), Project (10%) and examination (60%)

xiv) Course Name : WEED BIOLOGY

Course Level : 2

Course Credit : 3 CU

Brief Course Description

This course will introduce students to the origin and history of weed, their biological characteristics, effects, economic importance and management.

Course Objectives

- To introduce students to the history and origin of weeds
- To understand genetic and biological aspects that enable plant become weeds e. g. competitive / invasive
- To gain knowledge on the distribution of weeds
- To understand crop / weed interactions
- To understand economic importance of weeds
- To keep students with knowledge, skills and methods of weed control

Detailed Course Description

Definition of 'a weed'. Morphological diversity and classification of weeds of crops, pasture, forest and aquatic environment: Lectures 30 hours

(i) Economic aspects of weeds: utilization for food and drugs, stock poisons, their effect on crop yield by competition.

(ii) Root systems, soil factors, growth and water relations.

(iii)Reproductive mechanisms, sexual and vegetative: dispersal mechanism of fruit, seed and vegetative parts, longevity of weed seeds; germination and dormancy mechanisms including the 'light' effect; weed establishment and seedling cohorts.

(iv) Weed control: mechanical, biological and chemical (herbicides): the physiological basis of herbicide action; herbicide practice.
(v) Evolution of weedy mode of life
(vi) Weed crop interactions
(vii) Practicals **(30 hours)**

Mode of Delivery:

Lectures, assignments, tutorials and practicals

Assessment:

Practicals, assignment and tests (30%), Project (10%) and examination (60%)

xv) Course Name : CROP IMPROVEMENT METHODS AND PLANT BIOTECHNOLOGY

Course Level : 2

Course Credit : 4 CU

Brief Course Description

The course examines qualitative and quantitative inheritance, breeding methods for self-pollinated and cross-pollinated crops, mutation breeding, crop breeding for disease and pest resistance, genetic engineering and biotechnology.

Course Objectives

The objectives of the course are:

- To enable students understand qualitative and quantitative inheritance
- To introduce students to breeding methods for self-pollinated and cross-pollinated crops
- To enable students understand mutation breeding
- To introduce methods of crop breeding for disease and pest resistance
- To enlighten students about genetic engineering and biotechnology

Detailed Course Description

QUALITATIVE AND QUANTITATIVE INHERITANCE (15 hours)

Gene interactions and Modification of phenotypic ratios. Different forms of Haritability and its interpretation. Heterosis and its estimation. Genetic aspects of selection and response to selection. Carrying out breeding experiments. Experimental designs (Random Models). Diallel analysis. G X E analysis (Regression models and pattern analysis). Path analysis. Principle component analysis (PCA).

BREEDING METHODS FOR SELF POLLINATED CROPS (8 hours)

Selection techniques (Pure line selection, Mass selection). Hybridisation techniques (Pedigree breeding, Bulk selection, Backcrossing, single seed descent). Guiding principles under self-pollination. Role of Heritability and inbreeding coefficient.

BREEDING METHODS FOR CROSS POLLINATED CROPS (10 hours)

Population improvement Cuemes (Mass selection, stratified mass selection, Recurrent selection, Reciprocal recurrent selection, etc). Development of inbred lines for hybrid production (Use of male sterility, Hybrid production, Synthetic variety production, etc). Predicting Hybrid performance.

Specific and General combining ability (SCA and GCA), and their estimation. Selection strategies (Visual, Tandem, Truncation or culling levels, index selection). Cultivar release, testing release, and maintainance of cultivar integrity.

MUTATION BREEDING (10 hours)

Mutagens and Mutagenesis, Plant material. Induction and screening of Mutants. When to use mutation breeding. Plant characters to be improved by mutation techniques. Selection procedure. Cross-pollinated spp. Vegeatively propagated spp (with special reference to *Musa* spp). A sexually propagated spp but capable o sexual reproduction. Breeding apomictic crops.

BREEDING FOR DISEASE AND PEST RESISTANCE I CROPS (10 hours)

Principles of resistance breeding. The disease Triangle. Types of resistance. Host-pathogen interactions. Genetic of host-pathogen interactions. Genetic resistance to plant diseases and insect pests. Viability systems in pathogenic fungi. Breeding and screening disease resistant varieties.

GENETIC ENGINEERING AND BIOTECHNOLOGY (7 hours)

Scope of Biotechnology

Plant Cell and Tissue Culture

Princples of plant cell and tissue culture. Culture techniques. Meristem culture. Orchid culture. Anther culture. Application of culture techniques (*in vitro* methods) in plant breeding. Merits and demerits of cell and tissue culture techniques. Selection role of phytotoxins in culture filtrates for pest resistance.

Genetic engineering and Recombinant DNA Technology

Molecular basis of plant breeding. The central theme of Molecular biology. Recombinant DNA, and Recombinant DNA techniques. Principles and applications of polymerase chain reaction (PCR). Biochemical and Molecular markers. Marker-assisted selection (MAS) in plant breeding. Principles and applications of Molecular cloning. Methods of DNA transfer (Genetic transformation) in plants. Generation of transgenic crops. Bio-safety, bio-policy and ecological implications.

Mode of Delivery:

Lectures, assignment, tutorials, Practicals and fieldwork.

Assessment:

Practicals, tests (40%), Final examination (60%)

List of Electives:

- Advanced Plant Taxonomy
- Genetics
- Microbiology and Plant Pathology
- Natural Resources Ecology
- Plant Physiology

Requirements for Botany

1. Glassware

Test tubes, Boiling tubes, Beakers (all sizes), Flat bottomed flasks (different sizes), Round bottomed flasks, Pipettes, Burettes, Petri dishes (Glass and plastic), Measuring cylinder (All sizes), Watch glass, Glass slides, Cover slips, Glass jars(different sizes), Specimen bottles,

2. Equipment

Compound microscopes, Stereomicroscopes, Autoclaves, Weighing balances of all types, Research microscopes, Water baths, Refrigerator, Incubators, Ovens, Water distillers, Deioners, Retort stands, pH meters, Gas cylinders, Respirometers, Potometers, rubber tubing, centrifuges, distillers, water-baths, hand- lenses, ovens, thermometers, spectroscope, colour filters, Microscope with attached camera, Water containers for field work, Camping equipment and tents, Metre rulers, Vehicles for transport (field work), Deep freezers, Cold room, Computers accessories, Microtomes, , tripod stands, Bunsen burners, gas cylinders, spirit lumps, hotplates,

Chemicals and Reagents

Mineral acids, Alcohols, Acetone, Xylene, ethyl ether, DPX, Alkalis, Salts, Sugars, Proteins and amino acids, Dyes of various kinds, Consumables or microbial experiments, Esters, Ethers, Spirits, Starch, Plant hormones, oils

General Materials and Equipment required:

Plant-press, herbarium facilities, fitter papers, meter rulers, clamps

MINIMUM REQUIREMENTS FOR COURSES IN CHEMISTRY

i) Course Name : INORGANIC CHEMISTRY I
Course Level : 1
Course Credit : 3 CU

Brief Course Description:

Atomic structure, Periodic table, general properties of the main elements, Chemical bonding.

Course Objectives:

- To enable the student predict chemical stability and reactivity after understanding the structure of the atom.
- To enable the student to understand and account for the geometry and shapes of molecules.

Detailed Course Description:

- Atoms, molecules, and ions – Structure of the atom, chemical formulas, ions and ionic compounds, and naming inorganic compounds (**4 hours**)

- Atomic structure:
  - Classic experiments: Faraday's guidelines, experiments of Millikan, Rutherford, Crooks and Thomson. (**4 hours**)
  - Atomic spectra, atomic energy levels, Bohr theory and introduction to quantum mechanics (**6 hours**)

- Periodic table: History of the periodic table, electron configurations, aufbau principle, relationship of the physical properties of the elements (size, ionization energy, electron affinity, nuclear shielding, and electronegativity) in comparison to the position in the periodic table. (**8 hours**)

- Chemical bonding:
  - Types of bonding, intermolecular forces, metallic bonding, ionic bonding, covalent bonding. (**8 hours**)
  - Lewis structures of covalent molecules. **(3 hours)**
  - VSEPR, effects of lone pairs, multiple bonding, bond angles, bond lengths, dipole moments; (**4 hours**)
  - Molecular orbital theory for homonuclear diatomics, bond order, sigma, pi, and delta bonds, multi-center bonding (**4 hours**)
  - VB theory: Hybridisation and resonance (**4 hours**)

Mode of Delivery:
Lectures, assignments, tests and tutorials

Assessment:
Assignments, tests (30%) and Examination (70%)

Equipment: Power point, overhead projectors

ii) Course Name : PHYSICAL CHEMISTRY I

Course Level : 1

Course Credit : 3 CU

Brief Course Description:

This course will explore the basic principles of physical chemistry including stoichiometry, chemical reactions, chemical equilibrium, chemical thermodynamics, electrochemistry, and the phases of matter.

Course Objectives:

The student should be able to:

- understand and apply the fundamental concepts of stoichiometry in chemical reactions.
- understand the forces that hold compounds together and to interpret the differences between the three phases of matter.
- understand properties of solutions and to carry out calculations of properties which depend upon the concentration of a solute in solution.
- carry out basic calculations concerning chemical equilibrium and chemical thermodynamics.

Detailed course description:

- Matter and Measurement – Units, dimensional analysis, classification of matter, properties of matter (**2 hours**)
- Stoichiometry – Chemical equations, stoichiometric calculations, moles, empirical formulas, limiting reagents (**3 hours**).
- Aqueous reactions – Precipitation, acid-base, and redox reactions, concentrations. (**3 hours**)
- Thermochemistry and Thermodynamics – First and second laws of thermodynamics, enthalpies of formation, Hess' law, calorimetry, Gibbs free energy (**4 hours**).
- Phases of matter – Gas laws, partial pressures, kinetic-molecular theory, diffusion structures of liquids and solids, intermolecular forces. (**3 hours**).
- Properties of solutions – Viscosity, surface tension, phase changes, vapour pressure, phase diagrams, phase equilibria, solubility, concentration units, colligative properties, colloids. (**5 hours**).
- Chemical Equilibrium – Equilibrium constants, LeChatelier's principle, acid-base equilibrium, buffers, titrations, solubility equilibria. (**6 hours**).
- Electrochemistry – Balancing redox reactions, voltaic cells, Nernst equations, batteries, electrolysis (**4 hours**).

Mode of delivery:

Lectures, assignments, tests and tutorials

Assessment:

Tests and assignments (30%), Examination (70%)

iii) Course Name : INORGANIC/PHYSICAL PRACTICALS

Course Level : 1

Course Credit : 2 CU

Brief Course Description:

Instrument/equipment manipulative skills, volumetric analysis techniques, quantitative analysis, accurate observation and recording of scientific data

Course Objectives:

- To acquire manipulative skills to handle scientific equipment and tools;
- To impart ability to take care of equipment
- To foster a sense of accurate observation, recording of data and sensible interpretation or inferences using the available data.
- To learn how to analyze scientific data using computer software.

Detailed description:

- Exposure to essential tools for chemical analysis **(4 hours)**
- Review of volumetric analysis techniques **(4 hours)**
- One 4-hours experiment in each of the following areas:

  Standardisation of hydrochloric acid, quantitative analysis of impure samples, simple preparatory inorganic chemistry, complexometric titrations, determination of solubility products, thermochemistry, Ion exchange resins, potentiometric, thermometric and conductometric titrations, reaction kinetics, solution chemistry of selected ions, titrations with ironclads

Mode of Delivery:

Laboratory talk, hands-on with equipment and reagents,

Assessment:

Experimental results and report write-up as a basis of assessing the

students. The results contribute 100% to the final mark.

iv) Name of Course : ORGANIC CHEMISTRY I

Course Level : 1

Course credit : 5 CU

Brief Course Description

Introduction to organic chemistry in daily life, various aspects of bonding in organic chemistry and methods of structure determination, nomenclature, synthesis, and reactions of simple organic compounds will be covered. Practical aspects of physical constant determination, synthesis and purification of simple organic molecules will also be covered.

Course Objectives

At the end of the course, the students will be able to:

- Know the role of organic chemistry in every day life
- Define organic chemistry and outline its importance
- Outline methods of determining structures of organic compounds
- Distinguish different conformations of organic molecules
- Complete equations, predict products and write plausible reaction mechanisms
- Synthesize organic molecules.

Detailed course description *(the time allocated includes theory 45 hours and practicals 60 hours)*

- Carbon and the uniqueness of carbon, catenation and hybridisation: atomic and molecular orbitals and bond formation processes, formation of methane, ethane, ethene, ethyne, and benzene **(2 hours)**
- Organic chemistry importance/everyday life usage: plastics, detergents, fibers and insecticides. Definition of organic chemistry, contrast of covalent and ionic bonds. Breaking and forming bonds: free radicals, carbocations, carbanions. Distribution of charges of electrons in bonds, inductive effects and dipole moments. Conformation: eclipsed and staggered conformation in Sawhorse and Newman conventions. Energy level diagrams **(9 hours)**
- Structure determination of organic compounds: purification, liquid and gas chromatography and determination of formula mass. Outline of spectroscopy: mass, UV-visible, Infrared, and Nuclear Magnetic Resonance (NMR). **(15 hours)**
- Nomenclature, synthesis and reactions of: alkanes, alkenes, alkynes, benzene, alkyl halides, alcohols, carbonyl compounds, and amines. **(19 hours)**
- Practicals **(60 hours)**

Mode of Delivery:

Lectures, assignments, tests, tutorials, and practicals

Assessment:

Tests and assignments (20%), Practicals (20%), Examination (60%)

v) Course Name : ANALYTICAL CHEMISTRY I

Course Level : 2

Course Credit : 4 CU

Brief Course Description:

Sampling methods and estimation of errors. Titrimetry and gravimetry. UV-visible and IR spectrometry, gas-chromatography, electrophoresis, and ion exchange analytical methods. Solvent extraction techniques.

Course Objectives

At the end of this course students shall be able to:

- To apply basic chemical principles in analytical chemistry.
- To judge the accuracy and precision of experimental data.
- To use a wide range of techniques of modern analytical chemistry.

Detailed Course Description

A. Theory

- Methods of sampling. Accuracy, precision, causes and estimation of errors. **(2 hours)**
- Titrimetry. Titrimetric method, acid-base, redox, complexometric, precipitation **(4 hours)**
- Non-aqueous vis-à-vis aqueous titrations **(2 hours)**
- Gravimetry – factors affecting solubility of precipitate: excess reagent, ionic strength, pH and solvent **(5 hours)**
- Spectroscopic methods: UV-visible and IR spectrometry; principles and instrumentation. Separation techniques. Gas chromatography principles, instrumentation and applications **(10 hours)**
- Eletrophoresis: apparatus and applications. Ion exchange: synthetic ion-exchange materials; mechanism of ion-exchange, selectivity, various applications. Solvent extraction, fundamental principles, practical considerations and applications. **(8 hours)**

B. Practicals **(30 hours)**

Acid-base Titration **(4 hours)**

- Standardisation of hydrochloric acid, sodium hydroxide with sodium carbonate and sulphamic acid respectively.

Application of Neutralisation titrations **(16 hours)**

- Determination of sodium carbonate in an impure salt.
- Determination of sodium carbonate and sodium bicarbonate in a mixture.
- Determination of carbonate and hydroxide in solution.
- Analysis of sodium carbonate and bicarbonate in rock salt.
- Analysis of various types of cement, Hima, Bambuli, Tanga and Tororo Cement.
- Determination of ammonia in an ammonium salt.
- Determination of Boric acid.
- Analysis of pharmaceutical preparations.

Oxidation – Reduction Titrations **(8 hours)**

- Standardization of $KMNO_4$ against Arsenic (III) oxide.
- Determination of iorn(II) and Iron (III) in solution.
- Determination of total iron in environmental samples.

Argentiometric titrations **(8 hours)**

- Standardization of silver nitrate solution.
- Determination of chloride by the volhard method.
- Determination of chloride by Fajans method.
- Analysis of Katwe, Magadi and rock salts.

Iodometric titrations **(8 hours)**

- Standardization of thiosulphate solution.
- Analysis of copper in an ore from Kilembe.
- Determination of formaldehyde.
- Determination of ammonia in ammonium salt.
- Determination of ammonia in urea –fertilizers.

Complexometric titrations **(16 hours)**

- Preliminary observation in complex formation
- Standardization of EDTA.
- Determination of total hardness in tap water.
- Determination of calcium and magnesium in the mixture.

- Determination of Ca and Mg in limestone from W. Uganda.
- Indirect determination of sulphate.
- Direct determination of lead.
- Analysis of Bi-Pb, Cd-Sn in alloys.

Mode of Delivery:

Lectures, assignments, practicals

Assessment:

Tests and assignments (20%), Practicals (20%) Examination (60%)

vi) Course Name : INORGANIC CHEMISTRY II

Course Level : 1

Credit Unit : 3 CU

Brief course description:

This course covers the descriptive chemistry, nuclear chemistry and coordination chemistry of the elements and their applications in everyday life.

Course objectives:

i) To enable students to learn some descriptive principles of main group chemistry, transition metal chemistry, and coordination chemistry, and their applications in real life. The course will emphasize the trends from Inorganic I and how they can be used to understand the unique chemical properties of each element.

ii) To enable students to understand how theoretical principles can be applied to descriptive reactions.

iii) To enable the student to understand the theory of complex formation and their utility in modern chemistry.

Detailed description:

- Review of bonding theories and periodicity from Inorganic I. (**2 hours**)
- Acids and Bases – Lewis acid/base theory, hard/soft acids and bases, superacids. (**5 hours**)
- Inorganic electrochemistry – half-cell potentials, oxidation states, Latimer diagrams. (**5 hours**)
- Nuclear chemistry – nuclear decay, nuclear stability (**5 hours**)
- Descriptive chemistry of the main group elements (groups 1-8) (**7 hours**)
- Coordination chemistry – Introduction, naming, and theories of transition metal complex formation, physical properties of transition metal complexes, including magnetic properties, colour, stability, and reactivity. (**10 hours**)
- Descriptive chemistry of the transition metal elements (**8 hours**)
- Descriptive chemistry of the lanthanides and actinide elements (**3 hours**)

Mode of delivery:

Lectures, assignments, tests and tutorials

Assessment:

Course work (tests, assignments) 30%, Examination (70%)

vii) Course Name : INORGANIC PRACTICAL II

Course Level : 2

Course Credit : 2 CU

Brief Course Description:

This advanced laboratory course emphasizes synthetic procedures and analytical techniques used by chemists in the synthesis of modern inorganic materials and molecules.

Course Objectives:

- To give students experience in synthesizing inorganic materials and molecular structures using a variety of synthetic techniques.
- To enable students carry out a variety of comparative chemical reactions and perform stoichiometric calculations.
- To enable students to characterize and quantify specific constituents.
- To enable students properly store and safely handle a variety of chemical materials.

Detailed Course Description:

This course involves practical inorganic syntheses of the following substances:

Tin(II) chloride, tin (IV) iodide, copper(I) chloride, sodium thiosulphate hydrate, potassium tris(ethanedioato)-aluminate (III), cis- and –trans-potassium bis (ethanedioato)diaquachromate (III), nitro- and nitritopentaminecobalt (III) chloride, dipyridineiodine (I) nitrate, tris (thiourea)-copper(I) sulphate, dichloro-bis(2,4-pentanedionato)titanium (III), and potassium tris(ethanedioato)manganese(III).

As an alternative to the above, with materials permitting the following inorganic substances may also be considered for synthesis of:

- High temperature superconductors, ferromagnetic compounds, zeolite, pillared clays, magnetic compounds, solid-state compounds synthesized in a high temperature furnace, and others.
- $[Co(NH_3)_5Cl]Cl_2$, $Mn(acac)_3$, $[Co(en)_3]Cl_3$, $CrCl_2(H_2O)_4^+$, $Cr(acac)_3$, $[Cr(NH_3)_5](NO_3)_3$, $Cu(O_2CCH_3)$, $[Co(en)_2Cl_2]Cl$, Co(salen), $K_4Mo_2Cl_8$, and others.
- ICl_3, GeH_4, $K_2S_2O_8$, $PhBCl_2$, siloxane polymers, adducts, and others.
- $Cp_2Fe(CO)_4$, $Ir(Cl)(CO)(PPh_3)_2$, Cp_2Fe, Cp_2Ni, $Fe_3(CO)_{12}$, $PtCl_2$(1,5-cyclooctadience, and others.

Mode of delivery:

Laboratory talk, hands-on with equipment and reagents

viiii) Course Name : ORGANIC CHEMISTRY II

Course Level : 2

Course Credit : 4 CU

Brief description

The course deals with the chemistry of polyfunctional aliphatic and alicyclic compounds. The compounds in the two groups are discussed with respect to methods of preparation, nomenclature and chemical reactions.

Course objectives:

By the end of this course, students should be able to:

- Define and propose structures for selected common Polyfunctional compounds
- Predict products of 1,2-and 1,4-addition reactions between compounds known as dienes with selected reagents
- Suggest Diene-Dienophile combinations that will give you a desired Diels-Alder adduct.
- Predict and show products for reactions between epoxides (Oxiranes) and common reagents
- Show that in vicinal diols one of the hydroxyl groups is more reactive than the other
- Demonstrate that vicinal diols undergo oxidative cleavage reactions
- Formulate a mechanism for oxidative cleavage of vicinal diols

Detailed Course Description

- Polyfunctional aliphatic compounds ,occurence and applications **(3 hours)**
- Dienes and their reactions **(3 hours)**
- Diols and their reactions **(5 hours)**
- Epoxides and their reactions **(4 hours)**
- Dicarbonyl compounds and their reactions **(4 hours)**
- Synthetic methods and reactions of alicylic compounds **(7 hours)**
- Stability and stereochemistry of selected cyclic systems **(4 hours)**
- **Practicals** **(60 hours)**

Mode of Delivery:

Lectures, assignments, tutorials and practicals

Assessment:

Tests and assignments (20%), Practicals (20%), Examination (60%)

ix) Course Name : AROMATIC CHEMISTRY I
Course level : 2
Course Credit : 2CU

Brief Course Description

This course deals with the reactions commonly encountered with benzene as an aromatic nucleus. The conditions that influence substitution reactions in benzene are covered. Fused benzene compounds (polynuclear aromatics) namely naphthalene, anthracene, and phenanthrene are investigated and contrasted with their aromaticity.

Course Objectives:

At the end of the course, students should be able to:

- Explain why benzene though highly unsaturated is inert toward addition reaction
- Learn that benzene is more activated towards electrophilic substitution.
- Predict and write equations of such reactions with clear mechanisms.
- Account for the rate and direction of electrophilic substitutions
- Synthesize or make large aromatic molecules from simple ones.
- Appreciate and apply aromatic chemical principles to solve real life problems such as synthesis of dyes, indicators, etc.

Detailed Course Description

- Aromaticity and its effects on the benzene ring reactions. **(3 hours)**
- Benzene substituent qroups' effect in electrophilic aromatic substitutions **(5 hours)**
- Ortho to para (o:p) ratio in electrophilic aromatic substitutions **(2 hours)**
- Aromatic amino compounds and the mechanisms of their conversions to diazonium salts. **(2 hours)**
- Reactions of diazonium salts involving loss of the nitrogen molecule and those where it is retained. **(6 hours)**
- Nucleophilic aromatic substitution reactions of benzene **(4 hours)**
- Molecular rearrangement reactions involving electron-deficient carbon, nitrogen and oxygen and those triggered electron-rich carbon **(3 hours)**
- Introduction to the chemistry of fused benzene compounds (polynuclear aromatics) namely naphthalene, anthracene and phenanthrene in terms of synthesis, properties and reactions. **(5 hours)**

Mode of Delivery:

Lectures, assignments, tests

Assessment:

Tests and assignments (30%), Examination (70%)

x) Course Name : SUGAR AND PROTEIN CHEMISTRY

Course Level : 2

Course Credit : 2 CU

Brief Course Description:

Carbohydrate chemistry – monosaccharides, tetrasaccharides and polysaccharides. Nature of linkages in polysaccharides. Amino acids, polypeptides (proteins). 3-D structure of proteins. RNA and DNA.

Course objectives.

At the end of the course, the student is expected to:

- Distinguish different classes of sugars
- Account for the linkages between the monomers in the complex sugars
- Analyse the composition of a given peptide
- Account for the structure of proteins
- Identify the components of nucleic acids.

