Science Laboratory Technology Chemistry Option - Higher National Diploma (HND)

Curriculum and Course Specifications

November 2004

NATIONAL BOARD FOR TECHNICAL EDUCATION

Produced by the National Board for Technical Education (NBTE)
Plot B, Bida Road, P.M.B. 2239, Kaduna Nigeria.

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GENERAL INFORMATION

1.0 CERTIFICATION AND TITLE OF THE PROGRAMME:

The certificate to be awarded and the programme title shall read:

"HIGHER NATIONAL DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY - CHEMISTRY OPTION"

A transcript showing all the courses taken and grades obtained shall be issued on demand.

STRUCTURE OF PROGRAMME

The Higher National Diploma programme is structured to last for two years (four semesters).

EVALUATION OR AWARD

All terminal Higher National Diploma programmes must be externally moderated after every five years. In grading the awards the Board's unified grading system should be applied.

ACCREDITATION

All programmes leading to the award of Higher National Diploma in chemistry must be accredited by the National Board for Technical Education. Details of accreditation of programmes are available from the Executive Secretary Programmes Department, National Board for Technical Education, Plot 'B' Bida Road, P.M.B. 2239, Kaduna,

2.0 GOALS AND OBJECTIVES

The Higher National Diploma Programme in Chemistry is designed to produce technologists capable of carrying out various laboratory analysis and practical works independently.

Specifically

1. Carry out chemical analysis and quality control in: industry (oil, food, brewing, detergent, textiles, etc.), hospitals, schools, colleges and research institutions.

2. Carry out general chemical work in industrial and academic laboratories.

3. Assist in biochemical analysis and experiments in hospitals, schools, colleges and research institutes

4. Prepare students for employment in related work such as sales, marketing, administration and management in the industries in 1 above and, also, for self-employment.

3.0 ENTRY REQUIREMENTS:

3.1 HIGHER NATIONAL DIPLOMA

The entry requirement into Higher National Diploma Programme in Science Laboratory Technology-Chemistry is at least a Lower Credit grade in National Diploma in Science obtained from an accredited science programme with one year supervised Industrial Experience. In exceptional cases, at least two years Industrial Experience for candidates with Pass grade or any other equivalent certificate.

4.0 CURRICULUM

4.1 The curriculum of the HND programme consists of three main components. These are:

(a) General studies/education
(b) Foundation courses
(c) Professional courses

4.2 The General Studies/Education component shall include courses in:

Language and Communication - English language and communication. This is compulsory.

and

Social Studies- Citizenship (the Nigeria constitution) is compulsory.

The General Education component shall account for not more than 10% of total contact hours for the programme.

Foundation Courses - Courses in mathematics and computer studies. The number of hours will vary with the programme and may account for about 10-15% of the total contact hours.

Professional Courses - Courses which give the student the theory and practical skills he needs to practice his field of calling at the technician / technologist level. These may account for between 60-70% of the contact hours depending on programme.

5.0 CURRICULUM STRUCTURE

5.1 HND Programme:

The structure of the HND Programme consists of four semesters of classroom, laboratory and workshop activities in the college. Each semester shall be of 17 weeks duration made up as follows:

15 contact weeks of teaching, i.e. lecture and practical exercises, etc. and 2 weeks for tests, quizzes, examinations and registration.

6.0 CONDITONS FOR THE AWARD OF THE ND

Institutions offer accredited programmes for the award of the Higher National Diploma to candidates who successfully complete the programme after passing prescribed course work, examinations and project. Such candidates should have completed a minimum of between 90% and 100% of credit units depending on the programme. Higher Diplomas shall be awarded based on the following classifications:

Distinction - CGPA 3.50-4.0
Upper credit - CGPA 3.00-3.49
Lower Credit - CGPA 2.50- 2.99
Pass - CGPA 2.00-2.49

7.0 GUIDANCE NOTES FOR TEACHERS TECHING THE PROGRAMME

7.1 The new curriculum is drawn in unit courses. This is in keeping with the provisions of the National policy on Education, which stress the need to introduce the semester credit units which will enable a student who so wish to transfer the units already complete in an institution of similar standard from which he is transferring.

7.2 In designing the units, the principle of the modular system has been adopted; thus making each of the professional modules, when completed self-sufficient and providing the student with technician operative skills, which can be used for employment purposes.