Detailed Course Description

- Carbohydrates: configuration, classification, Killian reaction applied to glyceraldehyde **(2 hours)**
- Tetroses, aldopentoses ring structure of aldopentoses, aldohexoses and ketohexoses **(3 hours)**
- Reactions of monosaccharides, eg. Mutarotation, osazone formation, isopropylidines derivative, reduction and oxidation. **(4 hours)**
- Action of acids and alkalis. **(1 hour)**
- Determination of ring sizes of monosaccharides, including glyco-splitting reagents.Structures of di-, tri-, and tetrasaccharides and their determination **(4 hours)**
- Amino acids: configuration, nomenclature, Strecker synthesis,amino acids as dipolar ions **(2 hours)**
- Analysis of amino acids: reaction with nitrous acid, the ninhydrin test, and their mechanisms sulfur containing amino acids **(2 hours)**
- Introduction to the chemistry of peptides and proteins. Structures of peptides: polymers of amino acids. **(3 hours)**
- Isolation of proteins from natural products: structure elucidation of proteins, hydrolysis and identification of products, determination of the amino acid sequences **(4 hours)**
- Difficulties encountered in structure analysis of proteins, synthesis of peptides and proteins. 3-D structure of proteins. **(3 hours)**
- Polysaccharides, nucleosides and nucleotides (RNA and DNA) **(2 hours)**

Mode of Delivery:

Lectures, assignments and tutorials.

Assessment:

Tests and Assignments (30%), Examination (70%)

xi) Course Name : PHYSICAL CHEMISTRY II

Course Level : 2

Course Credit : 4CU

Brief course description:

- Chemical kinetics and applications to elementary, composite and complex reactions
- Review of properties of ideal and real gases
- Basic thermodynamics principles and their applications to the liquefaction of gases and to the Carnot cycle
- Thermochemistry; the second and 3rd laws of thermodynamics

Course objectives:

Students should be able to:

- understand the basic principles of chemical kinetics, thermodynamics, and gases, and to apply them to solving problems in science.
- apply the basic principles of calculus to the concepts in chemistry.
- solve problems in physical chemistry from numerical, analytical, and graphical perspectives.

Detailed description:

- **Chemical Kinetics**

  Rate equations for chemical reactions. Determination of reaction orders. Experimental methods. Examples of zero order, 1st, 2nd and 3rd order reactions in gas and solution phases. Energy of activation, the Arrhenius equation. Introduction to theories of gas-phase reactions: collisions theory, transition state theory. Unimolecular reaction theory. Introduction to reactions in solution and homogeneous acid-base catalysis. (**12 hours**)

- **Review of gases**

  Properties of real and ideal gases, critical constants, compressibility factor (**3 hours**)

- **First Law of Thermodynamics**

  Heat, work, internal energy, enthalpy, thermodynamically reversible and irreversible processes, state functions, heat capacities of gases, isothermal and adiabatic expansions (**5 hours**)

- **Thermochemistry**

  Hess' Law, standard, enthalpies of formation, bond energies. (**4 hours**)

- **Second and Third Laws of Thermodynamics**

  Carnot's cycle, entropy, calculation of entropy changes, measurement of entropy, entropy and probability, Gibb's Free energy. **(6 hours**)

- **Practicals** **(60 hours)**

Mode of delivery:

Lectures, assignments, practicals and tutorials

Assessment:

Tests and assignments (40%) and Examinations (60%)

xii) Course Name : TRANSITION METAL CHEMISTRY

Course Level : 2

Course Credits : 2 CU

Brief Course Description

General characteristics of transition elements of the *d*- and *f*-blocks. Theories of transition metal complex formation: crystal field theory; molecular orbital theory and ligand field theory. Stability and application of transition metal complexes; and ligand substitution reactions of metal complexes. Brief comparative chemistry of lanthanides and actinides

Course Objectives

At the end of the course, the learner is expected:

- To review and outline the general physical and chemical behaviour of transition elements that are entirely or largely restricted to themselves and not shared by the main group elements.
- To know and summarize concepts of metal complex formation and hence its application in a variety of fields including quantification of analytes, separation of interferences and extraction of metals.
- To write mechanisms of ligand substitution reactions in square planar and octahedral complexes, an area that has rapidly grown in importance in the last three decades.
- To know and account the descriptive chemistries of the *d*- and *f*-block elements and be able to compare and contrast trends in similarity thereof.

Detailed Course Description.

- **General characteristics of transition elements (4 hours)**

Introduction, Variable oxidation states, Exhibition of colours, High tendency to form complexes, Exhibition of paramagnetism, Determination of paramagnetsim

- **Transition metal complex formation (4 hours)**

Constituents of a metal complex, Metal complex *Vs* Coordination compound; Primary and secondary bond interaction in coordination compounds; Shapes of metal complexes; Nomenclature of metal complexes; Isomerism of metal complexes

- **Theories for metal complex formation (4 hours)**

Valence Bond Theory (VBT); Crystal field theory (CFT); Molecular orbital theory (MOT)

- **Thermodynamic stability of metal complexes (4 hours)**

Thermodynamic and kinetic stability; Stability constants; Determination of stability constants; Factors influencing stability of metal complexes; Class A and Class B metals; Applications of stability constants

- **Kinetics of ligand substitution reactions of transition metal complexes (4 hours)**

Labile and inert metal complexes; Factors affecting the lability or inertness of metal complexes; Mechanisms of ligand substitution reactions;

- **Chemistry of period 4 d-block elements and their compounds (2 hours)**

Introductory remarks; Some physical properties of the elements; Important halides of the elements; Important oxides of the elements; The Chemistry of Titanium and its compounds.

- **Comparative chemistry of periods 5 and 6 d-block elements and their compounds (4 hours)**

Introduction; Some physical properties of the elements; Important halides of the elements; Important oxides of the elements

- **Comparative chemistry of periods 6 and 7 f-block elements (4 hours)**

Introductory remarks; Some physical properties of lanthanides and actinides; Lanthanide contraction; Oxidation states; Magnetic and spectral properties; Brief comparative chemical behaviour of lanthanides and actinides

xiii) Course Name : ORGANIC CHEMISTRY III

Course Level : 2

Course Credit : 2 CU

Brief Course Description

This course covers basic principles of physical organic chemistry and elements of stereochemistry.

Course Objectives

This course is intended to enable students:

- To understand and predict organic reactions.
- To review definitions of acids and bases and organic compounds on basis of Lewis and Bronsted theories
- To review and write mechanisms of nucleophilic substitution reactions and conditions which affect them.
- To explain elimination and addition reactions and conditions that affect them
- To understand and interpret stereochemistry of organic compounds and implications on organic reactions

Detailed Course Description

- **Acids and bases (4 hours)**

Lowry –Bronsted theory and the Lewis theory, Strong and weak acids and bases, factors which affect acidity,

- **Nucleophilic substitution reactions (8 hours)**

Common categories of nucleophilic reactions, S_N1 and S_N2 mechanism and their characteristics

Factors which affect substitution reactions including, Mixed $S_N1 – S_N2$, Merged mechanism,

The Doering – Zeiss structural hypothesis, The dual ion pair and the unifying ion pair,

- **Addition and elimination reactions** **(4 hours)**

Polar elimination and addition reactions, E1 and E2 mechanisms, Regioselectivity of Elimination reactions

- **Basic Stereochemistry** **(8 hours)**

Optical and geometrical isomerism, Enantiomers, absolute and relative configurations.

Conventions for assigning configurations, chirality, stereocenters and geometrical isomerism,

- **Application of stereochemistry principles** **(6 hours)**

Formation of stereoisomers and resolution of racemic mixtures, conformation and stereochemistry of some cyclic systems and how it affects their reactivity.

Mode of Delivery:

Lectures, assignments, tests and tutorials

Assessment:

Tests and assignments (30%), Examination (70%)

xiv) Course Name : ENVIRONMENTAL CHEMISTRY

Course Level : 2

Course Credit : 2 CU

Brief course description:

The course explores environmental issues from the Chemistry point of view.

Course objectives:

- To enable the students understand and solve environmental problems arising from industry, use of agrochemicals and other human activities, with emphasis to both the Ugandan environment and the global environment

Detailed description:

- Fundamental definitions in Environmental Chemistry **(2 hours)**
- Properties of water and Aquatic Chemistry **(4 hours)**
- Oxidation and reduction Phenomena **(4 hours)**
- Water pollution and water treatment **(4 hours)**
- Inorganic and organic pollutants **(3 hours)**
- Greenhouse gases and global warming **(2 hours)**
- Waste management **(2 hours)**
- Energy resources **(3 hours)**
- Mitigation measures against chemical pollution **(2hours)**
- Conventions, protocols, agreements, to protect the environment **(2 hours)**

Mode of delivery:

Lectures, field work, modules, assignments and tutorials

Assessment:

Field work, tests and assignments (40%), and final exams (60%)

xv) Course Name : QUANTUM CHEMISTRY

Course Level : 2

Course Credit : 3 CU

Brief course description:

The application of quantum mechanics to fundamental problems in chemistry

Course objectives:

At the end of the course students will be able to:

- understand the basic models of quantum mechanics and be able to apply them to problems in physical chemistry.
- apply the basic principles of calculus to concepts in physical chemistry.
- demonstrate that quantum mechanics is needed to describe the world around us, and how it is related to descriptive chemistry.
- demonstrate the importance of computers in analyzing the electronic structure of molecules, and to introduce students to this critical tool in understanding chemical reactions.

Detailed description:

Fundamental Concepts

- Failures of classical mechanics, wave-particle duality, Schrodinger equation, eigenfunctions. (**6 hours**)

Model Systems

- Particle-in-a-box, harmonic oscillator, rigid rotor, hydrogen atom, spectra of vibrations and rotations (**20 hours**)

Atoms and Molecules

- Multielectron atoms, aufbau principle, quantum mechanics for molecules (**8 hours**)

Computational methods

- Huckel theory, self-consistent field theory, Hartree-Fock theory, approximate treatments, *ab initio* treatments (**11 hours**)

Mode of delivery:

Lectures, modules, assignments and tutorials

Assessment:

Tests and assignments (30%), and final exams (70%)

xvi) Course Name : SPECTROSCOPY

Course Lev el : 2

Course Credit : 2 CU

Brief Course Description

Various spectroscopic techniques, such as Infrared (IR), Ultra Violet (UV), Nuclear Magnetic Resonance (NMR), Mass Spectrometry (MS), will be discussed and then used to identify functional groups in compounds. The combined spectral data of a given unknown compound then be evaluated to identify the actual structure of the unknown compound.

Course Objectives

By the end of the course, the student should be able to:

- Identify simple unknown organic compounds on the basis of their functional groups using infrared spectroscopy
- Apply splitting patterns for sets of adjacent protons to given substances.
- Identify the molecular formula of a compound by mass spectrometry
- Relate characteristic MS fragmentation patterns with compounds that have different functional groups
- Determine the presence of conjugated double bonds using ultra violet spectra.
- Formulate fragmentation patterns for simple classes of organic compounds
- Determine the structure of an unknown compound by combining information from IR, UV, NMR and MS.

Detailed Course Description

- **Infrared spectroscopy (8 hours)**

Electromagnetic spectrum and its uses, typical radiation induced molecular vibrations bond and absorption trends, interpretation of the ir spectrum using correlation charts IR characteristics of different functional groups

- **Nuclear Magnetic Resonance (NMR) spectroscopy: (8 hours)**

Magnetic properties of atomic nuclei, spin-spin splitting and its origin, effect of hydrogen bonding on chemical shifts and chemical shifts and the proton environment, chemical shifts of exchangeable protons, electronegativity effect on chemical shifts, hybridisation effect on chemical shifts

- **The mass spectrometer (8 hours)**

Ionization chamber and the ionization process, types of ions formed and the mass spectrum characteristic fragmentation patterns for different classes of compounds, determination of structure using IR, NMR and mass spectrometry

- **Problem solving tutorials** **(6 hours)**

Use of index of hydrogen deficiency, use of correlation charts, interpretation of spectral data Interpretation of real spectra, combination of information from above operations

Mode of Delivery:

Lectures, assignments, spectral data interpretation, tests

Assessment:

Tests and assignments (30%), Examination (70%)

xvii) Course Name : INORGANIC CHEMISTRY III

Course Level : 2

Course Credit : 2 CU

Brief Course Description:

Modern applications of inorganic chemistry namely: organometallic, solid-state, materials, catalysis, and bioinorganic chemistry.

Course Objectives:

Students should be able to:

- apply the theoretical principles of atomic and molecular orbitals, periodic trends, acid/base theory, and electrochemistry to modern problems in inorganic chemistry.
- understand and interpret the modern trends in the field of inorganic chemistry

Detailed Description:

- **Solid state chemistry**
  Solid state structures, synthesis of solid state compounds, ceramics, modern solid state materials, including semiconductors and superconductors. (**8 hours**)
- **Crystal Chemistry**
  Factors determining structure of crystalline solids: bond types, stoichiometry, radius ratio, lattice energy, and temperature. **(3 hours)**
- **Organometallic chemistry**
  Stability of early and late transition metal organometallic compounds, reactions involving organometallic chemistry, spectroscopy of organometallic chemistry, uses of organometallic molecules in modern catalysis. (**7 hours**)
- **Modern materials**
  Nanomaterials and polymers. Such as nonlinear optical materials, thin films, liquid crystals, biomaterials, plastics, nanowires, and coatings. (**8 hours**)
- **Bioinorganic chemistry.**
  Nitrogen fixation catalysts, metalloporphyrins, electron transfer proteins, trace elements in biological systems, and enzymes containing metals. **(4 hours)**

Mode of Delivery:

Lectures, modules, assignments and tutorials

Assessment:

Tests and assignments (30%), and final examinations (70%)

xviii) Course Name : POLYMER CHEMISTRY

Course Level : 2

Course Credit : 2

Brief Course Description:

This course will cover the fundamentals and physico-chemical aspects of polymerisation and its applications to modern science. All the basic concepts of polymerisation and polymer characterization will be covered.

Course Objectives:

At the end of this course students will be able to:

- Classify polymers.
- Outline the step chain and condensation polymerisation processes and methods of carrying them out.
- Evaluate rate constants for free radical polymers, ionic polymerisation, and co-polymerisation processes.
- Derive the co-polymer equation and evaluate monomer activity ratios.
- Outline the kinetics of polymerisation processes.
- Outline theories and methods of performing polymerisation processes.
- Determine formula masses of polymers using characterisation, distribution, fractionation, sedimentation, viscometry and osmometry methods.

Detailed Course Description

- History and classification of polymers: Natural, synthetic and condensation addition polymers. Physical chemical aspects of polymerisation reactions. **(4 hours)**
- Structures of condensation polymers, functions of polymers in modern science. Natural, synthetic, free radical, emulsion, ionic and solution polymerisation types. **(5 hours)**
- Kinetics of polymerisation: initial, propagation, terminal and transfer rates. Initiator and transfer agents coefficient **(4 hours)**
- Copolymerisation: definition, types and reactivity ration evaluation. **(2 hours)**
- Ionic polymerisation (cationic and anionic) mechanisms, rates evaluation for initial, termination and propagation process. **(3 hours)**
- Solution polymerisation: methods and theories.
  Mechanisms of methylmethacrylate polymerization **(4 hours)**

- Distribution of molar mass, fractionation, light scattering **(3 hours)**
- Distribution of molar mass: sedimentation viscometry **(2 hours)**
- Distribution molar mass: osmometry **(2 hours)**

Mode of Instruction:

Lectures, assignments, tests

Assessment:

Tests and assignments (30%), Examination (70%)

xix) Course Name : AROMATIC CHEMISTRY II

Course Level : 2

Course Credit : 2CU

Brief Course Description

Non-benzenoid conjugated carbocyclic polyene compounds and conjugated heterocyclic compounds are covered in this course with consideration of the structures, aromaticities and reactions.

Course Objectives:

By the end of the course the students will be able to:

- Show that aromaticity exists in some carbocyclic polyenes and heterocycles.
- Appreciate and write the essential conditions for the presence of aromaticity in a molecule or structure.
- Interpret the behaviour and characteristics of cyclic conjugated polyene substances with respect to their level of aromaticity
- Outline the characteristics of conjugated heterocyclic molecules in terms of the lone pairs of electrons contained on the heteroatom and those in the ring.

Detailed Course Description

- Evidence for presence of aromaticity in benzenoid and heterocyclic systems and conjugated cyclic polyenes of up to 18 carbon atoms. **(4 hours)**
- Cyclobutadiene and its reactions **(2 hours)**
- Synthesis, properties and reactions of cyclopentadienide ion **(4 hours)**
- Synthesis, properties and reactions of tropones, tropolones, and azulenes **(8 hours)**
- Synthesis, properties and electrophilic substitution of five-membered heterocycles, namely: furan, thiophene and pyrrole **(8 hours)**
- Synthesis and nucleophilic substitution reactions of pyridine **(2 hours)**
- Synthetic methods for indole, quinoline and isoquinoline **(2 hours)**

Mode of Delivery:

Lectures, assignments and tutorials

Assessment:

Tests and assignments (30%), Examination (70%)

xx) Course Name : INSECTICIDES CHEMISTRY

Course Level : 2

Course Credit : 2CU

Brief Course Description

This course generally discusses the naturally occurring plant insecticides. Emphasis is put on the safe or environment friendly compounds specially pyrethroids, rotenoids, affinin, etc, with respect to their structure, mode of insecticidal action, and current use. The above compounds will be contrasted with chlorinated hydrocarbon insecticides, phosphorus- containing, and carbamate insecticides. Novel methods of insect control, namely sex attractants, food lures, chemical repellants, antifeedant compounds, chemosterilants, anti-metabolites, insect hormones and growth regulators will be covered.

Course Objectives

At the end of the courses student should be able:

- To identify and differentiate insecticides that are less dangerous to man and his environment.
- To know and promote by way of synthesis environmentally-friendly insecticides that are similar to those that are produced naturally by plants.
- To identify and promote other aspects of insect control mechanisms other than insecticides usage.
- To advise on policy for insecticide usage.

Detailed Course Description

- Definitions of review of naturally occurring plant-based insecticides such as nicotine, affinin, rotenoids and pyrethroids. **(3 hours)**
- Synthesis of some pyrethroid-based insecticides with special emphasis on structure, mode of action, and current applications. **(3 hours)**
- Other synthetic insecticides to be investigated and evaluated in terms of structures, insecticidal potency and mode of action will include:
  - Organo-arsenicals, dinitrophenols, and organothiocyanates. **(3 hours)**
  - Organochlorine insecticides, namely DDT and its analogues like lindane and cyclodienes (chlordane, Aldrin, and Dieldrin) **(7 hours)**
  - Organophosphorus namely shradan, parathion, malathion, dichlorvos, diazinon, and phorate **(4 hours)**
- Carbamate insecticides (piricarb, carbaryl, and aldicarp **(4 hours)**

Other novel methods will include insect pheromones (sexattractants and food lures),

chemical repellants, antifeedant, chemosterilant and antimetabolite compounds, and growth-regulating hormones. **(4 hours)**
- Fieldwork **(2 hours)**

Mode of Delivery:
Lectures, fieldwork, assignments, tutorials

Assessment:
Tests and assignments (30%), Examination (70%)

xxi) Course Name : ANALYTICAL CHEMISTRY II

Course Level : 2

Course Credit : 2 CU

Brief Course Description:

This course discusses the basic equipments used in modern chemical analysis. The techniques include among others, magnetic susceptibility measurements, UV-Vis, NMR, IR, X-Ray diffraction, polarimetry, chromatography, conductivity, atomic absorption.

Course Objectives

Students should be able:

- To handle and use modern chemical instruments.
- To interpret instrumental data in terms of both qualitative and quantitative aspects of substances.

Detail course Description

- Instrumentation of photometers: fluorescence, flame, I.R, UV-visible, spectroscopy **(4 hours)**
- Features of emission and absorption spectroscopy **(2 hours)**
- Non-flame devices of analysis: x-ray, neutron, electron analysis. **(4 hours)**
- Differences between IR, U.V-visible spectroscopy instruments. **(3 hours)**
- Characteristics of IR absorption bonds, chromophoric group **(3 hours)**
- Beer's Law and its limitations with regards to light absorption. **(3hours)**
- Quantitative analysis of mixtures and photometric titrations; standards used **(3 hours)**
- Flame photometric analyses. **(2 hours)**
- Electrochemical methods: conductivity, potentiometry and polarography. **(4 hours)**
- Hyphenated methods of analysis **(2 hours)**

Mode of Delivery:

Lectures, assignments and tutorials.

Assessment:

Tests and assignments (30%) and Examination (70%)

xxii) Course Name	**:**	**APPLICATIONS OF GROUP THEORY IN CHEMISTRY**
Course Level	**:**	**2**
Course Credit	**:**	**2 CU**

Brief Course Description:

Introduction of group theory and its applications in Chemistry. Symmetry, symmetry elements, symmetry operations, point groups and space groups. Use of concepts of mathematical groups to identify operations in a point group. Character tables and irreducible representations. Group theory applications to molecular vibrations, orbitals, spectra and magnetism.

Course objectives.

At the end of the course, the student will be able to:

- Explain symmetry, symmetry elements, symmetry operations, point groups, and space groups.
- Define a group and derive character tables
- Write the reducible and irreducible representations of a symmetry operation.
- Draw and interpret Orgel and Tanable-Sigano diagrams for transition metal complexes.
- Calculate magnetic susceptibilities of a variety of substances.

Detailed Course Description

- Symmetry in nature and compounds: symmetry elements & operations **(2 hours)**
- Point groups and space groups: examples and their elements **(2 hours)**
- Mathematical groups: characteristics of a point group and illustrations Using C_3U point group **(2 hours)**
- Matrices, matrix multiplications and multiplication tables **(2 hours)**
- Character tables, derivation and use **(2 hours)**
- Generalizations about character tables for point groups **(2 hours)**
- Reducible and irreducible representations **(2 hours)**
- Single-electrons and multi-electrons systems, degeneracy, lifting degeneracy **(3 hours)**
- Racah parameters, F-terms of energy **(2 hours)**
- Spectra of complexes: splitting patterns **(2 hours)**
- Forbidden and allowed electrons transition in spectra complexes **(2 hours)**
- Magnetic properties of materials: classification and relative magnitudes of magnetic moments **(2 hours)**
- Variations of dia-para-antiferro-magnetism with temperature **(3 hours)**
- Magnetic susceptibility values of substances **(2 hours)**

Mode of Delivery:

Lectures, assignments and tutorials

Assessment:

Tests and assignments (30%), Examination (70%)

xxiii) Course Name : DIVALENT SPECIES

Course Level : 2

Course Credit : 2 CU

Brief Course Description:

The methylene (:CH_2, carbene) species and its derivatives will be covered in terms of preparations and reactivity. Its insertion reactions involving cyclic aromatic and non-aromatic molecules, alkenes, alkynes, amino-containing compounds will be covered.

Course Objectives.

By the end of the course, the learner should be able to:

- Outline sources of carbenes (divalent species)
- Account for the reactivity of carbenes
- Synthesize a variety of molecules
- Write reaction mechanisms involving carbenoid species.

Detailed Course Description

- Definition and structure of carbenes **(1 hour)**
- Preparation of dihalocarbenes (:CX_2) from trihalomethane, dicarboxylation of trihaloacetates, basic cleavage of trichloroacetate and thermodecomposition of organometallic trihallides. **(2 hours)**
- Reactivity and mechanism involved in dihalocarbene attack by (a) Insertion on benzothiopyrans, 2,5-dihydrofuran, para di-isopropyl benzene Tetralin, diphenyl methane and cyclohexane, (b) addition on indene, benzofuran, aliphatic ketene, acetals, cyclopentene, enamines, methoxynaphtalenes, anisole, dihydroanisole, ethyne, aliphatic ethers, phosphines and anions. **(8 hours)**

(c) Insertion and addition with nitrogen compounds namely triethylamine, trimethyl amine, benzyl dimethylamine, aminobenzene, pyrrole and its derivatives, N-methylaminobenzene, N,N-dimethyl amino benzene, iminium salts. **(4 hours)**

- Preparation of chlorocarbenes and its reactions with hydroxybenzenes, pyrrole, indole, cyclooctatetraene, triphenylphosphine and benzene **(4 hours)**
- Carboalkyl carbenes – formation; its insertion reaction into C-H bonds, addition to alkenes and alkynes.

- its reactions with heterocycles, carbonyl compounds, ethers, diazirine, hydrocarbons, methylhalides, methylene halides and ylides.
- its reactions with hydrogen, carbon monoxide, carbon dioxide, oxygen and nitric oxide.
- its reactions with C-H bond by way of insertion and abstraction **(6 hours)**

- Decomposition of diazomethane (CH_2N_2) using various catalysts. **(1 hour)**
- Reactions of :CH_2 (carbene) with dienes, aromatic compounds, C-H, and C-O bonds and organometallic compounds. **(4 hours)**

Mode of Instruction:

Lectures, assignments, tests.

Assessment:

Tests and assignments (30%), Examination (70%)

xxiv) Course Name : THERMODYNAMICS

Course Level : 2

Course Credit : 3 CU

Brief Course Description

This course will cover the following topics: free energy, intensive and extensive state functions, the concept of chemical potential, chemical equilibrium, the phase equilibria, thermodynamics of mixing, colligative properties of solutions, and statistical thermodynamics

Course Objectives

This course is intended to enable students:

- predict chemical processes basing on thermodynamic principles
- relate the properties of a system to the energy transfers within individual particles
- understand and apply the laws of thermodynamics on a molecular level.

Detailed Course Description

Free energy **(3 hours)**

- relationship to other state function
- variation with temperature and pressure
- Gibbs-Helmholtz equations.

Intensive and extensive state functions **(2 hours)**

- partial molar quantities and their measurement.

The concept of chemical potential **(4 hours)**

- Dependence of chemical potential on pressure and mole fraction.
- Non-ideal gases: fugacity and its measurement.

Chemical equilibrium **(3 hours)**

- reaction isotherm, equilibrium constant, Van't Hoff equation
- Factors affecting position of equilibrium: Le Chatelier principle. Thermodynamic conditions for equilibrium between phases. Clausius - Clapeyron equation

The phase equilibria **(6 hours)**

- The phase rule
- One-component systems: water, sulphur.
- Two component systems:
- Solubility of gases in liquid, Henry's Law, effect of temperature on solubility, ideal solubility of non-ionic solids in liquids.
- Phase diagrams for two component solid-liquid systems.
- Introduction to three-component

Thermodynamics of mixing **(6 hours)**

- Homogenous liquid mixtures
- Raoult's law and its deviations
- Partial miscibility, Immiscibility, partition between solvents.
- Boiling point Vs composition diagrams, Steam distillation.
- Choice of standard states for non-ideal solutions.

Colligative properties of solutions: **(9 hours)**

- vapor pressure lowering, elevation of boiling point, depression of freezing point, osmotic pressure

Statistical Thermodynamics: **(9 hours)**

- Thermodynamic and Non-Thermodynamic properties,
- Microstates, configurations, ensembles,
- relationship between thermodynamic probability and entropy,
- Boltzmann distribution law and molecular energy levels,
- statistical interpretation of Second and Third Laws of Thermodynamics.

Lasers

- Properties of lasers, use of lasers in chemistry. (**3 hours**)

Mode of Delivery

Lectures, assignments and tutorials

Assessment

Tests and assignments (30%) and examination (70%)

xxiv) Course Name : COLLOID CHEMISTRY

Course Level : 2

Course Credit : 3 CU

Brief Course Description

This course will give an overview of the fundamental principles of colloid and surface chemistry. Theoretical background to thermodynamics of surface tension, physical and chemical basis of adsorption and related experimental methods will be covered in details.

Course Objectives

This course is intended to enable students to:

- Explain and account for the action of detergents
- Derive equations and account for wasteful washing with soap and hard water

Detailed Course Description

- **Surface Tension its determination and measurement;** Equation of Young and Laplace contact angle; Kelvin equation Surface activity, micelle formation, Consentration changes within an Interface, surface (excess) concerntration, relative adsorption, Gibbs adsorptionequation Traube's sule.

"Two dimensional " Gas law,

- **Cohesion, adhesion and spreading, wetting;** detergency, solubilization. Liquid repellence, Floatation of minerals, Insoluble films on water.
  Measurement of surface pressure, phase changes in films

- **Adsorption of gases on solids:** physical and chemical. Classifications of isotherms. Freundlich and Langmuir equations. Chemisorption and catalysis.
  Brief account of adsorption on solids from solutions. Adsorption leading to multilayer formation – B. E. T. equation.

- **Colloidal dispersions:** Classification, preparation, stabilization and purification of sols, coagulation of lyo phobic and Lyophilic sols. Introduction to electro Kinetic phenomena, kinetic and optical properties of colloids.
- **Heterogeneous catalysis and kinetics of surface reactions:** Specific surface area by B.E. T and Harkins – Jura methods, Electrical double layer and the DVLO theory, Average molar mass by Kinetic and Electrokinetic propertries, Molecular mass (molecular weight) from film studies.
- **Suggested Teaching Program**

I. Surface Tension its determination and measurement: (6 hours)

- Equation of Young and Laplace contactangle;
- Kelvin equation
- Surface activity and micelle formation
- Concentration changes within an Interface
- Surface (excess) concentration, relative adsorption
- Gibbs adsorption equation
- Traube's rule. " Two dimensional" Gas law,

II. Cohesion, adhesion and spreading, wetting (4 hours)

- Detergency and solubilization
- Liquid repellence
- Floatation of minerals and Insoluble films on water
- Measurement of surface pressure, phase changes in films

III. Adsorption of gases on solids: (6hours)

- Physical and chemicaladsorptions
- Classifications of isotherms
- Freundlich and Langmuir equations
- Chemisorption and catalysis
- Adsorption leading to multilayer formation – B. E. T equation.

IV Colloidal dispersisions: (6hours)

- Classification, preparation, stabilization and purification of sols
- Coagulation of lyo phobic and lyophilic sols
- Kinetic and optical properties of colloids

V. Heterogeneous catalysis and kinetics of surface reactions: - (6 hours)

- Specific surface area by B. E. T and Harkins – Jura Metods
- Electrical double layer and the DVLO theory
- Average molar mass by Kinetic and Electrokinetic properties
- Molecular mass (molecular weight) from film studies.

VI. Course review

- Review of the sections that need clarifications as pointed out by students.

Mode of Delivery

Lectures, practicals, assignments and tutorials

Assessment

Practicals, course tests and assignments (40%) and examination (60%)

Materials/Equipment (for the entire Chemistry programme):

Balances (top-pan and analytical), ice-making machine, U.V. spectrophotometers. Nuclear magnetic resonance (NMR), atomic absorption spectrometer (AAS), Gas chromatogram/Mass spectrometer (G.C/M.S.), differential scanning calorimeter x-ray diffraction machine, bomb calorimeters, automatic viscometer, magnetic susceptibility balance, micro- analytical balance, steam distillers, water deionisers, pH meters, polarimeter, IR spectrometer, high pressure liquid chromatograph (HPLC), high temperature furnace, refrigerators, Bunsen burners, assorted glassware, assorted chemicals and solvents.

MINIMUM REQUIREMENTS FOR COURSES OFFERED BY THE DEPARTMENT OF GEOLOGY (GLO)

i) Course Name : EXTERNAL PROCESSES

Course Level : 1

Course Credit : 3 CU

Brief Course Description

This course covers geological processes that take place on the earth's surface. They include weathering, erosion, transportation and deposition of sediments.

Course Objectives

The objectives of the course are to enable students:

- Understand why and how rocks weather.
- Understand the role of temperature and pressure in mineral stability.
- Understand the principles of geological map reading and interpretation.
- Recognize the role the external process play in forming geomorphological features of the earth.

Detailed Course Description

I. Weathering **(10 hours)**

Chemical weathering, Physical weathering

II. Erosion **(10 hourrs)**

Transportation of sediments, Deposition of sediments.
Transportation and deposition in deserts.

III. Mass movements: **(4 hours)**

Landslides, rock falls, soil creep.

IV. Climate and topography: **(6 hours)**

Hydrologic cycle and Geological field techniques used in mapping

V. Practicals **(30 hours)**

Mode of delivery

The course will be taught by using lectures, tutorials, assignments, and practicals.

Assessment

Assignment and tests	20%
Practicals	20%
Final examination	60%
Total	**100%**

Course Name : LAEONTOLOGY

Course Level : 1

Course Credit : 3 CU

Brief Course Description

This course deals with fossils, taxonomy, the geologic time-scale and the use of fossils in dating.

Course Objectives

At the end of the course students should be able to:

- Use fossils to date or give an age to the different rock strata.
- Understand the role of fossils in the sub-division of the geological time-scale.
- Apply the knowledge of modern living organisms to interpret paleoenvironments.
- Understand that fossils as a record of past life and as evidence to the theory of evolution.
- Understand the origin of man.

Detailed Course Description

I. Fossils: **(10 hrs)**

Definition, uses and conditions of fossilization,

post-depositional changes. Taxanomy

II. The geological time-scale: **(3 hrs)**

Appearance and extinction of organisms. The stratigraphic concepts, Importance of fossils in dating

III. Fossil record: **(17 hrs)**

Characteristics, life span and life style, sedimentary environment, vertebrate, invertebrates and man.

IV. Practicals **(30 hrs)**

Mode of delivery

The course will be taught by using lectures, tutorials, assignments, and practicals.

Assessment

Assignment and tests	20%
Field visits and practicals	20%
Final examination	60%
Total	**100%**

iii) Course Name : CRYSTALLOGRAPHY AND MINERALOGY

Course Level : 1

Course Credit : 3 CU

Brief Description

The course introduces students to various types of crystals and minerals as well as their physical properties and classification.

Course Objectives

At the end of the course students should be able to:

- Identify different minerals based on their physical properties.
- Understand the crystal forms and shapes of various rock-forming minerals.

Detailed Course Description

I. Crystallography: **(14 hrs)**

Historical backgrounds, Crystal symmetry, form internal crystal structure and crystal classes. Crystal indexing and the law of rational indices. Zones and the zone (Weiss) law, projections. Systematic crystallography. Crystal twinning.

II. Mineralogy: **(5 hrs)**

definition of a mineral. Nomenclature of minerals. Economic importance of minerals. Types of minerals. Composition variation of minerals. Principles of mineral chemistry.

III. Physical properties of minerals. **(5 hrs)**

Mechanical optical electrical, magnetic and other properties.

IV. Classification of minerals: native elements, oxides, sulphides, carbonates, halides, silicates, sulphates, phosphates, arsenates and vanadates, borates. **(6 hrs)**

V. Practical **(30 hrs)**

Mode of Delivery

The course will be taught by using lectures, tutorials, assignments, and practicals

Assessment

Assignment and tests	20%
Practicals	20%
Final Examinations	60%
Total	**100%**

iv) Course Name : PETROLOGY

Course Level : 1

Course Credit : 3 CU

Brief Course Description

This is an introductory course on what rocks are, the different rock types, their genesis and evolution processes as well as their relationship to the theory of plate tectonics.

Course objectives

At the end of the course students should be able to:

- Understand the different rock types and how they are formed.
- Identify different rocks.
- Relate the different rocks to various tectonic processes.
- Understand the principles of optical mineralogy, structural and other more advanced courses in geology.

Detailed Course Description

I. Introduction: **(4 hrs)**

Definition, rock types, structure/texture, rock cycle, petrology and plate tectonics.

II. Igneous rocks: **(8 hrs)**

Magma evolution, Magma differentiation, Textures of igneous rocks. Classification.

III. Metarmorphic rocks: **(8 hrs)**

Metamorphism. Types of metamorphism, Textures. Rock types, Nomenclature, Classification, Metamorphic facies.

IV. Sedimentary rocks: **(10 hrs)**

Classification sedimentary environments, Clastic and non-clastic sedimentary processes.

Composition, Textures of clastic and non-clastic sedimentary rocks.

V. Practicals **(30 hrs)**

Mode of delivery

The course will be taught by using lectures, tutorials, assignments, and practicals

Assessment

Assignments and tests	20%
Practicals	20%
Final examination	60%
Total	**100%**

v) Course Name : INTERNAL EARTH PROCESSES

Course Level : 1

Course Credit : 3 CU

Brief Course Description

The course provides an understanding of the earth and its history, origin, age and internal composition. It also covers internal processes including earthquakes, volcanism, metamorphism and plate tectonics.

Course objectives

At the end of the course students should be able to:

- Have a basic understanding of the earth, internal process and its role in the formation of the earth's resources
- Understand the causes of the tectonic events and their importance in the history of the earth.
- Understand the importance of geology in the history of the earth's formation

Detailed Curse Description

I. Introduction of geology: **(3 hrs)**

Introduction , Terminology and definitions, Scope, Research areas and history and

Relations to other sciences.

II. The earth: **(6 hrs)**

what is the earth? Age and composition of the earth,

Hypothesis advanced towards the earth's formation and

Formation of the oceans, atmosphere and oceans.

III. Earthquakes: **(9 hrs)**

Earthquakes waves and their relationship with the internal composition of the earth, Causes, intensity and magnitude of earthquakes, Location of earthquakes, epicentre and

distribution pattern, Prediction models of earthquakes, Earthquake effects and Control or modification of

earthquake damage.

IV. Volcanism: **(6 hrs)**

Volcanic and plutonic deposits, Eruptive styles,

Distribution patterns and prediction. Effects and

significance.

V. Metamorphism: **(5 hrs)**

Conditions and types of metamorphism significance.

VI. Plate tectonics: **(12 hrs)**

Hypothesis, Plate boundaries, Plate mechanism

continental drifting and supporting evidence. Seafloor spreading and supporting evidence, Earth magnetism and magnetic tape recorder and Plate tectonics and rock

assemblages.

VII. Geochronology: **(4 hrs)**

Principles of age dating, Types of age dating and

Stratigraphic timescale.

Mode of Delivery

The course will be taught by using lectures, tutorials and assignments

Assessment

Assignments and tests	30%
Final examination	70%
Total	**100%**

vi) Course Name : REGIONAL GEOLOGY I

Course Level : 1

Course Credit : 2 CU

Brief Course Description

This is an introductory course of the geology of Uganda and covers the basic geology of different geologic system in terms of their names, ages, genesis, rock type, structures and economic importance.

Course Objectives

At the end of the course students should be able to:

- Have an overview of the geology of Uganda.
- Relate the different topics of geology covered in different courses to the entire geologic setting of Uganda.
- Understand the principles of the regional geology course covered in year III (Level II).

Detailed Course Description

I. Archean: **(3 hrs)**

Basement Complex and Nyanzian-Kavirondian System

II. Proterozoic: **(3 hrs)**

Buganda – Toro system. Karagwe-Ankolean System, and Bunyoro series

III. Palaeozoic: **(1 hrs)**
Karroo formation

IV. Cenozoic: **(3 hrs)**
Miocene, Pliocene and pliestocene formations, structural development of the western rift including the origin of its volcanoes and lakes.

V. Economic potential of the different rock systems **(1 hr)**

VI. Sedimentary basins in Uganda and their hydrocarbon potential **(2 hrs)**

VII. Geohazards, geotourism, agrominerals and groundwater development in Uganda. **(2 hrs)**

VIII. Practicals **(30 hrs)**

Mode of Delivery

The course will be taught by using lectures, tutorials, assignments, and practicals

Assessment

Assignments and tests	20 %
[redacted]	20%
Final examination	60%
Total	**100%**

vii) Course Name : REGIONAL GEOLOGY II

Course Level : 2

Course Credit : 2 CU

Brief Description

This course deals with the detailed geologic aspects of the different rock systems of Uganda from Precambrian age to present. The geologic Systems are discussed in terms of their genesis, lithology, structure, stratigraphy, age, metamorphism and mineralisation.

Course Objectives

At the end of the course students should be able to:

- Understand the geology of Uganda in detail.
- Make comparisons of the geology of Uganda to other countries in the region and the world.
- Understand the economic potential of the different parts of Uganda based on available geologic resources.

Detailed Description

I. Review of Precambrian and Phanerozoic rock Formations occurring in Uganda. **2 hrs**

II. Archean: **4 hrs**
Ancient cratons and Nyanzian-Kavirondian.

III. Proterozoic: **8 hrs**
Rwenzori fold belt, Buganda-Toro System, Kibaran belt, Mozambiquan belt, and Bukoban System.

IV. Palaeozoic: **4 hrs**
Karoo basins and grabens.

V. Tertiary volcanics of eastern Uganda. **6 hrs**

VI. Western rift development, volcanics and lakes. **6 hrs**
Rift sediments, soils and glaciers

Mode of delivery

The course will be taught by using lectures, tutorials, assignments, and field excursions
.

Assessment

Assignments and tests	20%
Field excursions	20%
Final examination	60%
Total	**100%**

viii) Course Name : PROSPECTING AND MINING GEOLOGY

Course Level : 2

Course Credit : 2 CU

Brief description

The course covers the following: mineral exploration programmes, exploration guides, mineral prospecting methods and sampling, mining methods, ore dressing and mineral economics.

Course Objectives

At the end of the course students should be able to:

- Provide students with an understanding of some of the concepts necessary for mineral exploration.
- Introduce students to the various mineral prospecting methods.
- Enable students understand the different mining and ore dressing methods with emphasis on safe working environment.
- Introduce students to mining economics.

Detailed Course Description

I. Mineral exploration programme: **(4 hrs)**
Definitions and sequential exploration model

II. Exploration guides: **(4 hrs)**
Physiographic, structural, lithologic and stratigraphic and mineral guides and Alteration

III. Mineral prospecting methods and sampling: **(7 hrs)**
Geologic mapping, geochemical and geophysical prospecting, sampling, tonnage and grade calculations

IV. Mining methods: **(5 hrs)**
Factors affecting choice of a mining method, surface, underground and solution mining and Mine safety

V. Ore dressing: **(6 hrs)**
Hand picking, gravity and magnetic methods, flotation, amalgamation, cyanidation and bio-leaching

VI. Mineral economics: **(4 hrs)**
Ore reserves, ore value, profitability and life cycle of a mine.

Mode of delivery

The course will be taught by using lectures, tutorials, assignments, and field excursions

Assessment

Assignments and tests	20%
Field visits	20%
Final examination	60%
Total	**100%**

ix) Course Name : ENGINEERING GEOLOGY
Course Level : 2
Course Credit : 3 CU

Brief Description

The course introduces students to engineering properties of soil/rock materials and soil/rock masses. They also cover stages of geotechnical site investigations, engineering geological evaluation of dam and reservoir sites as well as rock and soil slope stability.

Course Objectives

At the end of the course students should be able to:

- Understand rock and soil mechanics, rock mass and soil mass engineering properties and laboratory testing techniques and relate these to engineering projects.
- Understand the importance of geology in site investigation and characterization in engineering projects.

Detailed Course Description

I. Engineering properties of geological materials: (7 hrs)

General mechanics of soils, geotechnical significance of soils, mechanical properties of rocks, discontinuities and their engineering effects, engineering significance of rocks, weathering and engineering effects.

II. Stages of site investigation: (8 hrs)

Objectives, stages and site investigation methods, subsurface investigations, geotechnical logging, sampling, field measurements, geophysical surveys.

III. Water reservoirs and dams: (3 hrs)

Terminology and definitions, classification of dam types, causes of dam failure and case histories.

IV. Transportation routes: (2 hrs)

Geological requirements on the design of transportation routes, terrain evaluation for highway projects.

V. Building foundations: (2 hrs)

Demand of structures on foundations

VI. Underground excavations - tunnels: (6 hrs)

Terminology and definitions, types and uses of underground structures, site investigations for tunnel, geological conditions tunnelling and water in tunnels.

VII. Rock slope stability: (2 hrs)

Slope terminology, cause of slope movements, engineering classification of slope movements, modes and causes of slope failures, basic mechanics of slope failure and methods of slope stabilization.

VIII. Practicals (30 hrs)

Mode of delivery

The course will be taught by using lectures, tutorials, assignments, and practicals

Assessment

Assignment and tests	20%
Practicals	20%
Final Examination	60%
Total	**100%**

x) Course Name : ENVIRONMENTAL GEOLOGY

Course Level : 2

Course Credit : 2 CU

Brief Description

The course covers mass movements; environmental impact assessment; air, water and soil pollution; disposal and recycling of liquid, solid and radioactive waste material; geologically hazardous environments; disaster predictions and controls; land use and regional planning.

Course Objectives

At the end of the course students should be able to:

- Understand the natural geologic and human induced environmental hazards and identify and apply possible remedial measures.
- Acquire skills for proper and sustainable use and management of geological resources/materials.

Detailed Course Description

I. Introduction to earthquakes, volcanicity, environmental effects and possible mitigation measures. **(4 hrs)**

II. Mass movements disaster predictions and control **(3 hrs)**

III. Land use and waste management: **(4 hrs)**
disposal and recycling of liquid, solid
and radioactive waste, land use and environmental impact assessment.

IV. Air, water and soil pollution **(4 hrs)**
Air: primary and secondary pollutants transformation and removal
Water: sources of pollution, alteration of pollution, water quality,
monitoring of ground water quality.
Soil pollution: sorption and retention of pollutants.

Practicals and field excursions **(30 hrs)**

Mode of delivery

The course will be taught by using lectures, tutorials, assignments, and practicals

Assessment

Assignments and tests	20%
Field excursion and report, practicals	20%
Final examination	60%
Total	**100%**

xi) Course Name : STRATIGRAPHY
Course Level : 2
Course Credit : 2 CU

Brief Description

This course deals with measurement of geological time, correlating of rocks, stratigraphic breaks and gaps, stratigraphy and depositional environments, stratigraphic columns as well as applications of stratigraphy.

Course Objectives

The objectives of the course are to enable students:

- Understand the deposition processes of geologic resources in stratified rocks.
- Understand the history and evolution of the earth using the different rock units.
- Identify sites for safe waste disposal in stratified rocks.
- Understand the dating of ores associated with igneous and metamorphic rocks that are in contact with layered rocks.

Detailed Course Description

I. Measurement of geologic time:
methods, geologic time scale, geologic time units and global chronostratigraphic units, well logs, seismic events and biocorrelations.

II. Breaks and gaps:
concepts of missing sections in a geologic section, types of unconformities.

III. Stratigraphy and depositional environments:
types of depositional environment and their relation to stratigraphy.

IV. Applications:
In petroleum and water exploration, solid waste management.

V. Stratigraphic column:
construction of stratigraphic columns, geologic symbols.

Mode of Delivery

The course will be taught by using lectures, tutorials and assignments

.

Assessment

Assignments and tests	30%
Final examination	70%
Total	**100%**

xii) Course Name : GEOCHEMISTRY

Course Level : 2

Course Credit : 3 CU

Brief Course Description

This course covers the chemistry of the earth in relation to the universe structure and chemicals composition of the earth's layers, element distribution in relation to rock forming process, water chemistry in relation to sedimentary processes, cosmic abundances and applied aspects of geochemistry.

Course Objectives

The objectives of the course are to enable the students:

- Understand the chemical composition of the earth and its various parts.
- Understand the laws governing the distribution of the individual elements.
- Gain experience in doing geochemical analyses.

Detailed Course Description

I. The earth in relation to the universe: nature and age of the universe, nature and age of the solar system, composition of the planets, meteorites, cosmic abundances. **(8 hrs)**

II. Structure and chemical composition of the earth's layers: The structure and composition of the crust, mantle and core; primary differentiation of elements within the earth and geochemical classification of the elements. **(8 hrs)**

III. Geochemistry of igneous, sedimentary and metamorphic rocks: chemical and mineralogical composition of igneous, metamorphic and sedimentary rocks. Behaviour of elements during crystallization of magma. Physical chemical factors in sedimentation. **(4 hrs)**

IV. Atmosphere, hydrosphere, and biosphere: Composition and structure of the atmosphere, composition of the hydrosphere, composition of the biosphere, formation of coal and petroleum. **(6 hrs)**

V. Applied geochemistry: In mineral and petroleum exploration, public health, agriculture, hydrogeology, geochronology, archaeology, paleoclimatology, medicine etc. **(4 hrs)**

Practicals **(30 hrs)**

Mode of delivery

The course will be taught by using lectures, tutorials, assignments, and practicals

Assessment

Assignments and tests	20%
Practicals	20%
Final examination	60%
Total	**100%**

xiii) Course Name : IGNEOUS PETROLOGY

Course Level : 2

Course Credit : 3 CU

Brief Course Description

The course deals with the petrogenesis of various groups of igneous rocks and puts emphasis on rock types whose parental melts sample the upper mantle.

Course Objectives

At the end of the course students should be able to:

- Understand and use the models employed in classification of igneous rocks.
- Know and identify the source regions and mode of formation of the parental magmas of important rock types.
- Interpret the composition of the earth's interior by studying igneous rocks.

Detailed Course Description

I. Present day igneous activity. **(7 hrs)**
Magma evolution and processes

II. Petrogenesis of igneous rocks: **(7 hrs)**
basalts, granites, andesites and alkaline igneous rocks.

III. Tectonic environments of igneous rocks in Uganda and East Africa **(8 hrs)**
carbonatites, nephelinites, kimberlites and ultra potassic rocks.

IV. Classification of igneous rocks **(8 hrs)**

Practicals **(30 hrs)**

Mode of delivery

The course will be taught by using lectures, tutorials, assignments, and practicals

Assessment

Assignments and tests	20%
Practicals	20%
Final examination	60%
Total	**100%**

xiv) Course Name : FIELD GEOLOGY AND SURVEYING

Course Level : 2

Course Credit : 2 CU

Brief Course Description

This is a comprehensive course that introduces students to the different things that a geologist is required or expected to do right from the planning stage through the fieldwork to delivery of a complete, clearly understandable final report at the end of the project.

Course objectives

At the end of the course students should be able to:

- Understand and use different geologic mapping and surveying techniques.
- Identify the different rock types and their field relationships during mapping.
- Understand and use different methods and equipment for collecting geologic data.
- Recognize and distinguish between different rock structures.
- Carry out proper collection, analysis and interpretation of geologic field data.

Detailed Course Description

I. Planning for a field project: **(10hrs)**

Consultation of existing sources (maps, aerial photos). Consideration of resource-funds, personnel and equipment and Basic requirements for fieldwork.

II. Mapping: **(20 hrs)**

Observation of geologic features and collecting of data methods and equipment for measuring distances, bearings and differences. Maps and control surveys, field relations of rocks, correlation of rocks, interpreting complex relations, field recognition of structures, field water investigations.