7.3 As the success of the credit unit system depends on the articulation of programmes between the institutions and industry, the curriculum content has been written in terms of behavioural objectives, so that it is clear to all, the expected performance of the student who successfully completed some of the courses or the diplomates of programme is clearly defined. There is a slight departure in the presentation of the performance based curriculum which required the conditions under which the performance are expected to be carried out and the criteria for the acceptable levels of performance. It is a deliberate attempt to further involve the performance that can take place and to follow that with the criteria for determining an acceptable level of performance. Departmental submission on the final curriculum may be vetted by the academic board of the institution. Our aim is to continue to see to it that a solid internal evaluation system exists in each institution for ensuring minimum standard and quality of education in the programmes offered throughout the polytechnic system.

7.4 The teaching of the theory and practical work should, always where possible, be integrated. Practical exercise, especially those in professional courses and laboratory work should not be taught in isolation from the theory. For each course, there should be a balance of theory to practice depending on the course objectives and content. Life data, case studies, mini-projects and visits to and from available organizations should be incorporated wherever and whenever possible.

CURRICULUM TABLE

HIGHER NATIONAL DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY - CHEMISTRY OPTION

FIRST YEAR - FIRST SEMESTER

Course Code	Course Title	L	P	CU	CH	Prerequisite
STC 311	Inorganic Chemistry I	2	3		5	
STC 312	Physical Chemistry I	2	3		5	
STC 313	Organic Chemistry I	2	3		5	
STC 314	Analytical Chemistry I	2	3		5	
GLT 311	Laboratory Management	2	0		2	
GLT 312	General Instrumentation	2	3		5	
STC 316	Higher Technical English	2	3		5	
	TOTAL	14	18		32	

FIRST YEAR - SECOND SEMESTER

Course Code	Course Title	L	P		CH	Prerequisite
STC 321	Polyfunctional Compounds	2	3		5	
STC 322	Physical Chemistry II (Chemical Kinetics)	2	3		5	
STC 323	Industrial Chemistry	2	3		5	
STC 324	Analytical Chemistry II	2	3		5	
STC 325	Biochemistry for Chemists	2	3		5	
GLT 323	Biological and Chemical	2	3		5	
STC 326	Instrumentation Research Methods	2	2		4	
	TOTAL	14	20		34	

SECOND YEAR - FIRST SEMESTER

Course Code	Course Title	L	P		CH	Prerequisite
STC 411	Inorganic Chemistry II	2	3		5	
STC 412	Physical Chemistry III (Chemical Thermodynamics)	2	3		5	
STC 413	Organic and Heterocyclic Chemistry	2	3		5	
STC 414	Analytical Chemistry III	2	3		5	
STC 415	Petroleum and Petrochemicals	2	3		5	
STC 416	Computer Applications in Chemistry	1	3		4	
STA 418	Small Business Management II	1	1		2	
	TOTAL	12	19		31	

SECOND YEAR - SECOND SEMESTER

Course Code	Course Title	L	P	CU	CH	Prerequisite
STC 421	Medicinal Chemistry	2	3		5	
STC 422	Physical Chemistry IV (Electrochemistry and Photochemistry)	2	3		5	
STC 423	Natural Products and Stereochemistry	2	3		5	
STC 424	Food Chemistry and Brewing	2	2		4	
STH 422	Forensic Biochemistry	1	3		4	
STC 426	Higher Practical Project and Seminar	1	8		9	
	TOTAL	10	22		32	

FIRST YEAR - FIRST SEMESTER

Course: Inorganic Chemistry I

Department/ Programme: Higher National Diploma Chemistry			
Course: Inorganic Chemistry I	**Course Code: STC 311**	**Credit Hours:**	**5**
Year: 1 Semester: 1	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours/week**

GENERAL OBJECTIVES:

1. Understand the relationship between the electronic structures and properties of the d- and f- block elements
2. Understand the chemistry of co-ordination compounds d- and f- block elements
3. Understand selected examples of the bioinorganic chemistry of d-and f-block compounds