III. Surveying instruments and techniques: **(10 hrs)**

Compass clinometer levels, theodolite, alidade, altimeter, surveying methods, geologic mapping techniques, point-fixing methods in field surveys, tacheometry, sampling and data collection.

IV. Report writing: **(35 hrs)**

Field communications, verbal communication types and purposes of written communications, preparing geologic reports.

Mode of Delivery

The course will be taught by using field work, tutorials and , assignments.

Assessment

Assignments and tests	20%
Practicals	20%
Final examination	60%
Total	**100%**

xv) Course Name : OPTICAL MINERALOGY

Course Level : 2

Course Credit : 4 CU

Brief description

This course introduces students to the use of a microscope to study different properties of minerals in rocks, soils, aggregate or individual crystals. It deals with thin section preparation, optics, optical properties of minerals under orthoscopic and conoscopic observation.

Course Objectives

At the end of this course the students are expected to have learnt how to:

- Prepare thin sections for geologic materials.
- Identify various minerals in any geological sample based on optical properties.
- Identify the rock type based on the optical properties of the constituent minerals.
- Make diagrammatic representations of the optical properties of different minerals for a given geologic material.

Detailed Course Description

I. Preparation of thin section: **(6 hrs)**

Polished and unpolished sections, characteristics of resins and immerssion liquids.

II. Polarizing microscope: **(3 hrs)**

Use, distinctive features and parts of a polarizing microscope. Centering the microscope use Optical systems.

III. Optics: **(6 hrs)**

Wave and quantum theory. Lights as a transverse phenomena. Constructive and destructive interference. Ray velocity surface. Light as an electromagnetic wave. Dispersion. Light additions and subtractions and Refractive index.

IV. Optical properties of minerals under orthoscopic and conoscopic observation: **(6 hrs)**

Relief, birefringence, colour, interference colours, habit, form cleavage, parting, extinction, twinning, inclusions, alteration, zoning, interference figures, sign of elongation etc.

V. Diagrammetic representations of optical properties using refractive index and velocity: **(4 hrs)**

Optical properties using refractive index and velocity: Optical indicatrix. Ray velocity surface.

VI. Optical properties of rock-forming minerals: **(20 hrs)**

Silicate minerals, Metamorphic silicates, Secondary silicates, Carbonates, Halogenides, Phosphates, Sulphates and Ores and mineralizers.

Practicals **(30 hrs)**

Mode of delivery

The course will be taught by using lectures, tutorials, assignments, and practicals

Assessment

Assignments and tests	20%
Practicals and tutorials	20%
Final examination	60%
Total	**100%**

xvi) Course Name : SEMINAR
Course Level : 2
Course Credit : 2 CU

Brief Course Description

The students are provided with a list of research topics from which they choose one. During the research the students consult the library, the Internet and the literature provided by the supervisors. Each student is expected to make a 45-minutes presentation in a Departmental Seminar and the final report is submitted to the supervisor for assessment.

Course Objectives

At the end of the course students will have learnt:

- How to conduct literature search
- How to write research report.

Detailed description

I. **Briefing by supervisors and choice of research topics**	**(4 hrs)**
II Literature search and preparation of presentation	**(12 hrs)**
II. Presentation	**(4 hrs)**
III. Final report writing and submission	**(10 hrs)**

Mode of Delivery

Most of the work is done by the student. The student is free to consults the supervisor and any other relevant source of information. The students prepare their reports and then present their findings in Departmental seminar. Their final reports are marked by the supervisors.

Assessment

Presentation	40 %
Final report	60 %
Total	**100%**

xvii)	Course Name	:	PROJECT
	Course Level	:	2
	Course Credit	:	5 CU

Brief Course Description

This is a field course that involves a fieldwork one week. Students do systematic geological mapping taking structural, lithogical and mineralogical data. Petrographic data is obtained in the laboratory. All the data is compiled into a project report.

Course objectives

The main objectives are to:

- Equip students with the skills of geological mapping.
- Enable students acquire skills in systematic data collection and report writing.
- Enable students analyze and interpret geological data,
- Enable students acquire skills of preparing geological specimens for analysis and/or preservation.
- Enable students learn geological features in the field which is the perfect laboratory for geologists.

Detailed course description

I. Field work: **(140 hrs)**

Mapping lithologic units and structures. Interpretation of the geological features and history of rocks and Compiling all geological field data.

II. Laboratory analysis: **(24 hrs)**

Preparation of thin sections and petrography and Stereographic analysis of structural data.

III. Project report writing: **(21 hrs)**

Interpretation and presentation of all the data analysed in form of text, tables and diagrams as well as a geologic map and a cross-section of the study area.

Mode of Delivery

Field mapping training, supervision of laboratory work and final report writing.

Assessment

Field participation and geologic base mapping	40%
Project report	60%
Total	**100%**

xviii) Course Name : INDUSTRIAL FIELD ATTACHMENT
Course Level : 2
Course Credit : 2 CU

Brief descriptions

This is a course where students are attached to a Government Department or Private Companies dealing in minerals, water, petroleum exploration, road construction, dam construction or any other relevant field of geology.

Course Objectives

The objectives of the course are:

- To expose students to hands-on experience in both the public and private sectors relevant to their professional training.
- To explore possible job opportunities for students.
- To enable students acquire skills in practical problem solving.

Detailed description

I. Field observation and job training

II. Report writing

Mode of Delivery

Report writing
Joint supervision of the student by both the practitioners and academic staff. Report writing and submission for examination.

Assessment

Weekly reports from student	20%
Supervisors reports	20%
Final reports	60%
Total	**100%**

xix) Course Name : INTRODUCTION TO COMPUTING AND GEOSTATISTICS
Course Level : 2
Course Credit : 2 CU

Brief Description

This is an introductory course in computing and statistical applications in geology. It covers computer components, operating systems, software applications with emphasis on Geographic Information Systems (GIS).

Course Objectives

The objectives of the course are to:

- Enable to students use GIS as a tool in geological research, planning and management of natural resources.
- Enable students acquire computer skills for applicable in their profession.
- Enable students learn and apply statistical tools in geology.

Detailed Course Description

I. Introduction to computing: **(14 hrs)**

Definitions, computer components, classification, word processing, use and application of relevant computer programmes. Networking and programming.

II. Geographic Information Systems: **(14 hrs)**

Introduction to GIS, data type, data models, data sources, GIS databases and analytical capabilities.

III. Univariate statistics and sampling theory: **(4 hrs)**

Sampling theory, standard error of sampling, frequency and cummulative distributions; Mean, standard deviation and variance of normal distribution.

IV. Univariate data analysis: **(8 hrs)**

Typical univariate analysis, anomaly, test of a model, point and interval estimations.

V. Continuous distributions: **(8 hrs)**

Normal distributions, chi-square distributions, t- distributions and F-distributions. Estimations of areas under a normal distribution curve.

VI. Bivariate statistics: **(4 hrs)**

Types of bivariate analysis.

VII. Geostatistcs: **(8 hrs)**

Concepts and principles, why geostatistics, methods used and estimation of surface points.

Mode of delivery

The course is lecture-oriented with assignments, practicals and tests.

Ways of assessment

Assignments and tests	20%
Practicals	20%
Final examination	60%
Total	**100%**

xx) Course Name : ORE MICROSCOPY

Course Level : 2

Course Credit : 2 CU

Brief Course Description

This course deals with metallic minerals and other associated minerals found in ores and their properties when observed in a reflecting microscope. The properties studied include colour, reflectance, birereflectance, pleochroism, cleavage, isotropism/anistropism, parting and qualitative hardness, primary and secondary textures.

Course Objectives

The major objectives of the course are to enable students to:

- Identify ore minerals under the microscope.
- Understand the differences between the useful metallic minerals from the worthless (gauge) minerals.
- Learn and use ore microscopy in ore mining operations.

Detailed Course Description

I. Importance of ore microscopy in ore deposit studies and ore processing: **(7 hrs)**

Ore mineral properties (colour, reflectance, birereflectance, pleochroism cleavage, isotropism/anistropism, parting and qualitative hardness

II. Primary textures: **(3 hrs)**

Crystallisation from silicate melts and Cavity filling.

III. Secondary ore textures: **(5 hrs)**

Replacement textures, Twinning and exsolution. Ore mineral paragenesis and zoning.

Practicals **(30 hrs)**

Mode of Delivery

The course is in form of lectures, practicals assignments and tests.

Assessment

Assignments and tests	20%
Practicals	20%
Final examination	60%
Total	**100%**

xxi) Course Name : PHOTOGEOLOGY AND REMOTE SENSING

Course Level : 2

Course Credit : 2 CU

Brief Course Description

This course deals with information technology and data acquisition (units, structures and landforms) through aerial photography and satellite images. It gives an introduction to the link between remote sensing and GIS.

Course Objectives

The objectives are to enable students to:

- Understand remote sensing and aerial photographs as a qualitative and quantitative used to collect timely and reliable geoinformation.
- Recognize and interpret geological features on aerial photographs and satellite images.
- Understand the important role of remote sensing and photogeology in resources exploration and environmental monitoring.

Detailed Course Description

I. Photogeology and aerial photography: **(3 hrs)**

Introduction, electromagnetic spectrum, types and characteristics of aerial photographs, stereoscopic view, emulsions and filters used and geometric aspects of aerial photos.

II. Stereoscopy: **(1hr)**

Principles and applications, significance in geological research and interpretations.

III. Geological interpretation of rocks and structures: **(3 hrs)**

Advantages of Aerial photography over Ground-Based Observation, Basic elements of Air Photo Interpretation. Introduction to drainage patterns, erosion patterns and topographic expression in enhancing interpretation and Base lining of aerial photos.

IV. Spatial data acquisition through remote sensing: **(1 hr)**

Electromagnetic energy and remote sensing. Wave phenomena concepts. Acquisition processes and platforms. and Application.

V. Sensors and platforms: **(1 hr)**

Types used. Image data characteristics. Types of land form. Data selection criteria.

VI. MultiSpectral Remote sensing: **(3 hrs)**

Data types and characteristics. Landsat image characteristics. Interpretation of Landsat Data, SPOT images and their interpretation, MSS, Thermal remote sensing, Radar (Microwave) Scanning and interpretations.

VII. Digital Image processing and interpretations: **(2 hrs)**

Introduction to basic principles of digital image interpretations. Image restoration, Image enhancement and Image Multispectral classifications.

VIII. Ground-truthing and map compilations: **(1 hr)**
why groundtruthing. Base map construction and map compilations.

Practicals **(30 hrs)**

Mode of Delivery

The course will be taught by using lectures, tutorials, assignments, and practicals

Ways of assessment

Assignments and tests	20%
Practicals	20%
Final examinations	60%
Total	**100%**

xxii) Course Name : SEDIMENTARY PETROLOGY

Course Level : 2

Course Credit : 3 CU

Brief Course Description

The course introduces the student to the different geological aspects of sediments and sedimentary rocks including classification, composition, textures, structures, genesis and sedimentary environments.

Course Objectives

The objectives of the course are to enable students to:

- Identify sedimentary rocks and sediments under a polarizing microscope.
- Interpret and make deductions on the genesis and economic significance of the different rocks based on mineralogy and texture/structure.
- Understand the process of diagenesis leading to rock formation.

Detailed Description

I. Introduction: **(4 hrs)**
Classification of sedimentary rocks in the stratigraphic record.

II. Sedimentary structures: **(2 hrs)**
Fabrics and structures of sediments and sedimentary rocks.

III. Terrigenous sedimentary rocks: **(8 hrs)**
Genesis and characterisation of conglomerates, breccias, sandstones and mudrocks.

IV. Allochemical sedimentary rocks: **(6 hrs)**
Genesis and characterisation of limestones and dolomite.

V. Orthochemical sedimentary rocks: **(6 hrs)**
Genesis, characterisation, composition of evaporites and ironstones.

VI. Sedimentary textures. **(4 hrs)**

Practicals **(30 hrs)**

Mode of Delivery

The course will be taught by using lectures, tutorials, assignments, and practicals

Assessment

Assignments and tests	20%
Practicals	20%
Final examination	60%
Total	**100%**

xxiii) Course Name : SEDIMENTOLOGY
Course Level : 2
Course Credit : 2 CU

Brief Course Description

This course covers weathering processes, transportation of sediments, deposition and depositional environments, post-depositional processes and sedimentary structures.

Course Objectives

The objectives of the course are to:

- Enable geology students to interpret the history of sediments and their depositional environments.
- Enable students attain basic skills in petroleum research and exploration.

Detailed Course Description

I. Weathering processes: **(6 hrs)**
Chemical and mechanical weathering processes in humid, polar and desert environments,Soil formation and Sedimentary cycle.

II. Erosion and the agents of transport for sediments in humid, polar and desert environments. **(4 hrs)**

III. Deposition and depositional environments: **(12 hrs)**
rivers, lacustrine, marine and deserts (Sabkas). Eustatic movements of the sea and Deposition in polar zones.

IV. Post-depositional processes: **(4 hrs)**

Bioturbation, erosion and formation of hiatus and diagenesis.

V. Sedimentary structures **(4 hrs)**

Mode of delivery

The course will be taught by using lectures, tutorials and assignments

Assessments

Assignments and tests	30%
Final examination	70%
Total	**100%**

General Material and Equipment Requirements for Geology

- Four-wheel drive vehicles (2)
- Microsopes (polarizing, reflecting)
- Computers
- Global Positioning Systems (GPS)
- Hammers (sledge, geologic)
- Hand lenses
- Binoculars
- Compass
- First aid box
- Camping equipment (tents, sleeping bags, beds, mattresses, tables, chairs, lamps, cooking utensils, gas cylinders, canvass sheets, jerry cans)
- Sample bags
- Sample bottles
- Water bottles
- Rack sacks
- Hardness kit
- Chemicals (hydrochloric acid, sulphuric acid)
- Beakers
- Measuring cylinders
- Spatulas
- Funnels and filters
- Streoscopes
- Aerial photographs and satellite images
- Maps (geologic and topographic)
- Rock cutting equipment.
- Glass slides and clips
- Resins
- Abrasives

MINIMUM COURSE REQUIREMENTS IN PHYSICS

i) Course Name : PROPERTIES OF MATTER

Course Level : 1

Course Credit : 2 CU

Brief Description

This course introduces properties of solids, liquids and gases. It deals with forces and energy between atoms and between molecules, and with mechanical and thermal properties.

Course Objectives

At the end of the course the student should be able to:

- Distinguish between the different forces that hold atoms together.
- Explain capillarity.
- Explain the applications of the elastic properties of solids.
- Explain thermal expansion of a solid in terms of interatomic forces
- Describe diffusion through a gas in molecular terms.
- Explain thermal conduction in matter.

Detailed Course Description:

- Forces and energy of interaction between atoms and between molecules. **(2hrs)**

- **Liquids:** **(4hrs)**

Surface tension, Capillarity, Adhesion and cohesion.

- **Solids:**

Strength properties and elastic deformation, Brittle and ductile solids; Examples of bending a beam and the cantilever; Waves along an elastic bar. **(10hrs)**

- **Thermal properties:**

Thermal expansion; Gruneisen's law; Heat flow along a bar Thermal diffusion. **(8hrs)**

- **Transport phenomena in gases:** **(6hrs)**

Elements of kinetic theory; Viscosity; Thermal conductivity and self-diffusion.

Total **(30hrs)**

ii) Course Name : ELECTRICITY

Course Level : 1

Course Credit : 3 CU

Brief Course Description

This is an introductory course in electricity. It is offered as a service course.

Course Objectives:

At the end of the course the student should be able to:

- Analyse DC and AC circuits.
- Describe the effect of magnetic fields and moving charges.
- Apply the laws of electromagnetic induction to electromechanical devices.

Detailed Course Description

- **Direct currents circuits:**

Emf and internal resistance of a battery, power delivered by a battery, Kirchoff's laws and electrical circuits. **(4hrs)**

- **Magnetic fields:**

Motion of charged particles in a magnetic field, force and torque on a current loop-the moving coil galvanometer, brief description of magnetic materials-magnetic domains and hysteresis. **(6hrs)**

- **Electromagnetic induction:**

Laws of electromagnetic induction, eddy currents, and their applications, electric generator, electric motor, self and mutual induction and transformer-energy stored in a magnetic field. **(8 hrs)**

- **Alternating current:**

Average and rms values, ac meters, and inductive and capacitive reactance. Power in ac circuits-power factor, R-L, R-C series circuit; RL and RC –time circuits, Low and high pass filters. Series and parallel resonance. **(12 hrs)**

Practicals **(30hrs)**

Total **(60hrs)**

Mode of Delivery:

Lectures, assignments, and tutorials and practicals

Assessment:

Tests, Assignment and practicals (40%) and examination (60%) total 100%

iii) Course Name : OPTICS

Course Level : 1

Course Credit : 3 CU

Brief Course Description

This is an introductory course in optics. It is offered as a service course.

Course Objectives:

At the end of the course the student should be able to:

- Describe the composition of the electromagnetic spectrum.
- Analyse the propagation of light and extend its applications to optical instruments.
- Explain reflection and refraction of light and apply it to optical devices.
- Explain interference and diffraction of light and their applications.
- Describe the various modes of polarization of light and how they are produced.

Detailed Course Description:

- **Electromagnetic spectrum:** **(1hr)**

components of electromagnetic spectrum.

- **Huygens' principle:**

Applications to reflection and refraction at plane surfaces; spherical mirrors, lenses and optical instruments. **(7hrs)**

- **Interference of light:**

Interference by division of wavefront and division of amplitude; Young's double slit interference, interference in thin films, Newton's rings. **(8hrs)**

- **Diffraction of light:**

diffraction from a single slit, diffraction grating, dispersive and resolving power of a grating. **(8hrs)**

- **Polarization of light:** **(6hrs)**

production, detection and applications.

Practicals **(30hrs)**

Total **(60hrs)**

Mode of Delivery:

Lectures, assignments, and tutorials and practicals.

Assessment:

Tests, Assignment and practicals (40%) and examination (60%)

iv) Course Name : PHYSICS PRACTICALS I

Course Level : 1

Course Credit : 2 CU

Brief Course Description:

The course consists 4 contact hours per week in the laboratory for 15 weeks. It covers

AC circuits, heat and thermodynamics, interference of light and radioactivity.

Course Objectives:

At the end of the course the student should be able to:

- Use standard measuring devices;
- Analyse and interpret experimental data;
- Develop scientific investigative skills in solving problems;
- Write scientific reports.

Detailed Course Description:

- **Alternating current circuits:** **(8hrs)**
  R-L-C circuits
- **Electromagnetic forces:**
  motion of charged articles in electrical and magnetic fields. **(8hrs)**
- **Amplification:** **(16hrs)**
  triode and transistors
- **Heat and Thermodynamics:** **(4hrs)**
  ratio of C_p to C_V.
- **Specific heats of gases** **(4hrs)**
- **Radioactivity:** **(8hrs)**
  absorption of gamma rays
- **Minimum deviation measurements** **(8hrs)**
- **Refractive index of glass** **(4hrs)**
- **Practicals** **(30hrs)**

Total **(60hrs)**

Mode of Delivery:

The course is laboratory based. Every student must do at least 15 practical exercises in a semester.

Assessment: Practicals **100%.**

v) Course Name : ELECTRICITY AND MAGNETISM

Course Level : 1

Course Credit : 3 CU

Brief Course Description:

This course introduces general concepts of electricity and magnetism to the undergraduate student. It covers electrostatics, AC and DC circuits, and electromagnetic effects. The course prepares students for more advanced studies in electromagnetism.

Course Objectives:

At the end of the course the student should be able to:

- Solve problems in electrostatics.
- Analyse DC and AC circuits.
- Apply the laws of electromagnetic induction to problem solving.
- Describe and apply effects of static magnetic fields on moving charges.

Detailed Course Description:

Electrostatics:
Coulomb's law; electric fields; Gauss's law and pplications; Electrostatic potential, electrostatic energy, dielectrics, capacitance. **(9hrs)**

Steady currents: **(6hrs)**
Conduction in metals; Ohm's law; Kirchhoff's laws.

Magnetic fields:
Moving charges and magnetic fields, magnetic flux density, Hall effect, Biot-Savart law, Ampere's law, electromagnetic induction; self and mutual inductance and energy stored in a magnetic field. **(15hrs)**

A.C. circuits:
Circuit elements; resistor, inductor and capacity, voltage – current relations; average and rms values. Inductive and capacitive reactances. Impedance; RLC series and parallel circuits, Power factor; low and high pass filters. **(15hrs)**

Total **(45hrs)**

Mode of Delivery:

Lectures, tutorials and assignments.

Assessment:

Assignments and tests (30%) and Examination (70)

vi) Course Name : HEAT AND THERMODYNAMICS

Course Level : 1

Course Credit : 2 CU

Brief Description

This is an introductory course in heat and thermodynamics. It covers the following major topics: equation of state for an ideal gas, basic heat transfer, kinetic theory, the laws of thermodynamics; and Maxwell's distribution of velocities.

Course Objectives

At the end of the course the student should be able to:

- State the relationship between temperature and heat;
- Analyze thermodynamic changes using laws of thermodynamics;
- Use the equation of state and the simple kinetic theory in solving problems;
- State and apply the laws of thermodynamics;
- State and apply the equipartition theorem.

Detailed Course Description:

- **Equation of state:**

Intensive and Extensive variables; Equation of state, Work and P-V diagrams. **(2hrs)**

- **Heat Flow:**

Heat conduction in solids and gases; thermal conductivity; convection radiation-black-body radiation and Stefan-Boltzmann's law. **(4hrs)**

- **Simple Kinetic Theory:**

Internal energy, the energy equation, boiling and vapour pressure. (4**hrs)**

- **Temperature:**

Thermodynamic equilibrium, concept of temperature, temperature scales and concept of heat; absolute zero. **(4hrs)**

- **The laws of thermodynamics:**

The Zeroth law, the first and second laws of thermodynamics, Clausius and Kelvin statements of the second law. **(4hrs)**

- **Thermodynamic changes:**

Reversible and Irreversible changes; the Carnot cycle, Clausius' inequality and entropy and heat engines. **(4hrs)**

Thermodynamic relations:

Specific heats, equation of state, Maxwell's relations, examples – liquid film, C_p-C_v. **(4hrs)**

Maxwell's distribution:

Mean speed and mean square speed, kinetic energy, equipartition of energy theorem and treated simply. **(4hrs)**

Total **(30hrs)**

Mode of Delivery: Lectures, tutorials and assignments
Assessment: Assignments and tests (30%) and Examination (70%)total 100%

vii) Course Name : PHYSICS PRACTICALS II

Course Level : 2

Course Credit : 2 CU

Brief Course Description

This course builds on the foundation of Level 1 Physics practical courses. The course consists of 4 contact hours per week in the laboratory for 15 weeks. It covers statistical analysis of errors, heat and thermodynamic properties of matter, AC circuits and electromagnetic phenomena.

Course Objectives:

At the end of the course the student should be able to:

- Evaluate errors resulting from experiment by using statistical methods;
- Use more sophisticated equipment;
- Discern equipment most appropriate for a given practical problem;
- Write comprehensive laboratory reports;
- Demonstrate a better understanding of theoretical principles.

Detailed Course Description:

● Statistical analysis of random errors	**(4hrs)**
● Properties of matter	**(8hrs)**
● Alternating current circuits	**(8hrs)**
● Earth's magnetic field	**(8hrs)**
● Electromagnetic induction	**(8hrs)**
● Thermodynamics	**(12hrs)**
● Properties of semi-conductors	**(12hrs)**
Total	**(60hrs)**

Mode of Delivery:

The course is laboratory based.

Assessment: Practicals: 100%.

viii) Course Name : CLASSICAL MECHANICS II

Course Level : 2

Course Credit : 3 CU

Brief Course Description

The course builds on classical mechanics offered at Level 1. It describes the dynamics of particles at a more advanced level. It covers wave motion, the Lagrangian and Hamilton's formulations, moving coordinate systems, and rigid body motion.

Course Objectives:

At the end of the course the student should be able to:

- Solve the wave equation for given boundary conditions;
- Set up equations of motion for various systems;
- Solve problems involving motion of rigid bodies.
- Solve problems involving relativistic motion.

Detailed Course Description:

- **Waves and wave motion:**
  The wave equations, waves on strings, particles, waves in fluids, the general wave quation, solution of the wave equation, boundary conditions, Fourier series and waves in a rectangular box. **(9hrs)**

- **Superposition and interference of waves:**
  Wave packets; phase and group velocities; de Broglie waves; energy density and intensity. **(3hrs)**

- **Special relativity:**
  Lorentz transformation matrix, space and time four vectors, force and energy in relativistic mechanics **(6hrs)**

- **The Lagrangian and Hamiltonian:**
  Generalized coordinates, Lagrangian formulation and applications, Hamiltonian and application to simple problems including central orbits and small oscillations; canonical coordinates and applications. **(9hrs)**

- **Moving coordinate systems:**
  Non-inertial frames, coordinate systems, velocity, acceleration, coriolis and centripetal forces. **(6hrs)**

- **Rigid Bodies:**
  Kinetic energy and angular momentum about a fixed axis, equation of motion and conservation laws. **(6hrs)**

- **Rotating frames of Reference:**
  Inertia tensor, Euler's (Cartesian and spherical) equations of motion, spin and procession – the top and the gyroscope. **(6hrs)**

Total **(45hrs)**

Mode of Delivery: Lectures, assignments, and tutorials.
Assessment: Assignments and tests (30%) and Examination (70)

ix) Course Name : SOLID STATE PHYSICS I

Course Level : 2

Course Credit : 2 CU

Brief Course Description

This course in solid-state physics covers elementary description of crystal structures; diffraction of X-rays by crystals; lattice vibrations; and thermal, dielectric and mechanical properties of solids.

Course Objectives:

At the end of the course the student should be able to:

- Describe the different crystal structures;
- Use Bragg's law to index powder diffraction lines;
- Identify simple crystal structures from their diffraction patterns;
- Calculate heat capacities of solids by using the Eistien's Debye models;
- Explain thermal, dielectric and mechanical properties of solids.

Detailed Course Description:

- **Elementary description of crystal structures:**
crystal periodicity, symmetry elements, crystal classes and crystal structure. **(4hrs)**

- **Diffraction of X-rays by crystals:**
Bragg's law, structure factor, powder diffraction patterns; indexing of powder diffraction lines **(4hrs)**

- **Lattice vibrations:**
linear monatomic and diatomic lattices, Brillouin zone; dispersion curves; acoustic and optic modes, infrared absorption in ionic crystals. **(6hrs)**

- **Thermal properties of solids:**
quantization of lattice vibrations – phonons, Einstein and Debye models of lattice heat capacity and thermal conductivity of insulators **(6hrs)**

- **Dielectric properties of solids:**
Electronic, ionic and orientational (dipolar) polarizability, dielectric constant, electric susceptibility, and resonance absorption in dielectrics. **(6hrs)**

- **Mechanical properties of solids:**
Dislocation, vacancies and interstitials, strength of materials. **(4hrs)**

Total **(30hrs)**

Mode of Delivery:
Lectures, assignments and tutorials
Assessment: Assignments and tests (30%) and Examination (70)

x) Course Name : EVOLUTION OF PHYSICS

Course Level : 2

Course Credit : 2 CU

Brief Description:

It covers the historical developments of physics, emphasising major innovations, which have revolutionalized the subject and led to technological advancement.

Course Objectives:

At the end of the course the student should:

- be able to relate the current trends of physics to the past;
- be able to develop the scientific way of thinking and solving problems.

Detailed Course Description:

- **Archimedes and the origin of mechanics** **(2hrs)**
- **The Pythagoras school 582 - 500 B.C.** **(2hrs)**
- **Euclidean geometry 330 – 260 B.C.:** **(2hrs)**

The problem of matter.

- **Dalton's atomic theory:** **(3hrs)**

Particulate theory of mater.

- **Newton and the gravitation.** **(3hrs)**
- **Advances in optics in the 17th century and the wave theory of light.** **(4hrs)**
- **Advances in heat and thermodynamics.** **(3hrs)**
- **19th and 20th century physics: electromagnetic waves and relativity;** **(5hrs)**

Quantum phenomena.

- **Advances in electronics and telecommunications;** **(6hrs)**

Computing and IT.

Total **(30hrs)**

Mode of Delivery:

Lectures assignments and tutorials.

Assessment:

Assignments and tests (30%) and Examination (70)

xi) Course Name : ELECTROMAGNETISM

Course Level : 2

Course Credi : 3 CU

Brief Course Description

This course builds on the Electricity and Magnetism course offered at Level 1. It covers electrostatics, stationary electric fields in conducting media, magneto-static field laws, Maxwell's equations and their applications.

Course Objectives

At the end of the course, the student will be able to:

- Solve problems in electrostatics;
- Explain electric conduction in metals, state and apply the equation of continuity, and calculate resistances of given pairs of conductors.
- Derive expressions for the capacitances of cylindrical and spherical capacitors; and densities due to simple current distributions.
- Solve problems involving static magnetic fields.
- Explain magnetic properties of matter.
- Apply the laws of electromagnetic induction to problems involving eddy currents, self and mutual induction, and derive Neumann's formula;
- State Maxwell's equations of electromagnetism and derive the wave equations for **E** and **H** in dielectrics, and in conducting media.
- Derive the relation between time-averaged Poynting's vector and the energy density of the electromagnetic field.
- Solve problems involving reflection and refraction of plane waves.

Detailed Course Outline:

- **Electrostatics:**
  Poisson's and Laplace's equation for solution of simple potential problems in cartesian spherical and cylindrical coordinates. **(10hrs)**

- **Stationary electric fields in conducting media:**
  Conservation of change and continuity equation, calculation of resistance of a coaxial cable. **(8hrs)**

- **Magnetostatic field laws:**
  Faraday's law; ampere's law; mutual inductance; magnetic vector potential. **(8hrs)**

- **Maxwell's equations:**
  Solutions in terms of electromagnetic waves in free space, Orthogonality of E, B and k, Poynting's vector in free space. **(12hrs)**

- **Plane electromagnetic waves in matter:**
  Solutions of the wave equations in conducting and non conducting media and skin-depth. **(7hrs)**

Total **(45hrs)**

Mode of Delivery:

Lectures assignments and tutorials.

Assessment: Assignments and tests (30%) and Examination (70)

xii) Course Name : ELEMENTS OF ASTRONOMY AND ASTROPHYSICS

Course Level : 2

Course Credit : 2 CU

Brief Course Description

This course gives the basics of astronomy and astrophysics. It covers galactic structure and interstellar matter, evolution of the stars and the solar system, galaxies and cosmology.

Course Objectives

By the end of the course, the student should be able to:

- Explain the formation of the universe and evolution of the solar system;
- Relate the stellar distances, motions and dimensions with the known parameters;
- Describe the nuclear reactions, energy production and synthesis of elements.
- Draw the Herzsprung-Russel diagram, and relate it to the stellar activities.
- Explain the big-bang theory.

Detailed Course Description:

- **Galactic structure and interstellar matter:**
  Stellar distances and motions, stellar dimensions and stellar atmospheres. **(4hrs)**

- **Evolution of the stars:**
  Types, formation and evolution and Herzsprung-Russel diagram, degeneracy, collapse and super-dense stars. **(6hrs)**

- **Formation of the elements:**
  Nuclear reactions, energy production, synthesis of elements from carbon to californium, isotopic clues in the stars and meteorites. **(8hrs)**

- **Evolution of the solar system:**
  Solar system stability, changes in the earth-moon system. **(4hrs)**

- **Galaxies**:
  Classification, correlation of morphology, luminosity, radio-emission lines, infrared. **(4hrs)**

- **Cosmology:** **(4hrs)**
  Big-bang theories versus steady state and remnant radiation

Total **(30hrs)**

Mode of Delivery:

Lectures, assignments and tutorials**.**

Assessment:

Assignments and tests (30%) and Examination (70) total 100%

xiii) Course Name : ELEMENTS OF ENVIRONMENTAL PHYSICS

Course Level : 2

Course Credit : 2 CU

Brief Course Description

This course covers energy exploitation, climatic changes, pollution, interaction of electromagnetic fields and nuclear radiations with matter and environmental policy.

Course Objectives:

By the end of the course, the student should be able to:

- List all types of energy sources and state their optimal use;
- Explain changes in the environment that lead to global warming and how this can be combated;
- Discuss the various types of pollutants and their effects;
- Enumerate the various effects of interactions of nuclear radiation with matter;
- State the national environmental policy.

Detailed Course Description:

- **Review:** **(2hrs)**
  Production, processing and transport of resources and services.
- **Energy exploitation:**
  hydroelectric, solar energy, biomass, nuclear energy, fossil energy, chemical energy and other renewable energy sources. **(4hrs)**
- **Climatic changes:**
  weather and climate elements, local seasons and atmospheric effects, energy balance, global warming, air motion and satellite meteorology. **(6hrs)**
- **Climatic changes:**
  weather and climate elements, local seasons and atmospheric effects, energy balance, global warming, air motion, satellite meteorology. **(5hrs)**
- **Pollution:**
  solid and fluid pollutants, basic acoustics and noise and transport of pollutants. **(3hrs)**
- Interaction of electromagnetic fields and nuclear radiations with matter. **(2hrs)**
- **Radiation and radioactivity:**
  radioactive sources, radiation monitoring and safety, radioactive pollution. Nuclear detection techniques and devices. **(6hrs)**
- **Environmental policy:**
  hazards and risks with technology, mitigation of global warming, damping of industrial and domestic waste, laws agreements and conventions governing environmental degradation. **(2hrs)**

Total **(30hrs)**

Mode of Delivery: Lectures, assignments and tutorials
Assessment: Assignments and tests (30%) and Examination (70)

xiv) Course Name : INTRODUCTION TO COMPUTER SCIENCE

Course Level : 2

Course Credit : 2 CU

Brief Course Description:

This is an introduction course to computer science for physics students. It covers the architecture of the computer, input and output devices, hardware and software development, operating systems and external storage.

Course Objectives:

At the end of the course the student should be able to:

- Identify the different parts of a computer assembly;
- Differentiate between input and output devices;
- Analyze the different operating systems;
- Analyze the memory structures and architecture.

Detailed Course Description:

- **Different types of computers.** **(1hr)**
- **Hardware development:** **(2hrs)**
  Intel and Motorola microprocessor.
- **Software development:** **(3hrs)**
  Operating systems, CPM, MS-DOS, UNIX.
- **The CPU, RAM and ROM storage, Input and Output devices, the clock, ports.** **(3hrs)**
- **External storage devices, computers and microprocessors.** **(3hrs)**
- **Memory structure and architecture.** **(3hrs)**

Practical sessions relevant to the theory will be arranged and carried out throughout the semester. **(30hrs)**

Total **(45hrs)**

Mode of Delivery:

Lectures, assignments and tutorials.

Assessment:

Assignments and tests (30%) and Examination (70%) Total 100%

xv) Course Name : PHYSICS PRACTICALS III

Course Level : 2

Course Credit : 2 CU

Brief Course Description

The course consists of 4 contact hours per week in the laboratory for 15 weeks. It covers atomic physics, electrostatics and magnetostatics, photovoltaics, physical optics and semiconductors.

Course Objectives:

At the end of the course the student should be able to:

- Use more sophisticated equipment;
- Discern equipment most appropriate for a given practical problem;
- Write comprehensive laboratory reports;
- Demonstrate a better understanding of theoretical principles.

Detailed Course Description:

- Atomic physics **(8hrs)**
- Electrostatics **(8hrs)**
- Magnetostatics **(8hrs)**
- Photovoltaics **(8hrs)**
- Physical optics **(16hrs)**
- Semiconductors **(12hrs)**

Total **(60hrs)**

Mode of Delivery:

The course is laboratory based.

Assessment:

Practicals **100%.**

xvi) Course Name : GEOPHYSICS I

Course Level : 2

Course Credit : 2 CU

Brief Course Description

This is an introductory course in Geophysics. The course covers the structure of the earth, gravity and its anomalies, isostasy, seismology, geomagnetism and an iintroduction to plate tectonics.

Course Objectives

At the end of the course the student should be able to:

- Describe the major components of the structure of the earth
- Explain the causes of earthquakes and how earthquakes are measured
- Describe how the source parameters can be determine and the seismic methods used for describing the Earth's Structure
- Describe variations in gravity g at all points on the earth surface and the different types of gravity anomalies
- Describe the earth magnetic field
- List the basic types of plate boundaries and the possible sources of forces that drive the plate

Detailed Course Outline

The Earth's structure**:** Crust, mantle, Core **(2hrs)**

- **Gravity:**

The Earth's gravity, gravitational force and acceleration, effect of shape, effect of inhomogeneities. **(4hrs)**

- **Gravity reduction and anomalies:**

Latitude, elevation, free air and Bouguer anomalies. **(4hrs)**

- **Isostasy:** **(4hrs)**

Pratt's and Airy's hypotheses.

- **Seismology:** **(4hrs)**

Earthquakes, seismic wave velocities.

- **Geomagnetism:**

Geomagnetic elements and magnetic maps, non-dipole field, secular variations and westward drift, generation of the main field. Magnetic reversals and polar wandering. **(8hrs)**

- **Introduction to plate tectonics.** **(2hrs)**

Total

(30hrs)

Mode of Delivery: Lectures, assignments, tutorials and field trips.

Assessment: Assignments and tests (30%) and Examination (70)

xvii)Course Name : FLUID DYNAMICS

Course Level : 2

Course Credit : 2 CU

Brief Course Description:

This course introduces the dynamics of fluid flow in different material media and also when under specific conditions/forms. It covers conservation laws, isotropic flows, shock wave structure, heat transfer and the basic concepts of pneumatics.

Course Objectives

By the end of the course, the student should be able to:

- Describe the propagation of disturbances in different material media.
- Derive the relations of the different forms of shock waves i.e. normal, oblique, weak and strong shocks.
- Discuss compressible flows when the fluid is subjected to area changes, friction and adding heat to it.
- Apply the basic concepts of pneumatics to various fluid flows.

Detailed Course Outline

- **Conservation Laws:** **(4hrs)**

Propagation of disturbances.

- **Isotropic flows:** Normal shock wave relations; oblique shock waves; weak and strong shocks. **(6hrs)**

- **Shock wave structure:**

Compressible flows in ducts; Effect in area change of ducts; Consideration of friction in duct, Application of heat to fluid in ducts. **(8hrs)**

- **Heat transfer**: High speed flows. **(2hrs)**

- **Basic Concepts of Pneumatics:**

Unsteady compressible flows; Riemann Invariants; Piston and shock tube problems; Steady 2D supersonic flow, Prandtl-Meyer function and Self-similar compressible flows. **(10hrs)**

Total **(30hrs)**

Mode of Delivery:

Lectures, assignments, tutorials and field trips.

Assessment:

Assignments and tests (30%) and Examination (70)

xviii) Course Name : WAVES AND OPTICS

Course Level : 2

Course Credit : 2 CU

Brief Course Description

This course introduces general concepts of wave propagation and optics. It covers wave concepts, Fraunhofer diffraction, Huygen's - Fresnel diffraction, vector nature of light and polarization, optical, lasers and introduction to holography.

Course Objectives

At the end of the course the student should be able to:

- Distinguish between isotropic and anisotropic media;
- Apply the division of amplitude and division of wavefront in solving problems;
- Distinguish between Fraunhofer and other types of diffraction;
- Discuss the vector nature of light in respect to polarizations;
- List a few uses of lasers.

Detailed Course Outline

- **Wave concepts:**
  Review of wave motion; electromagnetic spectrum, distinctions between isotropic and an isotropic media; Fermat's principle, principle of superposition, Interference by division of amplitude and wave front applications. **(4hrs)**

- **Frauhofer diffraction:**
  narrow single slit; n ≥ 2-slits; u-slit and the diffraction grating, Rayleigh criterion, rectangular and circular apertures. **(6hrs)**

- **Huygen's – Fresnel diffraction:**
  straight edge, 1-slit; the zone plate, Cornu's spiral and Fresnel integrals. **(6hrs)**

- **Vector nature of light and polarization linear:**
  Circular and elliptic polarization; Production of polarized light, Birefringence, Polaroids, Quarter-and half-wave plates, Uniaxial and biaxial crystals, O – and e – rays, Electron dipole oscillator and Scattering. **(8hrs)**

- **Brief mention of application of lasers:**
  Optical activity – rotary dispersion, Kerr, Faraday and Zeeman effects **(4hrs)**

- **Introduction to holography.** **(2hrs)**

Total **(30hrs)**

Mode of Delivery: Lectures, assignments and tutorials.
Assessment: Assignments and tests (30%) and Examination (70)

xix) Course Name : QUANTUM MECHANICS I

Course Level : 2

Course Credit : 3 CU

Brief Course Description

This course covers the atomic structure, the quantum effects, wave function and probability amplitude, and the commutation relations of linear operators.

Course Objectives

At the end of the course the student should be able to:

- Relate the Bohr model of the atom and the spectra of the hydrogen atom to atoms with higher atomic numbers;
- Interpret the quantum effects for different types of radiation;
- Explain the wave-particle nature of radiation;
- Derive the Schrödinger equation for a free particle and for a particle in the box, and relate it to all particle nature problems;
- Use the quantum mechanics operators when solving problems.

Detailed Course Outline:

- **The atom:**

Bohr model of the atom – spectra of the hydrogen atom, successes and failures of the Bohr model. **(5hrs)**

- **Quantum effects:**

Compton effect; Characteristic X-ray spectra; Moseley's law and Absorption of X-rays. **(12hrs)**

- **Wave function and probability amplitude:**

wave particle duality; de Broglie wavelength, Schrodinger's equation for a free particle and for a particle in a box, energy eigenvalues and eigenfunctions. **(16hrs)**

- **Linear operators:**

Postulates of quantum Mechanics and Potential barrier problems and commutation relations of operators. **(12hrs)**

Total **(45hrs)**

Mode of Delivery:

Lectures, assignment and tutorials.

Assessment:

Assignments and tests (30%) and Examination (70)

xx) Course Name : ELECTRONICS
Course Level : 2
Course Credit : 3 CU

Brief Course Description

This course introduces general concepts of electronics: analogue and digital electronics. In analogue electronics, it covers circuit theory, electronic devices, power generation and different amplifiers. The digital electronics part covers logic gates, combinatorial and sequential logic and digital converters.

Course Objectives

At the end of the course the student should be able to:

- Use the different theories in dealing with electronic devices;
- Connect simple circuitry;
- Apply the knowledge to the repair and maintenance of electronic devices.

Detailed Course Outline

- **Analogue Electronics:**

Circuit theory: circuit elements, network theorems, superposition, ac waveforms, transients, tank circuits and impedances. **(4hrs)**

- **Semiconductor Physics:**

p-n junctions, the diode, the bipolar transistor, its equivalent circuit and different circuit configurations. **(4hrs)**

- **Power generation:**

Three phase power generation, phase and line voltages, star and delta connection. **(4hrs)**

- **Amplification:**

single stage and two stage, input and output impedance, bandwidth, push-pull operation, field effect transistors and power transistors. **(4hrs)**

- **Feedback:**

positive and negative feedback, oscillators, noise, stability, ideal operational amplifier, multivibrators. **(4hrs)**

Filters and tuned circuits. **(2hrs)**

- **Digital Electronics:**

Logic gates, combinatorial logic, sequential logic. **(4hrs)**

Analog to digital converters (ADC) and digital to analog converters (DAC). **(4hrs)**

- **Memories.** **(2hrs)**

- **Practicals** **(30hrs)**

Total **(60hrs)**

Mode of Delivery: Lectures, assignments, tutorials and practicals.
Assessment: Practicals**, a**ssignments and tests (40%) and Examination (60%)

xxi)Course Name : ACOUSTICS

Course Level : 2

Course Credit : 2 CU

Brief Course Description

This course describes the different types of sound waves and their sources. It also introduces one to the different music instruments, hearing aids, natural sounds as well as sounds in medicine.

Course Objectives

By the end of the course, the student should be able to:

- Distinguish between the different types of sound waves.
- Describe the different types and designs of music instruments.
- Identify and discuss the different sources of sound and the intensity of sound.
- Describe the different applications of ultrasound in medicine.

Detailed Course Outline

- **Sound Waves:**
  Longitudinal and transverse waves, velocity of sound, transmission, reflection, refraction and absorption. **(4hrs)**
- **Sources of sound:** **(2hrs)**
  Vibrating strings, air columns and membranes.
- **Intensity of sound:** **(6hrs)**
  Sound energy; audio frequencies, beats and harmonics.
- **Music Instruments:**
  Types and design of microphones, types and design of loud speakers, types and design of attenuators and the human ear. **(6hrs)**
- **Hearing aids:**
  Radio and TV studios; acoustics of buildings; echoes and reverberations. **(6hrs)**
- **Natural sounds:** **(2hrs)**
  From animals, birds, wind etc;
- **Sounds in medicine:** **(4hrs)**
  ultrasound applications of sound in medicine.

Total **(30hrs)**

Mode of Delivery:

Lectures, assignments and tutorials.

Assessment:

Practicals**, a**ssignments and tests (40%) and Examination (60%)

xxii) Course Name : INDUSTRIAL TRAINING

Course Level : 2

Course Credit : 3 CU

Brief Course Description

This is Field Work, a practical course that is to help the students obtain practical skills. Students will be attached to various local industries to acquaint themselves with current industrial processes.

Course Objectives

By the end of the course, the student should:

- Be able to apply the theoretical principles acquired in class to real world scenarios;
- Have had exposure to various operations of industrial machinery;
- Have had the experience of operating industrial machinery.
- Gain insights to job creation.

Detailed Course Description

The course is a practical one, with topics varying from one industry to another. The contents of the course are to be agreed upon between the department and the industrial partner.

The student is required to have at least **90 hours** of training, leading to **3 CU.**

Mode of Delivery:

An instructor from the industry and a lecturer from the department will supervise and guide the students throughout the course

Assessment:

A report will be written and submitted for assessment. It will be awarded **100%.**

xxiii) Course Name : PHYSICS PRACTICAL IV

Course Level : 2

Course Credit : 2 CU

Brief Course Description

This is a purely electronics practical course, and it covers elements of analogue and

digital electronics.

Course Objectives

By the end of the course, the student should be able to:

- Apply the theoretical principles acquired in class to experiments;
- Connect more sophisticated electronic equipment;

- Discern equipment most appropriate for a given practical problem;
- Write comprehensive laboratory reports;
- Differentiate between Analogue and Digital systems.

Detailed Course Outline:

- **Analog electronics:** **(30hrs)**

dc. power supplies, diodes, bipolar transistors, triode, oscillators and wave shaping circuits.

- **Digital electronics:** **(30hrs)**

digital gates, digital flip-flops, binary addition, encoders and decoders, A/D and D/A conversion.

Total **(60hrs)**

Mode of Delivery:

This is a course where each student will be required to perform an weekly for 15 weeks

Assessment: Practicals **100%.**

xxiv) Course Name	**:**	**GEOPHYSICS II**
Course Level	**:**	**2**
Course Credit	**:**	**2 CU**

Brief Course Description

This course builds on Geophysics I. It covers the basic principles of the different geophysical methods :– gravity, magnetism, electromagnetism, and their use in locating resources such as hydrocarbons and metallic minerals, groundwater and litho logical mapping.

Course Objectives

By the end of the course the student should be able to:

- Describe the most important geophysical methods used to determine physical subsurface properties;
- Apply skills minerals of mineral exploration
- Identify and specify the most appropriate technique(s) to solve any particular geological problem;
- Design and execute geophysical survey for a given area; and
- Process and interpret geophysical data.

Detailed Course Description:

- **General survey of applied geophysics methods and field practice:**
  Rock properties, geophysical methods and survey environment. **(4hrs)**
- **Applications of geophysical methods:**
  geological mapping, oil and gas exploration, mineral exploration, ground water and engineering geology. **(6hrs)**
- **Phases of geophysical survey.** **(2hrs)**
- **Gravity method:**
  gravity meters, data reduction, drift and tidal; data presentation and applications. **(6hrs)**
- **Magnetic methods:**
  magnetometers, data reductions, data presentation and applications. **(4hrs)**
- **Electrical methods:** **(4hrs)**
  resistivity, induced polarization, applications.
- **Electromagnetic methods:**
  Principle, theory and measurements and applications. **(4hrs)**

Total **(30hrs)**

Mode of Delivery:
Lectures, assignments and tutorials.

Assessment:
Assignments and tests (30%) and Examination (70%)

xxv) Course Name : SOLID STATE PHYSICS II
Course Level : 2
Course Credit : 3 CU

Brief Course Description

This course covers the free electron theory of metals, introduction to band theory of solids, magnetic properties of solids and an introduction to superconductivity.

Course Objectives

By the end of the course, the student should be able to:

- Formulate the basic principle of electrical and thermal conduction in solids.
- Describe the Hall effect and its applications in semiconductors
- Illustrate the band theory of solids, and explain the difference between metals, insulators and semiconductors.

- Distinguish between the various types of magnetic materials.
- Explain the important role of the magnetic materials in technology.
- Relate the properties of superconductivity and the Meissner effect with material structures.

Detailed Course Description

- **The free electron theory of metals:**

Electron gas, electronic specific heat, electrical and thermal conduction, Hall effect and dielectric response. **(10hrs)**

- **Introduction to band theory of solids:**

Metals, insulators and semiconductors and application of the band theory to semiconductors. **(8hrs)**

- **Magnetic properties of solids:**

Diamagnetism and paramagnetism, ferromagnetic, anti-ferromagnetic and ferrimagnetic order. **(12hrs)**

- **Introduction to superconductivity:**

Experimental survey of properties of superconductors – the Meissner effect (type I and type II superconductors), heat capacity, energy gap; high T_c-superconductors; Applications of superconductivity. **(15hrs)**

Total **(45hrs)**

Mode of Delivery:

Lectures, assignment, and tutorials.