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1.0: Understand the relationship between the electronic structures and properties of the d- and f- block elements					
1	1. Outline the general properties of the d- block elements. 2. Occurrence and isolation 3. close packing concepts 4. metallic bonding 5. band theory 6. conductivity	Illustrate properties of d- block using the periodic table.	Classroom resources - do -	Preparation and characterisation of ZnS	Guide students and oversee demonstrators	Chemicals and glassware
2	7. High oxidation states 8. Intermediate oxidation states 9. Metal-metal bonded d-metal compounds	Lecture	"	Preparation and characterisation of $MoCl_3$		"
3	10. Noble character of group 12 elements 11. Metal Sulphides and Sulphide complexes	"	"	Oxidation of copper with Fe3+ and Cr6+ (titrations)		"
4	12. Write the electron configurations of the following groups of the d- block elements: Sc, T.V, Cr, Mn, Fe, Mo. 13. Explain the peculiar properties of the following transition metal groups listed above. 14. Relate properties of the group 12 elements to electronic structure			Prepare some transition metal complexes e.g. Ni as dimethylgloximate, Fe as hydroxyquinone, silver complexes etc.	Guide students to prepare complexes of Fe(iii), etc	Glassware Visible spectrophotometer, separating funnel

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
5	15. Explain the functions and uses of d- block elements and their compounds: e.g. alloy (steel), colouring of glass, paints etc. 16. Explain the nature of the f-block elements (lanthanides and actinides).			Characterise complexes prepared above by determining their stoichiometry, stability constant etc..	guide students through the characterisation of complexes prepared above.	
6	17. Write the electron configuration of some representative f-block elements. 18. Compare the electron configuration of d-block with those of f-block elements. 19. Outline the uses of Lanthanides and Actinides. 20. Explain the phenomenon of artificial radioactivity.			Determine the concentration of the metal ions in the complexes using titrimetry, spectrophotometry solvent extraction	Guide students	
	General Objective 2.0: Understand the Chemistry of Co-ordination Compounds of d- and f-block elements					
7	2.1 Explain the meaning of Coordination Compounds. 2.2 Illustrate the shape and disposition of d-orbitals with diagrams. 2.3 Define effective atomic number. 2.4 Relate 2.3 above to the following: (a) Co-ordination numbers (b) Ligands (c) Number of electrons lost and gained during bonding.	Lecture Use models to illustrate the shapes and disposition of d-block orbitals	Classroom resources Classroom resources	Determine the magnetic moment and magnetic susceptibility of some metal ions.	Demonstrate to the students how to determine the magnetic susceptibility of some metal ions	Guoy balance

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
8	2.5 Explain Alfred Werner theory. 2.6 Describe the various isomeric forms viz: geometric and optical isomerism, polymerization isomerism, ionization isomerism, Hydrate isomerism, linkage isomerism, co-ordination isomerism.			Synthesise some complexes at different oxidation states.	Demonstrate to the students how to synthesise complexes with: 1. different oxidation states 2. weak and strong field ligands.	Glassware, reagents.
9	2.7 Apply the I.U.P.A.C system of nomenclature in naming co-ordination compounds. 2.8 Illustrate the various structural arrangements possible in coordination compounds such as:- (a) Octahedral complexes (b) Square planner complexes (c) Tetrahedral complexes	Illustrate structural arrangement possible in co-ordination compounds using models	Models	Prepare co-ordination compounds of the same metal ion with weak and strong field ligands.		Glassware, reagents.
10	2.9 Explain the degenerate nature of the d- orbital in an atom. 2.10 Explain the splitting of the d-orbital under the influence of ligand field for octahedral, tetrahedral and square planar complexes.	Lecture " Lecture	Classroom resources Classroom resources.	Characterise the compounds prepared above in terms of crystal field stabilisation energy, magnetic moment, colour etc		Guoy balance

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	2.11 Describe the effect of the ligand field on the orbital electrons in the formation of:- (a) spin free outer orbital complex (b) spin paired inner orbital complex.					
11	2.12 Describe reactions of complexes: co-ordination equilibria 2.13 Know rates and mechanisms of ligand substitution 2.14 Illustrate the different degrees of stability of various oxidation states.	Guide the students to prepare and characterise named co-ordination compounds.		Prepare complexes of different structural arrangement and determine the different degrees of stability.	Guide the students to prepare and characterise named coordination compounds	
	General Objective 3. Understand selected examples of the bioinorganic chemistry of d-and f-block compounds					
12	3.1 Explain biological roles of some metal ions 3.2 Explain the roles of Fe complexes and Cu complexes in biological oxygen transport 3.3 Describe models of oxygen binding based on Co and Fe synthetic complexes 3.4 Know the structure of Vitamin B12			Prepare co-ordination compounds as chelates, anionic complexes and cationic complexes, Carry out experiments to illustrate their different charges.	Guide the students to prepare the complexes.	
13	3.5 Describe the structure of the active site of zinc-containing carboxypeptidase enzymes			Synthesise Co(salen) complex and measure oxygen binding		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
14	3.6 Describe the role of the zinc ion in the mechanism of action of the carboxypeptidases			Prepare cobaloxime, a model compound for vitamin B12		
15	3.7 Know the structure and mechanism of action of the anti-cancer drug cis-platin					