Assessment:

Tests and assignments (30%) and Examination (70%)

xxvi) Course Name : STATISTICAL MECHANICS

Course Level : 2

Course Credit : 3 CU

Brief Course Description

This course covers the fundamental postulates of statistical mechanics, which include quantum states, systems in contact, the different particle statistics and their applications, equipartition of energy and specific heat capacities of diatomic gases.

Course Objectives

By the end of the course, the student should be able to:

- State the fundamental postulates of statistical mechanics;
- Apply different particle statistics to relevant situations;
- Apply the Maxwell-Boltzmann statistics to monatomic ideal gases;
- Calculate the specific heat capacities of diatomic gases.

Detailed Course Description

- **Quantum states and enumeration of states.** **(5hrs)**

Fundamental postulates of statistical mechanics, two systems in thermal contact; two systems in diffuse contact, two systems in thermal and diffuse contact. **(8hrs)**

- **Bose-Einstein (B-E) statistics:**

Specific heat capacities of solids, blackbody radiation. **(8hrs)**

- **Fermi-Dirac (F-D) statistics:**

Electronic specific heat capacities of metals, white dwarfs, thermionic effect. **(10hrs)**

- **Maxwell-Boltzmann (M-B) statistics:**

Applications of M-B statistics to monatomic ideal gas; equipartition of energy specific heat capacities of diatomic gases. **(12hrs)**

Total **(45hrs)**

Mode of Delivery:

Lectures, assignment and tutorials.

Assessment:

Tests and assignments (30%) and Examination (70%)

xxvii) Course Name : QUANTUM MECHANICS II

Course Level : 2

Course Credit : 3 CU

Brief Course Description

This course builds on the concepts learnt in Quantum Mechanics I. It covers orbital angular momentum and orbital magnetic quantum number, vector addition of angular momenta, symmetry of state functions for two electron atoms, the Pauli exclusion principle, the variational principle and the Born approximation.

Course Objectives

At the end of the course the student should be able to:

- Work with orbital angular momentum and its vector additions;
- Solve time independent and time-dependent perturbation problems;
- Give vector symmetry functions;
- Use the Born approximation theories.

Detailed Course Description

- **Orbital Angular momentum and orbital Magnetic quantum number.** **(6hrs)**
- **Vector addition of angular momenta.** **(2hrs)**
- **Symmetry of state functions for two electron atoms.** **(8hrs)**
- **Further discussion of the Pauli exclusion principle.** **(6hrs)**
- **Variational principle, time-independent and time – dependent perturbation theory.** **(8hrs)**
- **Born approximation and its applications; partial wave analysis.** **(15hrs)**

Total **(45hrs)**

Mode of Delivery:

Lectures, assignments and tutorials.

Assessment:

Tests and assignments (30%) and Examination (70%)

xxviii) Course Name : ELECTRONICS AND INSTRUMENTATION

Course Level : 2

Course Credit : 3 CU

Brief Course Description

This course builds on the Electronics course taken in second year. It covers transducers, ransmitters and receivers, and gives examples of measuring instruments and of regulators.

Course Objectives

At the end of the course the student should be able to:

- Use the different theories in dealing with electronic devices;
- Connect more advanced circuitry;
- Apply the knowledge to the repair and maintenance of electronic devices.

Detailed Course Description

- **Transducers:**
  photodetectors, light emitting displays, mechanical detectors, thermoelectric transducers and radiation transducers. **(8hrs)**
- **Transmitters and receivers:**
  signal generators and detectors, transmission, modulation and demodulation, radio receiver. **(10hrs)**
- **Examples of measuring instruments:**
  the multimeter, the oscilloscopes and pressure gauges. **(6hrs)**
- **Examples of regulators:** **(6hrs)**
  thermostats, automatic switching and remote control.

Practicals. **(30hrs)**

Total **(60hrs)**

Mode of Delivery:

Lectures, assignments and practicals.

Assessment:

Practicals**,** assignments and tests (40%) and Examination (60%)

xxix) Course Name	**:**	**AGRICULTURAL PHYSICS**
Course Level	**:**	**2**
Course Credit	**:**	**3 CU**

Brief Course Description

This course covers the study of the atmosphere, heat and mass transfer, and an introduction to soil physics, with emphasis to conditions that enhance crop production.

Course Objectives

By the end of the course, the student should be able to:

- Discuss the atmosphere and its constituents;
- Explain how heat and mass transfers takes place in the atmosphere;
- To give the various soil compositions;
- Measure the soil moisture content and obtain the characteristics;
- Give the physical conditions that enhance crop growth and production.

Content

- **Atmosphere:**

Physics of gases, water vapour in the atmosphere, variation of pressure, density, vapour pressure in the atmosphere with altitude. **(15hrs)**

- **Heat and Mass transfer:**

Transfer of momentum. Heat and mass at boundary layers between the atmosphere and various surfaces, resistances to momentum, conservation – free and forced and conduction with application to heat flow in soils. **(15hrs)**

- **Introduction to Soil Physics:**

Energy balance concept, energy balance in soils, moisture content, soil densities, soil water potential, soil moisture characteristics and hydraulic conductivity. **(15hrs)**

Total **(45hrs)**

Mode of Delivery:

Lectures, assignments and tutorials.

Assessment:

Assignments and tests (30%) and Examination (70%)

xxx) Course Name	**:**	**PHYSICS PROJECT**
Course Level	**:**	**2**
CourseCredit	**:**	**3 CU**

Brief Course Description

This course introduces students to research. It covers workshop practice techniques, proposal writing and the research project. There will be oral presentations by each student.

Course Objectives

By the end of the course, the student should be able to:

- Apply the theoretical principles acquired in class to a given problem;
- Discern equipment most appropriate for a given project;
- Do research with minimum supervision;
- Present and defend his/her work with confidence.
- Write comprehensive project reports.

Detailed Course Description:

- **Workshop practice** **(10hrs)**
- **Proposal writing** **(10hrs)**

- **Implementation of project work** **(60hrs)**
- **Writing report** **(6hrs)**
- **Oral presentation of report (including preparation)** **(4hrs)**

Total **(90hrs)**

Mode of Delivery:

The students will attend sessions in workshop practice, prior to the commencement of the project. They will also be guided in proposal writing, before they submit the proposals to the Supervisor. The student will then work together with the Supervisor on a particular project. Each student will be expected to defend the project results before a Departmental audience.

Assessment:

Proposal writing and oral presentation	30%.
Actual project	70%

xxxi) Course Name : MATERIALS SCIENCE
Course Level : 2
Course Credit : 3 CU

Brief Course Description

This is an elective course offered to final year students in physics. It covers mechanical properties, oxidation and corrosion, ferrous materials, ceramics, polymers, and composites.

Course Objectives

By the end of the course, the student should be able to:

- Relate mechanical, thermal, electrical and optical properties to material structures.
- Describe and draw phase diagrams, and use phase rule and equilibrium conditions.
- Processing various materials, depending on the properties.
- Recognize the role of the interfacial boundary between the components in establishing a coherent composite.

Detailed Course description

Mode of Delivery:

Lectures, assignments and tutorials.

Assessment:

Assignments and tests (30%) and Examination (70%)

xxxii) Course Name : SOLAR ENERGY

Course Level : 2

Course Credit : 3 CU

Brief Course Description

This course aims at providing basic principles for research in solar energy at a higher level. The course is divided into two parts: solar radiation fundamentals and solar energy utilization.

Course Objectives

By the end of the course, the student should be able to:

- Explain the spectral distribution of solar energy;
- Analyze thermal conversion of solar energy with respect to the different surfaces;
- Explain photovoltaic conversion of solar energy.
- Design solar thermal panels and solar heating systems;
- Advise the general public about the most efficient ways of solar energy utilization.

Detailed Course Description

- **Solar Radiation Fundamentals:**

Radiation laws, the Sun, Sun-earth geometry, solar constant, extraterrestrial radiation, spectral distribution, attenuation of solar radiation by the atmosphere, terrestrial radiation, direct, diffuse and global, radiation, air mass, solar radiation on horizontal and inclined surfaces and measurement of solar radiation. **(15hrs)**

- **Solar Energy utilization:**

Fundamentals of heat transfer, optics of collectors, reflection and refraction at dielectric interfaces, transmittance and reflectance of single and multiple glazings, optical efficiency, concentrators, solar thermal panels, solar heating systems, heat exchangers and heat pumps, solar photovoltaics, efficiency of photovoltaic devices, photovoltaic array and systems and PV system sizing. **(15hrs)**

Practicals **(30hrs)**

Total **(60hrs)**

Mode of Delivery:

Lectures, assignments and practicals.

Assessment:

Practicals, assignments and tests (40%) and Examination (60%)

xxxiii) Course Name : MICROWAVE AND FIBRE OPTICS

Course Level : 2

Course Credit : 3 CU

Brief Course Description

This covers microwave physics, fibre optics, and optical communication systems and applications.

Course Objectives:

By the end of the course, the student should be able to:

- Apply the principles of generation, transmission and application of microwaves;
- Relate these principles to the telecommunication systems in the field
- Explore the optical communication systems techniques and compare with other methods of transmission.

Detailed Course Description:

- **Microwave**:

Review of electromagnetic theory, transmission lines, electromagnetic resonators, microwave generators, applications of microwaves, basic theory of guiding, TE and TM modes **(10hrs)**

- **Fibre-optics:**

Propagation characteristics and focusing effects of an optical wave-guide, single mode wave guide, optical sources for fibre communications, types of optical sources, modulation, de-modulation and optical integrated circuits, optical fibre transmission lines, transmission loss of optical fibre, jointing, connecting and cabling. **(15hrs)**

- **Optical communication systems and applications:**

Transmission distance with optical fibre, examples of optical transmission techniques. **(15hrs)**

Practicals **(30hrs)**

Total **(10hrs)**

Mode of Delivery:

Lectures, assignments, tutorials and practicals.

Assessment:

Practicals, assignments and tests (40%) and Examination (60%)

xxxiv) Course Name : NUCLEAR PHYSICS
Course Level : 2
Course Credit : 3 CU

Brief Course Description

This course covers the nuclear structure and the unified nuclear model, scattering of particles by the nucleus, particle accelerators and elementary particles.

Course Objectives

By the end of the course students should be able to:

- Describe the structure of the nucleus and the nature of nuclear forces,
- Explain the interactions of nucleons and other subatomic particles with nuclear matter,
- Use nuclear models to explain nuclear properties, nuclear stabilities and nuclear reactions.
- Give the properties and classify elementary particles.
- Describe some properties of nuclear science and technology in development.

Detailed Course Description

- **Nuclear structure:**

Rutherford's model and alpha-particle scattering, nuclear binding energy, radioactive decays, the law of radioactive decay, radioactive series and nuclear energy-fission and fusion. Nuclear masses. **(9hrs)**

- **Types of Nuclear Interactions:**

Strong, weak and superweak electromagnetic interactions.

- **Nuclear Models:**

Simple treatment of nuclear models: shell model, liquid drop model. The unified nuclear model. **(9hrs)**

- **Scattering, scattering amplitude and cross-section:**

Applications of the Born approximation – partial wave analysis; Parity, isospin, angular momentum; Transition probabilities, the Golden rule. **(12hrs)**

- **Particle accelerators.** **(6hrs)**

- **Elementary particles:**

Classification, lifetimes, quantum numbers, conservation laws, resonances and symmetries. **(9hrs)**

Total **(45hrs)**

Mode of Delivery:

This course is mainly lecture based, with occasional tutorials to allow for student-lecturer interaction and solving problems together.

Assessment:

Assignments and tests (30%) and Examination (70%)

xxxv) Course Name	**:**	**COMPUTER APPLICATIONS**
Course Level	**:**	**2**
Course Credit	**:**	**3 CU**

Brief Course Description

This course builds on Introduction to Computer Science taught earlier. It covers more advanced operating systems, computer applications, database management, computer programming and introduction to systems analysis and design.

Course Objectives

At the end of the course the student should be able to:

- Work with different operating systems;
- Differentiate between input and output devices;
- Analyze and design computer programs;

Detailed Course Description

- **MS-DOS, Windows, Introduction to Networks and Internet and UNIX**. **(6hrs)**

- **Some applications:**
  word processing (MS-word, Wordperfect), Spreadsheet management (lotus123, Ms-Excel), Database management (dBase III/IV, MS-ACCESS) **(8hrs)**

- **Computer programming:** **(6hrs)**
  Basic, Pascal, Introduction to C, Fortran, C++

- **Introduction to systems analysis and design:**
  problem definition, feasibility study, analysis, design, hardware/software selection, implementation. **(10hrs)**

Practical sessions relevant to the theory will be arranged and carried out throughout the semester. **(30hrs)**

Total **(60hrs)**

Mode of Delivery:

Lectures, assignments, tutorials and the practicals.

Assessment:

Practicals**, a**ssignments and tests (40%) and Examination (60%)

xxxvi) Course Name : ELEMENTS OF INDUSTRIAL PHYSICS

Course Level : 2

Course Credit : 3 CU

Brief Course Description

This course covers fluid flow, pressure, heat conduction, friction and lubrication, hazards, and thin film technology.

Course Objectives

At the end of the course the student should be able to:

- Apply the theoretical principles acquired in class to a real world scenarios;
- Explain operations of house-hold systems, such as refrigerators, vacuum systems and crop dryers.
- Demonstrate the awareness of hazards due to faulty connections;
- Analyse the thin film technologies.

Detailed Course Outline

- **Fluid flow:** **(2hrs)**

stream line and turbulence flow.
Pressure: compressions and applications, Vacuum systems, low pressures, vapours and moist content. **(6hrs)**

- **Heat conduction:**

heat exchangers, crop drying, refrigeration and air cooling, ventilation and air circulation in closed chambers. **(6hrs)**

- **Friction and lubrication:** **(4hrs)**

dangers from moving parts, slippery floors.

- **Noise and noise attenuators.** **(2hrs)**

- **Hazards:**

from poor power connections, charge accumulation, inflammable fluids, toxic materials and lighting intensity levels. **(4hrs)**

- **Thin films:**

fabrication technologies – evaporation, electron deposition, sputtering, chemical vapour deposition spray pyrolysis, characterisation of thin films – optical and magnetic methods, applications – photovoltaic, window coatings, protective coatings. **(6hrs)**

Practical . **(30hrs)**

Total **(60hrs)**

Mode of Delivery:

Lectures, assignments, tutorials and practicals.

Assessment: Practicals, assignments and tests (40%) and Examination (60%)

EQUIPMENT

Cathode ray oscilloscopes, spectrometers, microscopes, electrical oscillators, power packs (12V), batteries, voltmeters, current meters, multi-meters, diodes, triodes, transistors, resistors, moving coil galvanometers,

MINIMUM REQUIREMENTS FOR COURSES IN ZOOLOGY

i) Course Name : INVERTEBRATE I - Lower invertebrates

Course Level : I

Course Credit : 3 CU

Brief Course Description:

Classification, structure, distribution, evolution, origin and economic importance of acoelomaters, namely: protozoa, porifera, coelenterate, plathelminthes, Ascihelminthes and other minor phyla.

Course Objectives:

At the end of the course, the students should be able to:

- Recognise the diversity of groups, occurrence and possible evolutionary relationships;
- Understand and highlight the ecological and economic importance of lower invertebrates

Detailed description:

- Describe different phyla of lower invertebrates: protozoa, mesozoa, porifera, coelenterate, platy helminthes, ascihelminthes and other minor phyla (acoelomates).
- Examine the nature of the animal call and origin of multi-cellular organisms **(5 hrs)**
- Evolutionary relationships among groups **(1 hrs)**
- Structure and organisation of invertebrate body (metamerism etc) **(5 hrs)**
- Symmetry and its importance **(3 hrs)**
- Outlines of classification **(4 hrs)**
- Distribution **(5 hrs)**
- Economic importance **(7 hrs)**
- **Practicals** **(30 hrs)**

Mode of delivery:

Lectures, practicals, fieldwork

Assessment method:

Practical reports, assignments, tests (all contributing 40%) and

exams 60%.

ii) Course Name : INVERTEBRATE II - Higher invertebrates

Course Level : 1

Course Credit : 3 CU

Brief Course Description:

Classification, structure, distribution, evolutionary origins and economic importance of higher invertebrates namely: annelids, arthropods, molluscs and echinoderms.

Course Objectives:

At the end of the course, the students should be able to:

- Describe the structure, diversity of groups, their occurrence and possible evolutionary relationships
- Understand and highlight the ecological and economic importance of higher invertebrates.

Detailed Course Description:

- Describe different phyla of higher invertebrates: annelids, molluscs, arthropods, and echinoderms. **(5 hrs)**
- Examine the nature of the animal cell and origin of multi-cellular organisms **(5 hrs)**
- Nature of animal cell and origin of multicellular organisms **(5 hrs)**
- Evolutionary relationships among groups **(10 hrs)**
- Structure and organisation of invertebrate body (segmentation development of cephalisation, development of coelom (nature and origin) **(3 hrs)**
- Symmetry and its importance **(3 hrs)**
- Outlines of classification **(4 hrs)**
- Distribution **(5 hrs)**
- Economic importance **(7 hrs)**
- **Practicals** **(30 hrs)**

Mode of delivery:

Lectures, practicals, and fieldwork

Assessment :

Practical reports, assignments, tests (all contributing 40% and exams 60%).

vii) Course Name : VERTEBRATES I

Course Level : 1

Course Credit : 3 CU

Brief Course Description

This course will cover vertebrate origins and evolution; general characteristics of vertebrates: primitive chordate types with particular emphasis on Branchiostoma; invertebrate origins ofthe chordates; the geological time scale and succession of vertebrate life. The origins, fossil record, characteristic features adaptive radiation and array of vertebrates' race illustrated by reference to the following groups: ostracoderms, placoderms, cyclostomes, cartilaginous and bony fishes, amphibians, reptiles, birds and mammals. The functional morphology, phylogeny, natural history and aspects of physiology and development of the above-mentioned groups will be emphasized.

Course Objectives:

At the end of the course, the student should be able to:

- Distinguish Protochordates and chordates from all other animal phyla
- Describe the origins and evolution of vertebrates: fish, amphibians, reptiles, birds and mammals.
- Explain the distinguishing characteristics of each vertebrate class.
- Discuss the taxonomic classification of vertebrate classes.
- Outline the zoogeographical distribution of mammals.

Detailed Course Description

Mode of Delivery:

Lectures, assignments tutorials and practicals.

Assessment:

Tests, assignments and practicals (40%) and examination (60%) total 100%

iii) Course Name : VERTEBRATES

Course Level : 2

Course Credit : 3 CU

Brief Course Description:

This course examines Chordates and origin of vertebrates; their classification, structure, distribution, evolutionary relationships and their economic importance.

Course Objectives:

At the end of the course, the students should be able to:

- Understand and describe the evolutionary interrelationships of chordates
- Understand and highlight the structure, diversity, distribution, ecological and economic importance of the vertebrates.

Detailed Course Description:

- Chordates and origin or vertebrates. Structure and function of notochord (e.g. Amphioxus) **(4 hrs)**
- Characteristic features of different classes. **(7 hrs)**
- The vertebrates without jaws (Agnatha), organisation of the head evolution and adaptive radiation of elasmobranches. **(3 hrs)**
- The functional morphology, phylogeny, natural history and aspects of physiology and development of vertebrates with jaws (gnathostomata); fishes, amphibians, reptiles, birds and mammals. **(10 hrs)**
- Ecology of vertebrates **(3 hrs)**
- Economic importance **(3 hrs)**
- **Practical** **(30 hrs)**

Mode of Delivery:

Lectures, practicals and fieldwork

Assessment:

Practical reports, assignments, tests (all contributing 40%) and examination (60%) total 100%.

iv) Course name : INTRODUCTORY ECOLOGY
Course Level : 1
Course Credit : 3 CU

Brief Course Description:

This course will introduce ecological principles and concepts applying to ecosystems, community and populations.

Course Objectives:

At the end of the course, the students should be able to:

- Define and explain ecological principles and concepts
- Understand and explain natural ecosystem and interaction between living and no-living things
- Understand natural resources and environment and gain skills for their management.

Detailed Course Description

- Definition of ecology, scope, meaning and importance of ecology **(2 hrs)**
- Ecosystem, habitat, niche and guild concepts. **(3hrs)**
- Structure of ecosystem (biotic and biotic) components, examination of interrelationships (symbiosis) **(4hrs)**
- Studies on representative ecosystems e.g. grasslands, wetlands, soil, forests etc **(5 hrs)**
- Functions of ecosystems: autotrophy, heterotopy and decomposers **(4 hrs)**
- Biogeochemical cycles – mineral cycles or nutrient cycles, carbon, oxygen, nitrogen, and phosphorus **(3 hrs)**
- Ecosystem development; succession, climax community concepts, ecological diversity stability and ecosystem **(5 hrs)**
- Ecology of population: define a population, sampling population density and dynamics, regulation of population. **(2 hrs)**
- Uses and application of ecology to human life. **(2hrs)**

- **Practicals and Field Work** **(30 hrs)**

Mode of delivery:

Lectures, practicals, fieldtrips and project work

Assessment:

Field reports, assignments, tests (40%) and examination (60%).

v) Course name : CELL BIOLOGY

Course level : 2

Course Credit : 4 CU

Brief Course Description:

Introduces the concept of a cell as a unit of life. Examines the

cell structure, function and cell cycle.

Course Objectives:

At the end of this course students should be able to:

- Explain the principles of microscopy (theory) and application
- Describe the concept of a cell as a unit of life and the cell cycle
- Describe the role of a cell in growth, inheritance and reproduction.
- Describe the structure and functions of prokaryotic and eukaryotic cells
- Describe the structure and function of the endomembrane system

Detailed course description

- Principles of microscopy (theoretical and practical aspects). Light microscopes and other types including electron microscope. Importance of microscope in contribution to cell knowledge. **(6 hours)**
- An overview of the cell/cell theory **(3 hours)**
- Generalised structure of prokaryotic and eukaryotic cells. **(3 hours)**
- Intra cellular endomembrane system (organelles)such as the nucleus golgi complex, lysosomes, peroxisomes, endoplasmic reticulum, ribosomes mitochondria/chloroplast in plant cells and the plasma membrane, their structure and function. **(12 hours)**
- Specialisation of cell membrane: microvillosites, the cell coat, the case of plant cells and prokaryotes. **(5 hours)**
- The nucleus of the cell; aspect during the inter-phase membrane, chromatin, interchromatin spaces, nucleus. The cell cycle (inter-phase, mitosis, chromosomes, meiosis) **(10 hours)**
- Cytoplasm, cytosol and cytoskeleton: structure of microtubules, microfilament, their function of microtubules and microfilaments in cell motility, cell division, movement of secretory vesicles and beating of flagella and cilia. **(6 hours)**
- **Practicals** **(30 hrs)**

Mode of Delivery:

Lectures, assignments, tutorials and practicals,

Assessment:

Tests, assignments and practicals (40%) and examination (60%)

vi) Course Name : REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY

Course Level : 2

Course Credit : 4 CU

Brief Course Description

This course will deal with the importance and significance of reproduction, embryology, gametogenesis, the role of hormones, fertilisation, implantation and type of placentas.

Course objectives

By the end of the course, the student should be able to:

- Understand the importance and significance of reproduction and sex determination;
- Describe the process of, blastulation and gastrulation;
- Compare and contrast the developmental stages among amphioxus, frog , pig and man ;
- Identify the different embryonic membranes and where they are found ;
- Examine and describe the changes in development of in the chick ;
- Describe the development of the man embryo from fertilization till birth.

Detailed Course Description:

- Embryology of *Amphioxus* , development *of Amphioxus* **(4 hrs)**
- Embryology of Amphibia **(4 hrs)**
- Embryology of chick, the establishing of the body and laying down of the organ systems as exemplified by the chick **(14 hrs)**
- From the primitive streak stage to the appearance of Somites. **(2 hrs)**
- The notochord, the primitive streak as the centre of early growth, regression of the primate streak, caudal growth and cephalic precocity, growth of the endoderm and establishment of the primitive gut. **(9 hrs)**
- Growth and early differentiation of the mesoderm and formation of the neural plate. **(1 hr)**
- Formation of the blastula in *Amphioxus*, Amphibia, chick and mammals **(2 hrs)**
- Gastrulation in *Amphioxus*, Amphibia, chick and mammals. **(2 hrs)**
- Formation of the germ layers and origin in *Amphioxus*, Amphibia, chick and mammals **(2 hrs)**
- Organizers , induction , transplants and heteroblastic grafting (**1 hr)**
- **Types of placentas**: Development of 7mm pig embryo, external morphology internal morphology, spinal nerves, neural tube **(2 hrs)**
- **Human development**: human embryos and multiple births **(2 hrs)**
- **Practicals** **(30 hrs)**

Mode of delivery:

Lectures, assignments, tutorials and practicals

Assessment:

Practicals, assignments and tests (40%) and examination (60%)

viii) Course name : VERTEBRATES II

Course Level : 2

Course Credit : 4 CU

Brief Course Description

This course deals with **vertebrate structure and function:** comparative anatomy and physiology illustrating evolutionary changes an advances for different modes of life in different vertebrate groups.