Assessment:

Coursework/Assignments 10 % Practical 40 %; Examination 50 %

Recommended Textbooks & References:

Inorganic Chemistry by Shriver and Atkins, published by Oxford University Press, UK

Inorganic Experiments, Second Edition by J.D. Woollins (Ed) published by Wiley - VCH (2003)

Course: Physical Chemistry I

Department/ Programme: HND chemistry			
Course: Physical Chemistry I	**Course Code: STC 312**	**Credit Hours:**	**5**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Understand the general theory and applications of surface phenomena
2. Understand types, properties and use of colloids
3. Understand the principles and applications of phase equilibria.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1.0: Understand the general theory and applications of surface phenomena					
1	1.1 Explain the term surface phenomenon. 1.2 Define surface energy and surface tension. 1.3 Explain the effect of temperature and dissolved substances on surface tension. 1.4 State the condition for a liquid to wet a surface with which it is in contact.	Lecture and ask students questions "	Classroom resources "	Determination of the densities of mixtures of ethanol in water	Provide the lab. Manual for the experiment. Monitor the students to make sure they do not drink out of the ethanol provided.	Balance conical flasks pipette burette Specific gravity bottles beakers Thermostat Thermometer Stop watch Tissue paper Distilled water
2	1.5 Define work of adhesion and work of cohesion. 1.6 Distinguish between bubbles and cavities. 1.7 Explain the relationship between surface tension and adsorption. 1.8 Distinguish between adsorption and absorption	"	"	Determine the surface tension of a liquid using: i. capillary rise method ii. drop weight method	Demonstrate the determination of surface tension.	capillary tube stalagmometer

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
3	1.9 Classify adsorption as chemical adsorption or chemisorption and physical adsorption or physisorption. 1.10 List the factors that affect the adsorption of gases by solids. 1.11 Define adsorption isotherm. 1.12 Explain the activation energy of desorption. 1.13 Define sticking probability and fractional coverage.	Lecture - do - " " "	Classroom resources - do - " "	Determination of the coefficient of viscosity for glycerin by the falling sphere viscosimeter	Provide the lab. manual for the experiment Assemble apparatus for the students Thoroughly degrease the spheres and dry them, before use. Prepare and provide the lab. Manual	Long tubes of different diameters with short inlet tubes for axial descent of spheres. Jacket for tubes with stirrer thermometer Small steel ball bearings Callipers Stop watch
4	1.14 Derive and use the Langmuir adsorption isotherm. 1.15 Derive and use the Freundlich adsorption isotherm.			Determination of the adsorption isotherm of acetic acid from aqueous solution by charcoal.	Prepare and provide standard solutions of 0.5mol/dm^3 acetic acid, 0.1mol/dm^3NaOH, activated charcoal (heated to 450^{0}C).	Stoppered bottles Thermostat (25^{0}C) Balance Distilled water Filtration apparatus Conical flasks (250cm^3) Phenolphthalein indicator

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
5	1.16 Derive and use the Temkin adsorption isotherm. 1.17 Express the rate of a catalysed reaction using the adsorption isotherm.			Demonstrate the separation of compounds by using chromatographic techniques. Separation of a mixture of phenols (cresols, nitrophenols, trichlorophenol)	Provide the lab manual for the exp. - Guide the students to work in the fume chamber - Prepare and provide the mixture of phenols.	Silica gel CH2Cl2 Beakers Wide - mouthed bottle with seal Microscope slides Fume chamber Crucible tongs Filter papers m.p. capillary tubes
6	1.18 Describe the processes involved in catalytic hydrogenation, oxidation, cracking and reforming. 1.19 List the applications of surface tension. 1.20 List the applications of adsorption. 1.21 Separate compounds by using Thin layer chromatography as example of adsorption phenomenon.					Bunsen burner Watch glass Polythene bag Iodine crystals Safety spectacle Cresol, nitrophenol Trichlorophenol