Course Objectives:

At the end of the course, the student should be able to:

- Understand the basic structure of vertebrates
- Compare the external and internal structures of different vertebrate groups
- Understand and explain the functional significance of the systems of the evolutionary adaptations of different groups

Detailed Course Description:

Examination of comparative anatomy and physiology of different vertebrates with respect to the following functions:

- Adaptations to external environment **(5 hrs)**
- Habitat and modes of life, e.g. social organization **(8 hrs)**
- Feeding and nutrition (includes adaptations for food acquisition in different groups **(9 hrs)**
- Locomotion: biomechanics of musculature and skeletal systems **(6 hrs)**
- Internal regulation (circulatory, endocrine and nervous systems and thermoregulation **(9 hrs)**
- Reproduction, sexual reproduction, mating systems and parental care **(8 hrs)**
- **Practicals** **(30 hrs)**

Mode of Delivery:

Lectures, assignments, tutorials, practicals and field work

Assessment:

Practicals, field reports, tests (40%) and examinations (60%)

ix) Course Name : ENTOMOLOGY

Course Level : 2

Course Credit : 3 CU

Brief Course Description:

Class Insecta:

Classification of the orders, function, morphology; cuticle structure and function; ventilation (gaseous exchange), feeding and digestion (i.e., habits and adaptations). Circulation, excretion and water balance, neuroendocrinology and growth, molting and, phylogeny, systematics and identification of some pests and vectors, reproduction, locomotion, biotic associations, communications and behaviour.

Course Objectives:

By the end of the course students should be able to:

- Differentiate between the various groups of insects;
- Describe the external and internal structure of an insect;
- Describe the functions of the external and internal structures of an insect.

Details of Course Descriptions:

- Classification of insects. Distinguishing features of each of the various orders of insects. **(3hrs)**
- Functional morphology of the external and internal organization of an insect. **(3 hrs)**
- Structure and function of the cuticle **(2 hrs)**
- Ventilation (i.e. gaseous exchange) **(1 hr)**
- Nervous system and neurobiology **(1 hr)**
- Feeding and digestion **(2 hrs)**
- Circulation (.e. blood system) **(1 hr)**
- Excretion and water balance **(1 hr)**
- Neuroendoctrinology **(3 hrs)**
- Growth and moulting **(1 hr)**
- Phylogeny **(2 hrs)**
- Insect physiology **(2 hrs)**
- Taxonomy **(2 hrs)**
- Reproduction **(2 hrs)**
- Communications and behaviour **(1 hr)**
- Locomotion, including wing structure, function **(1 hr)**
- Biotic association including identification of some pests / parasites **(1 hr)**
- Economic importance **(1 hr)**
- **Practicals** **(30 hrs)**

Mode of Delivery:

Lectures, assignments, tutorials, practical and fieldwork.

Assessment:

Practicals, field reports and tests (40%) and examination (60%

x) Course Name : EVOLUTIONARY BIOLOGY

Course Level : 2

Course Credit : 3 CU

Brief Course Description

The course covers the explanation of the probable origin of life, the underlying mechanisms governing genetics, anatomy and behaviour among different groups and evidences of evolution.

Course Objectives

By the end of the course students should be able to:

- Describe probable origins of life;
- Explain why there is remarkable similarity in the underlying mechanisms governing genetics, anatomy, physiology and behaviour among different groups of organisms;
- Describe the mechanisms that maintain genetic and ecological diversity among populations;
- Explain the importance of evolutionary theory to other disciplines in the biological and social sciences.

Detailed Course Description

- History of Early Earth and Origins of life **(4 hrs)**
- Pre-Darwinian theories of evolution and Darwinian theory of evolution **(4 hrs)**
- Evidence for evolution and mechanisms of natural selection, sexual selection **(6 hrs)**
- Neo-Darwinian theory of evolution and Diversity and variability in evolving populations **(5 hrs)**
- Genetic processes, Hardy-Weinberg Principle and Polymorphism **(3 hrs)**
- Other mechanisms of evolution (mutation, genetic drift, founder principle, etc) **(3 hrs)**
- The species concept, modes of speciation and co-evolution **(5 hrs)**
- Adaptive radiation and evolution of supra-specific categories **(4 hrs)**
- Biological classification of organisms and phylogeny **(4 hrs)**
- Evolution of social behaviour and implications of evolutionary theories **(7 hrs)**

Mode of Delivery:

Lectures, tutorials and assignments

Assessment:

Assignments and tests **(**30%) and examination **(7**0%)

xi) Course Name : PARASITOLOGY

Course Level : 2

Course Credit : 3 CU

Brief Course Description

The course covers biological associations, types of parasites and hosts. Evolution of parasitism, geographical distribution of parasitic diseases; the host-parasite relationships, immunity and disease and parasitic groups.

Course Objectives

By the end of the course, the students should be able to:

- Describe the morphology of various parasites
- Describe the global and local distribution of parasites
- Describe the life cycles of parasites
- Use diagnostic features in identification of parasites
- Describe possible strategies for control of parasites
- Indicate the economic importance, both global and local of various parasitic groups (e.g. number of countries affected, number of people considered to be at risk, estimated number of cases

Detailed Course Description

(a) Classification of parasites: **(5 hrs)**

- Categories the organisms constituting each of the following groups:
- Single-celled (protozoan) parasites
- Multicellular (helminthic) parasites
- Arthropods (mostly ectoparasites)

(b) Protozoan parasites affecting the: **(7 hrs)**

- Gut and the urinogenital system
- Blood or tissue
- Skeletal system
- Integument (i.e. skin)

(c) Multicellular (helminthic) parasites: **(7 hrs)**

- Monogenea versus Digenia
- Blood helminthes
- Long helminthes
- Liver flukes
- Intestinal flukes

(d) Arthropods as: **(7hrs)**

- Ectoparasites
- Endoparasites
- Intermediate hosts
- Vectors of pathogens

(e) Mention of Non-parasitic disease – causing organisms **(4 hrs)**

- Viruses
- Bacteria
- Fungi

(f) Practicals **(30 hrs)**

Mode of Delivery:

Lectures, assignments, tutorials and practicals

Assessment:

Practicals, tests and assignments (40%) and examination (60%)total100%

xii) Course Name : BIOGEOGRAPHY

Course Level : 2

Course Credit : 3 CU

Brief Course Description

This course Coverst the regional and global distribution of animals, the environmental factors governing their distribution, the nature and origins of ecological realms and its subdivisions. The ecology, cause of dispersal and evolution of animals.

Course Objectives

By the end of the course, the students should be able to:

- Describe the distribution of plants and animals around the world
- Identify and explain the various plants and animals on earth and account for the possible factors that influenced their evolution and current distribution
- Understand the theory of island biogeography and explain how such information may be used to conserve the present day biodiversity

Detailed Course Description (45 hrs)

- Introduction to biogeography
- Dispersal and distribution of Species
- Factors influencing distribution of animal groups
- Concepts of species richness and diversity
- Continental drift (plate tectonics) and its relationship to biogeographic processes, especially to dispersal and distribution
- Biogeographic realms, provinces and regions of the world
- In-depth discussion of the flora and fauna patterns of biogeographical realm of Afrotropical
- The theory of Island Biogeography
- Island Biogeography and the Equilibrium theory
- Historical causes of disjunct biogeographic distributions
- Palaecology and historical biogeography
- Application of Biogeographic concepts to conservation to conservation of biological diversity

Mode of Delivery:

Lectures, tutorials and assignments

Assessment:

Tests and assignments (30%) and examination (70%) total 100%

xiii) Course Name : HISTOLOGY

Course Level : 2

Course Credit : 2 CU

Brief Course Description

This course provides an introduction to histology and histological techniques, microscopy, comparative histology of tissues, techniques of tissue fixing, sectioning and staining; classification, identification and functions of tissues; histochemical techniques.

Course Objectives

The objectives of the course are to enable students to:

- Master the skills in the manipulation of microscopy;
- Learn techniques for fixing, sectioning, staining and mounting;
- Interpret organ tissues from micro-structures;
- Distinguish diseased tissues from normal tissues;
- Understand and apply histo-chemical techniques;

Detailed Course Description

- Introduction to histology and histological techniques **(2 hrs)**
- Approaches comparative histology tissues **(3 hrs)**
- Evolutionary and histo-physiological approach **(3hrs)**
- Classification and identification of tissues **(2 hrs)**
- Structure, functions and distribution of animal tissues **(3 hrs)**
- Histo-chemical techniques **(2 hrs)**
- **Practicals** **(30 hrs)**

Mode of Delivery:

Lectures, tutorials, assignments and practicals

Assessment:

Tests, Practical and assignments (40%), and examination (60%)

xiv) Course Name : COMPARATIVE ANIMAL PHYSIOLOGY

Course Level : 2

Course Credit : 3 CU

Brief Course Description

This course covers organismic and population physiology. Phylogenic approach to the study of systems integrating invertebrate and vertebrate body functions in relation to environmental conditions; internal control of the body and homeostasis; coordination of body functions in response to external environment; feeding, nutrition and energy production as support to all the body functions.

Detailed Course Objectives

The objectives of this course are to enable students to:

- Understand and describe the biological body systems that support the integrity of the body
- Explain how the intrinsic and extrinsic factors control body functions
- Explain the proximate and ultimate factors in the integration of individual and animal populations in the environment.

Detailed Course Descriptions

- **Nutrition** **(6 hrs)**

  -Types of heterotrophic nutrition and modes of feeding

  -Mechanisms of digestion, absorption and assimilation

- **Osmoregulation and excretion** **4 hrs)**

  -Osmoregulationin fresh and marine protozoans, marine fish, terrestrial animals, including earthworms, snail, arthropods, insects, amhibians, birds and mammals.

  -Types excretory products

- **Comparative circulatory system** **(5 hrs)**

  -Types and characteristics of circulatory systems in animals

  -Types of oxygen carrying pigments

- **Gaseous exchange** **(5 hrs)**

  -Different types of respiratory surfaces and their characteristics in promoting gaseous exchange

- **Locomotion** **(5 hrs)**

  -Modes and types of locomotion in various media

  -Efficiency of various types of locomotion in animals

- **Coordination and Homeostasis in animals** **(5 hrs)**

  -General functions of coordination in lower and higher animals, types of coordination, including nervous and chemical coordination

  -Coordination of body functions in response to external environment

- **Practicals** **(30 hrs)**

Mode of Delivery:

Lectures, assignments, tutorials and practicals

Assessment:

Practicals, assignments and tests (40%) and examination (60%)

ELECTIVE COURSES IN ZOOLOGY :

(i) Commercial Entomology

(ii) Applied Entomology

(iii) Fisheries Biology

(iv) Integrated Pest and Vector Management

(v) Applied Human Ecology

(i) Forms, structures and classification for kingdoms Protista, Monera, Fungi and Plantae

(ii) Flowering plant growth and development

(iii) Plant Diversity and evolution Part I - Viruses, bacteria and fungi

(iv) Plant diversity and evolution Part II - lower plants – algae, mosses, ferns, lichens and gymnosperms

(v) Introduction to plant functions (3CU)

(vi) Plant diversity and evolution Part III - higher plants – angiosperms

(vii) Plant biochemistry (4CU)

(viii) Elementary genetics (2CU)

(ix) Plant - water relations and mineral nutrition (3CU)

(x) Applied bacteriology and virology (3CU)

(xi) Weed biology (3CU)

(xii) Crop improvement methods and plant biotechnology (4CU)

Electives

(i) Genetics

(ii) Microbiology and Plant Pathology

(iii) Wildlife and Natural Resources Ecology

(iv) Advanced Plant Taxonomy

(v) Plant Physiology

Zoology Courses

(i) Invertebrates I - Lower invertebrates

(ii) Invertebrate II - Higher invertebrates

(iii) VERTEBRATES I (Vertebrate origin, Evolution and General Characteristics).

(iv) VERTEBRATES II (Vertebrate Structure and Function)

Introductory ecology

(i) Cell Biology

(i) Reproductive And Developmental Biology

(iii) Entomology

(iv) Evolutionary Biology

(v) Parasitology (3cu)

(vi) Biogeography

(vii) Histology

(viii) Comparative Animal Physiology

(ix) Human Ecology (To Be Recast)

Requirements for Zoology

- Vehicles for transport
- Microscopes – binocular and high power and accessories
- Collecting equipment for aquatic organisms
- Glassware
  - for collecting
  - for culture and storage
  - for mounting slides

- Culture substances and media
- Insect collecting, capture and culturing facilities
- Insects boxes, pins etc
- Chemicals, preservation of speciment, section slides (alcohol, formalin etc)
- Apparatus for slide making
  - fixing
  - cutting (mirco
  - storage cabinets
- Bone collections for teaching anatomy
- Museum specimens of invert……
- Physilogical equipment
- Reagents for physiological experiments
- Fishing gear for fisheries studies
- Camping gear for field work

Requirements

Chemicals

- Reagents
  - Organic acids
  - Inorganic acids

- Equipment
- Centrifuges
- Incubators

- Water baths
- Heating blocks
- Vorted mixers
- Fridges
- Deep freezers
- Electrophoresis apparatus
- Blotter
- ELISA machine
- Chromatography apparatus
- Chromatography colums
- Blenders
- Heating mantles
- Freeze-dryer
- Rotary evaporators
- Thermocyclers
- Refractometers
- Thermometers
- Luminarflow cabinets
- Micro-plate reader
- Fourier-transform spectroscopy
- Spectrophotometers (U/V – visible)
- High-performance liquid chromatography system
- Glassware
- Conical flasks (in their various sizes)
- Beakers (in their various sizes)
- Volumetric flasks (in their various sizes)
- Measuring cylinders in their various sizes)
- Petri-dishes
- Burrets
- Pipettes
- Cuvetts
- Test tubes
- Universal bottles
- Sample bottles
- Soxhlet apparatus

Plastic ware

- Rubber tubings
- Beakers
- Measuring cylinders
- Pipette tips (in various sizes)
- Pipette trip boxes
- Epiendorf tubes
- PCR tubes
- Colorimeters
- Weighing balances
- Transilluminator
- Ovens
- Furnace
- Distillers
- autoclave

MINIMUM COURSE REQUIREMENT FOR CORE MATHEMATICS PROGRAMMES

Teaching and Assessment Pattern

The following were agreed upon:

Duration of Courses

The contents of the courses will be covered in one 15-week academic semester with three[1] hours of instruction per week and weekly one-hour problem sessions to go over the assignments or homework or tests.

Mode of Instruction

- Most of the instruction will be lecture-oriented, but students can still interrupt the instructor and ask some questions;
- Students are encouraged to seek help outside the Lecture Room from fellow students, the course instructor, other mathematics instructors or the web/internet;
- There will be fortnightly assignments;
- There will be at least two major homework assignments and two tests.

Assessment Pattern

The following instruments will be used to assess the extent of growth in skills, abilities and understanding acquired:

Requirements	No. of units	Contribution
Homework	(3)	10%
Research Assignment	(2)	20%
Tests	(2)	20%
Final examination	(1)	50%
Total		**100%**

All scores will then be converted to letter grades using the system shown below:

Responsibility of the Student

Regular attendance; do all assignments, homework, and tests

Responsibility of the Course Lecturer

- Regular and punctual teaching;
- Accurate and prompt grading of assignments, homework, tests and examinations and
- Available to assist students after formal lectures.

Programme Content

The following were the suggested core courses:
Some courses could, however, be covered in less than 15 weeks or 2 hours per week spread over the semester.

1. Calculus 1
2. Calculus II
3. Elements of probability and Statistics
4. Linear Algebra
5. Differential Equations I
6. Differential Equations II
7. Numerical Analysis I
8. Real Analysis
9. Linear Programming
10. Abstract Variable
11. Complex Variables I

The following were the suggested Electives:

1. Calculus III
2. Graph Theory
3. Number Theory
4. History of Mathematics
5. Classical Mechanics
6. Discrete Mathematics
7. Graph Theory
8. Statistical inference

SUGGESTED CORE COURSES FOR THE MATHEMATICS PROGRAMMES

1. Course Name : CALCULUS I

Course Code :

Course Description

This is an introductory course that is divided into the following six major topics:

- Functions
- Limits
- Differentiation
- Applications of differentiation
- Integration
- Applications of the definite integral.

The content of the course is selected in such way that it assumes no prior knowledge of the subject by the student.

Course Objectives

This course is intended

- To impart basic competence in the concepts, principles, procedures and applications of calculus;
- To encourage orderliness, speed and accuracy in the presentation of mathematics;
- To assist students to express themselves in proper mathematical language and using mathematical symbols correctly;
- To help students apply their knowledge of calculus to find solutions to real–life problems.

Course Outline

Review of Functions and Graphs

Limits

The concept of the Limit, Computation of Limits, Continuity and its consequences, Limits involving infinity, Formal definition of the Limit and Applications.

Differentiation

Tangent Lines and Velocity, the Derivative, Computation of Derivatives: The Power Rule, the Product and Quotient Rules, Derivatives of Trigonometric Functions, Derivatives of Exponential and Logarithmic Functions, The Chain Rule, Implicit Differentiation, The Mean Value Theorem, Rolles' Theorem.

Applications of Differentiation

Linear Approximation and Newton's method, Maximum and Minimum Values, Increasing and Decreasing Functions, Concavity, Overview of Curve Sketching, Optimization, Rates of Change and Applications.

Integration

Anti-derivatives, Riemann Sums and Sigma Notation, Area, The Definite Integral, The Fundamental Theorem of Calculus, Techniques of Integration.

Applications of the Definite Integral

Area between Curves, Volume, Disc**,** Shell**,** Arc Length and Surface Area,

Introduction (3 Hrs)

- Functions of one variable (domain and range)
- Roots, quadratic formula, factor/remainder theorems and synthetic division
- Linear equations: general form, slope-intercept, formulating equation, parallel/ perpendicular, distance and mid-point
- Trigonometric Functions
- Simplification of algebraic fractions
- Composite functions
- Absolute value functions

Limits and their properties (3Hrs)

- Introduction
- Techniques for evaluating limits
- Continuity and one-sided limits

Basic Differentiation (3Hrs)

- Definition
- Proof of differentiability
- Distinguish between continuous and differentiable
- Differentiation: Polynomials, constant functions, and sine/cosine functions

Differentiation Extended (6Hrs)

- Product Rule
- Quotient Rule
- Chain Rule
- Trigonometric Functions
- Implicit

Application of Differentiation (6 Hrs)

- Related Rates
- Curve Sketching
  - Extrema on an interval
  - Mean Value Theorem
  - Increasing/decreasing functions and 1st Derivative Test
  - Concavity and 2rd Derivative Test (points of inflection)
  - Limits at Infinity: horizontal asymptotes, oblique asymptotes and vertical asymptotes
- Optimisation (applied minimization/maximization problems: sum, distance, area and volume)

Integration (3Hrs)

- Antiderivatives and indefinite integration
- Integration by substitution ⇒ change of variable
- Area, Remain Sums and the Definite Integral
- The Fundamental Theorem of Calculus

Inverse Functions (differentiation/integration) (3 Hrs)

- Exponential ($f(x) = e^u$)
- Logarithmic
- Exponential ($f(x) = a^u$)
- Inverse Trigonometric (arcsin, arctan, arcsec)

Application of Integration (6 Hrs)

- Area of a region between two curves (points of intersection, sketch, and representative)
- Volume: Disc/Washer Method
- Volume: Shell Method
- Arc Length and Surfaces of Revolution

Integration Techniques (6 Hrs)

- Review of elementary integration formulae and techniques
- Integration by parts $\int u\,dv - \int v\,du$
- Trigonometric Integrals
- Trigonometric Substitution
- Partial fractions

Course Name : CALCULUS II

Course Code: (This is a level 2 course – extension of Calculus I)

Course Description

This is an introductory course to Calculus that is divided into the following eight major topics:

- Conics and Polar Equations
- Parametric Curves
- Vectors in the Plane and Space
- Lines and Planes in Space
- Motion and Vector – Valued Function
- Partial Differentiation
- Multiple Integrals
- Vector Analysis

The content of the course is selected in such way that it is a continuation of differentiation and integration taught in Calculus I.

Course Objectives

This course is intended :

- To impart basic competence in the concepts, principles, procedures and applications of calculus
- To encourage orderliness, speed and accuracy in the presentation of mathematics
- To assist students to express themselves in proper mathematical language and using mathematical symbols correctly
- To help students apply their knowledge of calculus to find solutions to real–life problems.

Course Description

Analytical Geometry

The four conics (parabola, ellipse, circle and hyperbola) and their equivalent representation as polar equations.

Parametric Curves and Vectors in a Plane/Space

Parametric Curve used to find: area, volume, arc length and area of surface of revolution for smooth parametric curves. The arithmetic of vectors and their use in finding area, volume and angles.

Lines and Planes in Space

Determine the equation of a line, a plane and the angle between lines and planes.

Motion and Vector – Valued Functions

Define and use position vector, velocity vector and acceleration vector. Fine the derivatives/integrals of vector – valued function. Discuss curature of plane curve and curves in space. Determine: arc length of curves, unit tangent vector, curvature, principal unit normal vector normal/tangential components of acceleration.

Partial Differentiation

All the main ingredients of single – valued differential calculus (limits, derivatives and rates of change, chain rule computations, and max/min techniques) can be generalized to functions of two or more variables. Determining the gradient at a point on a surface in any direction. Finding the extreme of functions of variables.

Application of the Definite Multiple Integrals (Double and Triple)

Area between Curves, Volume, Arc Length and surface Area.
Given the density functions of a solid: mass, centroid and moments of inertia.

Vector Analysis

Application of vector fields, line integrals, independence of path, Fundamental Theorem of Line Integrals Green's Theorem and its corollary, surface and integrals, Divergence Theorem, outward normal vectors to a surface, and Stoke's Theorem (giving the relationship between a surface integral over an oriented surface S, and a line integral over a closed space curve C forming the boundary of S)

Suggested Teaching Program

Conic Section, Polar Coordinates and Surfaces (Chap 10 and 13.6) (6Hrs)

- Define and determine loci of points

- Define and sketch each of the conic sections (circle, parabola, ellipse and hyperbola)
- Define polar coordinates
- Convert from rectangular coordinates/equations to polar coordinates/equations
- Given an equation of a surface in space to be able to write in standard form, name, give axis and traces.

Parametric Curve (Chap. 12: 1-2) **TEST 1**

Assignment 2 **(3Hrs)**

- Define parametric curve
- Use polar curve as parametric curves
- Determine tangent line to parametric curves
- Find area, volume arc length and area of surface of revolution for smooth parametric curves.

Vectors in the Plane and Space (12:3, 13: 1-2)

Assignment 3

Define vectors, position vector, equality of, addition of, multiplication by a secular, unit vector, length

- Define dot product and its interpretation
- Test for perpendicular vectors
- Determine direction angles
- Define and use vector products, scalar triple products (area, volume, angles)

Lines and Planes in Space (Chap 13:3)
Assignment 4

(3Hrs)

- Write parametric and symmetric equations of straight lines space
- Write the equation of a plane
- Find the angle between planes

Motion and Vector – Valued functions (Chap 12:4, 13:4-5)

Assignment 5

- Define position vector=r(t); velocity vector=v(t)=r'(t); and acceleration vector=a(t)=r"(t)
- Find the derivatives and integrals of vector-valued functions in 2- and 3-dimensions.
- Discuss curvature of plane curves, and curves in space
- Determine: arc length of curves, unit tangent vector, curvature, principal unit normal unit vector, normal vector, normal and tangential components of acceleration.

Partial Differentiation (Chap 14) Test 2,

Assignment 6 **(9 Hrs)**

(All the main ingredients of single-valued differential calculus {limits, derivatives, rates of change, chain rule computations and max/min techniques} can be generalized to functions to two or more variables).

- Determine partial derivatives in general at a point and tangent planes to a surface
- Find the maxima and minima of functions of several variables in general and over a closed region
- Determine incrementals and differentials
- Use the chain rule for the derivative of functions of functions
- Define and use implicit partial differentiation

- Determine directional derivatives and the gradient at points on a surface in any given direction
- Determine the relative extrema of functions of two variables.

Multiple integrals (Chap 15)

Assignment 7 **(6 Hrs)**

1. Double Integrals (15:1-2)
   - Determine double integrals over a rectangle
   - Determine double integrals over more generalized region
   - Sketch the region given a double integral and then reverse the limits of integration

2. Area and Volume (15:3)
   - Use double integrals to find the area between two curves
   - Use double integrals to find the volume below a surface and above a specified bounded region and surface area

3. Triple Integral (15:6)
   - Find the volume of a solid, or volume between two surfaces
   - Find the mass given the density function of a solid
   - Find the coordinates of a masses centroid
   - Find the moments of inertia about the 3 coordinate axes
   - Use of cylindrical and spherical where appropriate

Test 3

Vector Analysis (Chap 16)

Assignment 8

(12 Hrs)

1. Vector Field (16:1)
   - Study functions that assign a vector to a point in the plane or a point in space
   - Sketch the force field with representative vector
   - Determine whether a vector field is conservative
   - Determine the divergence of a vector field

2. Line Integrals (16:2)
   - Determine the length of a curve in the plane or space
   - Determine the line integral of a vector field

3. Independence of Path (16:3)
   - Show that the line integral is independent of path if the vector field is conservative
   - Determine and use the Fundamental Theorem of Line Integrals

4. Green's Theorem in a Plane (16:4)
   - Use Green's Theorem to evaluate line integrals
   - Use the corollary to Green's Theorem to evaluate area of a region bounded by piecewise closed curve

5. Surface Integrals (16:5)
   - Sketch and determine the surfaces of a solid
   - Determine the surface area of a solid using its projections

6. The Divergence Theorem (16:6)
   - Discuss the extension of Green's Theorem to three-dimensions

- Use and verify the Divergence Theorem given solids and a force field
- Find outward normal vectors to a surface

7. Stokes Theorem (16:7)
- Illustrate the a Theorem as an analogue of Green's Theorem
- Show that the line integral over a closed space is equal to the surface integral over an oriented surface

Course Name : ELEMENTS OF PROBABILITY AND STATISTICS

Course Code : (This is a level 1 course)

Course Description

Probability is measured in the scale from 0(=impossible) to 1(=certainty). If two events are equally likely to occur, the probability assigned to each event is 0.5. Statistics on the hand has no single definition. Statistical techniques provide descriptive procedures for classifying and converting a mass of quantitative data into a comprehensible form. Statistics also provides inductive techniques for using principles of mathematical probability to obtain generalizations from sample data that may be applied to the lager population. Probability and statistics have wide application in virtually all aspects of human endeavour such as industrial processes, telecommunication, aviation industry, commerce, politics, environment, health and demography just to cite a few examples.

Course Objectives

The purpose of this course is to introduce students at an early stage in a university program to many of the important concepts and procedures they are likely to need in order to:
- Improve their ability to make better decisions over a wide range of topics
- Improve their ability to measure and cope with changing conditions both at home and on the job
- Explain statistical procedures and interpret the resulting conclusions
- Help students apply their knowledge of statistics to find solutions to real life problems.

Detailed Course Curriculum

1 Descriptive Statistics (3Hrs)

Definition: data, statistics, elements, variables etc.
Data representing tabular and graphical i.e bar graph, pie chart, frequency distribution, relative frequency, histogram, cumulative distribution, ogive – explanatory data analysis: stem and leaf plot measures of location: mean media mode, percentiles quartiles.

2. Introduction to Probability (6Hrs)

- Experiment, sample space and counting rule
- Events and their probabilities
- Relationship of probability: component, addition law
- Conditional probability: independent events, multiplication law

3. Probability Distributions (6Hrs)

- Random variables
- Discrete probability distribution binominal, poisson
- Expected value, variance, permutation and combinations

- Continuous probability distributions
- Uniform probability, Normal probability distribution

4. Estimation and Sampling Theory Distribution (6Hrs)

- Definitions: population, sample
- Simple random sampling: finite and infinite populations
- Point estimation
- Interval estimation: population mean

5. Hypothesis Tests (9 Hrs)

- Development of null and alternative hypothesis
- Type I and II errors
- One tailed test about a population mean
- Two tailed test about population mean
- Hypothesis testing and decision making

6. Regression and Correlation (9 Hrs)

- Scatter plots
- Regression line and regression equation
- Correlation: Spearman's rank of correlation
- Kendal's rank of correlation

Course Name : LINEAR ALGEBRA

Course Code :

Course Description

Linear Algebra is an essential part of the mathematical background required of mathematicians, economists, engineers, physicists and other scientists.

- Systems of Linear Equations and Matrices
- Determinants
- Vector Spaces
- Linear Transformations
- Orthogonality

Course Objectives

By the end of this course, students should be able to

- find solutions to systems of linear equations using a number of methods
- explain the concept of vector spaces and their properties
- translate appropriate real-life problems into a suitable form to be solved using the knowledge of linear systems, vector spaces, linear transformations, etc.

Detailed Course Outline

Matrices and systems of equations (6 Hrs)

- Systems of Linear Equations
- Row Echelon Form
- Matrix Algebra
- Elementary Matrices
- Partitioned Matrices

Assign 1

Determinants (3Hrs)

- The Determinant of a Matrix
- Properties of Determinants
- Cramer's Rule

Assign 2

Test 1

Vector spaces

- Definition and Examples
- Subspaces
- Linear Independence
- Basis and Dimension
- Change of Basis
- Row Space and Column Space

Assign 3

Linear transformations (6Hrs)

- Definition and Examples
- Matrix Representations of Linear Transformations
- Similarity

Assign 4

Test 2

Orthogonality (9Hrs)

- The Scalar Product in Rn
- Orthogonal Subspaces
- Inner Product Spaces
- Least Squares Problems
- Orthonormal Sets
- The Gram-Schmidt Orthogonalisation Process

Assign 5

Eigen Values (6Hr)

- Eigenvalues and Eigenvectors
- Systems of Linear Differential Equations
- Diagonalisation

Assign 6

Course Name : DIFFERENTIAL EQUATIONS 1

Course Code :

Course Description

Pre-requisite: Calculus I

This is an introductory course to ordinary differential equations including related topics.

It is divided into the following 5 major topics:

- First Order Differential Equations
- Second Order Differential Equations
- Higher Order Differential Equations
- Power series & its Applications
- Introduction to Systems of Linear Differential Equations

The content of the course is selected in such way that it assumes no prior knowledge of the subject by the student.

Course Objectives

This course is intended to enable students;

- Engage in logical and critical thinking
- Acquire a proficiency in the topics covered in the course
- Translate written languages into mathematical statements, interpret information, analyze given information and formulate appropriate mathematical statements.

Detailed Course Curriculum

First Order Differential Equations & their Applications (9Hrs)

Classification of DE; exact, separable, Homogeneous

Linear & Non linear differential equations
Integrating factors.
Examples include; physical process,
Chemical process like radioactive process and Biological process

Second Order Differential Equations & their Applications (9 Hrs)

Real roots, Complex roots, Uniqueness and Existence Theorem.
Undetermined Coefficients; Difference Equations.

Higher Order Differential Equations (9Hrs)

Constant coefficients, Method of under determinant co-efficiency,
Variation of parameters. Linear independence and the wronskian method of order reduction

Power series & its applications (9 Hrs)

Power series solutions of first and Second order equations.
Linear equations of nth order.

Introduction to Systems of Differential Equations; (9Hrs)

Theory of Systems of differential Equations.
Homogeneous systems of differential equations.
Application to Eigen Values

Course Name : DIFFERENTIAL EQUATIONS 2

Course Code :

Course Description

Pre-requisite: Differential Equations 1

This course is an extension of the first course in Ordinary Differential Equations to Partial Differential Equations:

It is divided into the following 5 major topics:

- Power series & Lap lace Transform
- First Order Partial Differential Equations
- Second Order Partial Differential Equations
- Application of Partial Differential Equations
- Boundary Value Problems

The content of the course is selected in such way that it assumes no prior knowledge of the subject by the student.

Course Objectives

This course is intended to enable students;

- Identify methods for finding particular solutions to PDEs that are needed in physical applications.
- Choose the right initial conditions and boundary conditions required to obtain a particular solution to a PDE.

Detailed Course Curriculum

Introduction (1 week)

- Definitions
- Remarks on PDEs.
- Classification of PDEs.

Power series & Lap lace Transform; (6Hrs)

- Fourier Series & Applications
- Orthogonal polynomials
- Lap lace transform and application to solving differential equations.

First Order Partial Differential Equations; (9 Hrs)

- Characteristic/ Auxiliary equations
- Boundary conditions and Formation of PDE.
- Non-linear first order PDEs
- Separation of variables

Second Order Partial Differential Equations; (9 Hrs)

- Characteristic Equations
- Constant coefficients
- Boundary conditions
- Separation of variables
- Hyperbolic, Parabolic, and Elliptic Equations.

Application of Partial Differential Equations; (9 Hrs)

- Wave Equation
- Heat/Diffusion equation.
- Lap lace equation

Boundary Value Problems; (3 weeks)

- Solutions by Fourier Series
- Solutions by Bessel/Legendary functions

Course Name : NUMERICAL ANALYSIS I

Course Code :

Course Description

This is an introductory course that is divided into seven major topics:

- Errors
- Solution of Nonlinear Equations
- Finite Difference Operations
- Polynomial Interpolation
- Numerical Differentiation
- Numerical Integration
- Solution of Systems of Linear Equations

Course Objectives

This course is intended:

- To impart basic competence in numerical methods of solving mathematical problems
- To enable students to determine the level of accuracy of numerical approximations
- To help students appreciate the complexity of numerical computations

Course outline

Errors (3 Hrs)

- Sources of errors
- Round-off errors
- Absolute errors
- Percentage errors

Solution of Nonlinear Equations (9 Hrs)

- Need for numerical solution
- Definition and location of root
- Methods of solution: Bisection method, Newton's method, Secant method, Method of False Position.
- Order of convergence of the iterative methods

Finite Difference Operations (6 Hrs)

- Definition and properties of Forward, Backward and Shift operators.
- Construction of Difference Tables
- Use of Difference Tables to detect/correct errors

Polynomial Interpolation (6 Hrs)

- Lagrange interpolating polynomial
- Finite difference interpolating polynomials: Newton forward difference formula, Newton backward-difference formula, Centered-difference formulas e.g. Stirling's formula.

Numerical Differentiation (6 Hrs)

- Forward/Backward-difference formula
- Derivatives from Lagrange's interpolating polynomials: Three-point formulas, Five-point formulas

Numerical Integration (9 Hrs)

- Newton-Cotes formulas
- Trapezoidal rule
- Simpson's rule
- Simpson's three-eights rule
- Composite trapezoidal rule
- Composite Simpson's rule

Solution of Systems of Linear Equations (9Hrs)

- Gaussian Elimination
- Triangular decomposition
- Jacobi iteration
- Gauss-Seidel iteration

Course Name : REAL ANALYSIS I

Course Code :

Course Description

This is an introductory course that is divided into the following six major topics:

- Real Numbers
- Sequences of Real Numbers
- Limits and Continuity
- Differentiation
- Series of Real Numbers
- Sequence and Series of Functions

The content of the course is selected in such way that it assumes prior knowledge of an introductory course in calculus.

Course Objectives

This course is intended

- To impart basic competence in the concepts, principles, procedures and applications of real analysis
- To assist students to use mathematical language and mathematical symbols correctly in formulating abstract concepts
- To help students apply their knowledge of analysis to find solutions to real–life problems.

Course Outline

Real Numbers

- What is a real number?
- Absolute values, intervals, inequalities
- The Completeness Axiom
- Countable and Uncountable sets
- Real valued functions
- Subsets of R – open, closed, bounded
- Neighborhoods
- Limit points

Sequences of Real Numbers

- Convergent sequences
- Limit theorems
- Monotone sequences
- Cauchy sequences
- Subsequences

Limits and Continuity

- Formal definition of a limit
- Continuous functions
- Intermediate and extreme value theorems
- Uniform continuity
- Monotone functions and inverses

Differentiation

- The derivative of a function
- Mean value theorems
- L'Hospital's rule
- Derivatives of higher order
- Taylors's theorem

Series of Real Numbers

- Convergence of infinite sequences
- Convergence tests
- Absolute and conditional convergence
- Rearrangements and products
- Square summable sequences

Sequence and Series of functions

- Pointwise convergence
- Uniform convergence
- Uniform convergence and continuity
- Uniform convergence and integration
- Uniform convergence and differentiation
- Power series
- Differentiation and Integration of Power series
- Taylor and Maclaurin series

Course Name : LINEAR PROGRAMMING

Course Code :

Course Description

Linear Programming deals with the allocation limited resources to competing activities. This introductory course covers mathematical formulation of Linear Programming models, solving of the Linear Programming models, and Post Optimality Analysis.

The content is divided into six major topics:

- Introduction
- The Algebra of Linear Programming Models
- The Simplex Method
- Starting Solution and Convergence
- Duality
- Post Optimality Analysis

Course Objectives

This course is intended

- To impart basic competence in formulating Linear Programming models
- To help students solve Linear Programming Problems
- To enable student to carry out Post Optimality Analysis

Course Outline

Introduction (6 Hrs)

- The Linear Programming (LP)
- Problem Linear Programming Modeling and Examples

Geometric Solution (6 Hrs)

- Solution Space
- Unique finite optimal solution
- Bounded region
- Unbounded region
- Basic and optimal solutions to an LP problem

The Algebra of LP models (6 Hrs)

- Convex Sets and convex functions
- Polyhedral sets
- Polyhedral cones
- Extreme points
- Connection between basic solutions and Extreme points

The Simplex Method (9 Hrs)

- Extreme Points and Optimality
- Basic Feasible Solutions
- The Simplex Method
- Derivation of conditions for existence and optimality of the solution
- The Simplex Method in Tableau format

Starting Solution and Convergence (6 Hrs)

- The Initial Basic Feasible Solution
- The Big-M Method
- Degeneracy, Cycling and Stalling

Duality (6 Hrs)

- Formulation of the Dual Problem
- Primal-Dual Relationships
- Economic Interpretation of the Dual
- The Dual Simplex Method
- The Primal-Dual Method

Post Optimality Analysis (6 Hrs)

Investigation of how changes in the objective function and the constraint sets of an LP problem would affect the current solution

- Changes in Objective Function
- Changes in Constraint Sets
- Changes in right hand side vector
- Addition of new constraint

Course Name : ABSTRACT ALGEBRA I

Course Code :

Course Description

This is an introductory course that is divided into the following major topics:

- The Basics of Sets and Logic
- Introduction to Group Theory
- Homomorphisms of Groups
- Introduction to the Classification of Finite Groups
- Introduction to Rings and Fields

The content of the course is selected in such way that it assumes no prior knowledge of the subject matter by the student.

Course Objectives

This course introduces the student to the basic ideas that form the foundations of modern abstract algebra. The key ideas in group theory, rings and fields are introduced, illustrated and applied to develop basic competencies in the concepts, principles, and applications of algebra.

This course seeks:

- To impart basic competence in the concepts, principles, procedures and applications of abstract algebra;
- To train students to express themselves in abstract mathematical language and using mathematical symbols correctly;
- To help students apply their knowledge of abstract algebra to find solutions to problems in mathematics and related subjects.

Course Outline

The Basics of Sets and Logic

Elementary, Set Theory; Sets, relations, equivalence relations, mappings. Logic Methods of Proof.

Introduction to Group Theory

Group Theory: binary operations, groups, order of a group and order of an element, Subgroups, Cyclic groups, lattice diagrams, Cosets, Lagrange's Theorem. Permutations: cycles, transpositions, even and odd permutations, symmetric and alternating groups, dihedral groups.

Homomorphisms of Groups

Normal subgroups and Homomorphisms: Conjugacy, Centralisers, Centre, Normalisers, normal subgroup, Homomorphisms, kernel, image.

Quotient groups: Fundamental Homomorphism Theorem, The isomorphism Theorems.

Introduction to the Classification of Finite Groups

Cauchy's Theorem. Sylow's Theorems. Fundamental Theorem of Finite Abelian Groups. Simple and solvable groups. Applications

Introduction to Rings and Fields

Rings with examples. Fields with examples. Integral Domains, Basic Theorems, Applications in Number Theory e.g Fermat and Euler Theorems, Field of Quotients, Polynomial Rings and Factorization Theorems.

Course Name : COMPLEX VARIABLES I
Course Code :

Course Description

Complex Variables I is a course basically on complex variables and their properties. This is another useful and delightful field of mathematics. It is intended for prospective teachers of secondary mathematics and laboratory and non-physical scientists.

The course is divided into the following five major topics:

- Complex Numbers and their Geometrical Representation
- Point Sets, Sequences, and Mappings
- Single-Valued Analytic Functions of a Complex Variable
- Elementary Functions
- Integration

Course Objectives

This course is intended:

- To introduce to the students to yet another exciting field, of Complex Variables,
- To assist students develop the habit to express themselves in proper mathematical languages and in using mathematical symbols correctly,
- To provide a solid mathematical background for students majoring in Mathematics,
- To guide students in how to apply their knowledge of Complex Variables to find solutions to real-life problems.

Detailed Schedule/ Course Outline

Complex Numbers and Their Geometrical Representation Series

- Complex Numbers
- Subtraction and Division of Complex Numbers
- Conjugate and Absolute Value of a Complex Numbers
- Geometric Representation of Complex Numbers
- Polar Form of Complex Numbers
- Products and Quotients of Complex Numbers
- Powers and Roots of Complex Numbers
- The nth Root of Unity

Points Sets, Sequences, and Mappings

- Points Sets on the Real Line and in the Complex Plane
- Open, Closed, and Connected Sets
- Sequences
- Some Fundamental Properties of the Real and Complex
- Numbers System
- Compact Sets
- Algebraic Operation with Sequences
- Series of Complex Numbers
- Upper and Lower Limits
- Continuous Mappings
- Continuous Curves
- Sets of Points in k-dimensional Euclidean Space
- Stereographic Projection
- Stereographic Projection from the Point S(0,0,0)

Single –Valued Analytic Functions of a Complex Variable

- Functions of a Complex Variables
- Limits of Functions
- Continuity
- The Derivative of a Function
- The Cauchy-Riemann Condition
- The Laplace Partial Differential Equation
- Level Curves

Elementary Functions

- The Exponential Function
- The Trigonometric Functions
- The Logarithmic Function
- Multiple-Valued Functions
- The Inverse Trigonometric Functions
- The Elementary Operation and Elementary Functions

Integration

- Definition
- Contour Integration
- Variation of the Logarithm along the Contour

- The Winding Number
- Simple Closed Contours
- The Positive Direction along a Simple Closed Contour
- Simply Connected Domains
- Cauchy's Integral Theorem for the Interior of a Circle
- Integrals around Closed Contours in a General Domain
- The Cauchy Integral Theorems
- Indefinite Integrals
- The Cauchy Integral Formula
- Derivatives of Analytic Functions

ELECTIVES FOR THE MATHEMATICS PROGRAMME

Course Name : GRAPH THEORY

Course code :

Course Description

This course deals with following major topics

- The Basics Of Graphs
- Paths
- Trees, Spanning Trees and connectivity
- Rooted Trees
- Planner Graphs and Graph colouring

Course Objectives:

This course is intended

- To impart students with basic competence in graph theory
- To help students to solve graph theoretic problems
- To teach students the usability and importance of graphs

Detailed Course Outlines

The Basics: (9 Hrs)

- Introduction to Graphs, multigraphs ,the koeinsberg bridges ,bipartite graphs
- Terminology; directed and undirected graphs, graph representation
- Matrices of graphs: incidence matrix, circuit matrix, adjacency matrix, cut matrices ,isomorphism

Paths (9 Hrs)

- walks, paths and circuits
- Euler paths and circuits, Eulerian graphs
- Hamiltonian paths and circuits, directed Hamiltonian graphs,
- Directed graphs; graphs and relations, directed trees,
- Shortest paths and transitive closure

Trees ,Spanning Trees and connectivity (12 Hrs)

- Introduction to trees, application of trees, trees traversal,
- Spanning trees; introduction, depth first search, breadth-first search, minimum cost spanning trees and forests, cuts sets and cuts, cycle basis,
- Connectivity, connectedness and components of a graph, operations on graphs, cut vertices and separable graphs, special graphs

Rooted Trees (6 Hrs)

- Terminology
- Properties
- The number of binary trees

Planer Graphs, homomorphic graphs, colouring and chromatic number (9 Hrs)

- Planar graphs; introduction, Euler's formula, Kuratowski's Theorem,
- Graph coloring; introduction, the four color theorem, the chromatic number application of graph coloring matchings cliques and independent sets

Course Name : NUMBER THEORY

Course code :

Course Description

Number Theory deals with the properties of the series of natural numbers, one of the basic and most essential concepts of Mathematics. In this correct one finds that there exists many simple rules regarding numbers that are quite easy to discover and not too difficult to prove. Topics covered include: the natural numbers, divisors of a number, Fermat's Theorem, Congruence, Diophantine equations, etc.

Course Objectives:

By the end of this course, students should be able to discover and prove;

Some of the simple rules regarding numbers.

- Solve real-life problems using rules from number theory, such as the Chinese remainder theorem.
- Apply the theory of numbers o9f games, that leads to finding pleasure out of mathematics.
- Appreciate the contribution of both mathematicians and amateurs towards the area of number theory.

Detailed Contents

The factorization of integers

- Divisibility
- Prime numbers
- The greatest common divisor
- Unique factorization
- Linear Diophantine Equation
- Perfect numbers
- Mersenne numbers and Fermat's numbers

Congruences

- Definition
- Reduced residue system
- Euler φ-function
- Congruences
- Chinese remainder theorem
- Congruences module a prime power

Quadratic residues

- Legendre symbol
- Quadratic Reciprocity
- Jacobi's Symbol
- The order of an integer
- Primitive roots

Continued Fractions

- Simple continued fractions

Course Name : HISTORY OF MATHEMATICS

Course code :

Course Description:

This course is historical course without going into much details of Mathematical formulas.

We subdivide the course into four major topics

- Regional mathematics
- History of various fields in mathematics
- List of mathematicians
- Chronology

Course Objectives:

The course is intended

- To make the students familiar with the History of Mathematics in ancient cultures and pre –modern era
- To make the students familiar with the history of various fields in Mathematics
- To introduce the students with the names of great mathematicians of the world

Detailed Course Outlines:

Regional Mathematics **12Hrs)**

Babylonia	-	bibliography
Egypt	-	maps and bibliography
China	-	Timeline, chronology of Mathematics and mathematical works.
Greece	-	Chronology, maps and bibliography
Arab sphere	-	Chronology and bibliography
Japan	-	Chronology and bibliography
India	-	Chronology and bibliography
Europe	-	Chronology and bibliography

Subjects: **(24 Hrs)**

- The history of numerals and counting
- The history of Algebra
- The history of Geometry

- The history of Arithmetic and Number theory
- The history of Mathematical Analysis
- The history of Probability and statistics

Chronology: **(9 Hrs)**

List of Mathematicians :1700BCE, 700BCE,600BCE, 500BCE,400BCE, 300BCE,200BCE,100BCE, 1CE,100CE, 200CE,300CE, 400CE, 500CE, 600CE,700CE, 800ce, 900CE, 1000CE,110CE, 1200CE,1300CE, 1400CE, 1500cCE, 1600CE, 1700CE,1800CE,1900CE,1970CE.

Course Name : PROBABILITY THEORY/MATHEMATICAL STATISTICS

Course Code:

Course Description

Pre-requisite: Element of probability and statistics

This course continues and concretizes concepts pf probability including a more systematic treatment of the concepts using both mathematical and statistical methods.

It is divided into the following 4 major topics:

- Review of basic concepts of probability
- Probability & moment general functions
- Multi dimension random variables
- Distribution of functions of random variable

The content of the course is selected in such way that it assumes no prior knowledge of the subject by the student.

Course Objectives

This course is intended to enable students;

- Engage in logical problem solving
- Acquire a proficiency in the topics covered in the course

Detailed Course Curriculum

Review of the basic concepts of probability theory **(6 Hrs)**

- General Multiplicative rule, Boole's inequality & Bayes theorem
- Mathematical expectations; mean, variance & other moments.

Probability and moment generating functions **(12 Hrs)**

- Markov and Chebychev inequalities
- Derivation of common moments (third moment, fourth moment)
- Illustration of common distribution; Binomial, Bernoulli, Poisson, Normal, Geometric, Exponential, Weibull, Hyper geometric, gamma, and beta distributions.

Multi dimensional random variable **(15Hrs)**

- Bivariate & Trivariate random variables

- Joint marginal & Conditional distribution
- Independence of random variable
- Covariance & Correlation
- Conditional expectations, Variance.

Distribution of functions of random variables **(12 Hrs)**

- Using the definition of a distribution function.
- Change of variable technique.
- Jacobean technique.
- Limitations of the Jacobean methods.
- Mgf Technique
- Central limit theorem

Course Name : CLASSICAL MECHANICS

Course Code :

Course Description

This is an introductory course divided into six topics

- Rectilinear Motion
- Forces and Energy
- Newton's Law of Motion
- Two Dimensional Problems
- Projectiles
- Kinematics of assembles of particles and rigid bodies

Course Objectives

The course is intended:-

To provide the student with the basic concepts and principles in mechanics

- To enable students apply their knowledge of elementary mechanics to solve solutions to real life problems

Suggested Teaching Programme

- Rectilinear Motion

Uniformly accelerated motion **(3 Hrs)**

- Force, energy, momentum, conservative force, impulsive forces **(6 Hrs)**
- Newton's law of motion
  Resisted motion under gravity **(9 Hrs)**
- Hookes law, Simple Harmonic motion **(9 Hrs)**
- Projectiles **(6 Hrs)**
- Kinematics of assemblies of particles and rigid bodies **(6 Hrs)**
- Problems in 2 dimensions **(6 Hrs)**