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 2.0: Understand Types, Properties and Use of Colloids					
7	2.1 Define Colloid. 2.2 Classify colloids as Lyophilic or lyophobic. 2.3 Explain the differences between lyophilic and lyophobic sols. 2.4 Describe the preparation and purification of sols.	Lecture - do -	Classroom resources.	Prepare arsenic sulphide sols. and/or iron (III) chloride sol	Demonstrate and guide students to prepare a sol.	Glassware Reagents.
8	2.5 Define colloidal electrolyte. 2.6 List the optical properties of sols. 2.7 List the kinetic properties of sols.	Lecture - do - "	Classroom resources.	Prepare emulsions in the laboratory.	Demonstrate the nature of emulsions as form of colloid by preparing a simple emulsions	Glassware reagent.
9	2.8 Explain the electrical double layer. 2.9 Explain the electrokinetic effect as a consequence of electrical double layer.	" "	"	Perform electrophoresis of clay particles suspended in water.	Provide the lab. Manual. Demonstrate the experiment Grind the clay to powder.	Clay samples Distilled water Platinum electrodes Crocodile clips D.C. source U- tube Corks

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
10	2.10 Explain the difference between electropharesis and sedimentation potential. 2.11 Explain the difference between electro-osmosis and streaming potential. 2.12 Explain the terms - associated colloids, gels and emulsions. 2.13 List the uses of colloids.	Lecture - do -	Classroom resources.	Optical properties of colloidal sol: Detection of particles of colloid with ultra microscope	Provide the lab. Manual for the exp. Prepare the microscope for use	Ultra microscope Beakers (250cm^3) Light source Aluminum hydroxide Hydrochloric acid Measuring cylinder
	General Objective 3.0: Understand the principles and applications of Phase Equilibria.					
11	3.1 Define equilibrium. 3.2 Distinguish between true equilibrium, metastable equilibrium and unstable equilibrium. 3.3 Define the terms - system, phase, component, degrees of freedom.	Lecture - do - - do -	Teaching Tools " "	Demonstration of electro-osmosis	Provide the lab. Manual Demonstrate the experiment Provide lump of wet clay	Distilled water Platinum electrodes Crocodile clips D.C source U - tube Corks wet clay
12	3.4 State and derive the phase rule. 3.5 Apply the phase rule to one - component system. 3.6 Interpret liquid - vapour composition diagrams of two component systems using the phase rule.	- do - " "	" "	Construct and interpret liquid-vapour phase diagrams.	Construct phase diagram using experimental data.	Thermometer (0 - 360^o C) Stirrer

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
13	3.7 Describe the distillation of partially mixable liquids. 3.8 Interpret phase diagrams in which the components take part in a reaction.	Lecture Lecture	Classroom resources.	Construct and interpret liquid - solid phase diagrams and define the term eutetic.	Guide students to construct a liquid-solid phase diagram by using freezing point curves	Thermometer (0 - 360^{o} C) Stirrer mixtures of o-nitrophenol and p-toluidine.
14	3.9 Define the terms phase reaction and peritetic reaction. 3.10 Describe the principles and applications of zone-refining and zone-levelling.	- do - "		use the method of depression of freezing point to determine molecular weight of naphthalene	Provide the lab. Manual for the exp. Assemble the apparatus	Balance Thermometer Naphthalene Boiling tubes Bunsen burner stand, gauze Stop watch Beakers Air jacket.
15	3.11 Interpret triangular - coordinate phase diagrams for three partially mixable liquids. 3.12 Draw and explain the phase diagram of water, carbon dioxide and sulphur.	Lecture		Construct three - component phase diagrams using triangular coordinates.	Direct students to construct the triangular diagram from data obtained from the determination of the limit of homogeneous phase in the system chloroform - acetic acid - water.	Water bath with Thermostat, Reagent bottles.

Assessment:

Coursework/ Assignments 10 %; Practical 40 %; Examination 50%

Recommended Textbooks & References:

Atkins' Physical Chemistry by Peter Atkins and Julio de Paul, published by Oxford University Press 7th Edition 2002

Course: Organic Chemistry I

Department/ Programme: HND Chemistry			
Subject/Course: Organic Chemistry I	**Course Code: STC 313**	**Credit Hours:**	**5**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Understand the application of spectrophotometric techniques in the identification of organic compounds
2. Understand the chemistry of monosubstituted aromatic compounds and compare their reactions with those of their aliphatic analogues.
3. Understand the principles of organic reaction mechanism applied to aromatic systems.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1.0: Understand the application of spectrophotometric techniques in the identification of organic compounds					
1	1.1 List the frequency range of UV radiation. 1.2 Explain the effect of the interaction of UV light with organic compounds (electronic transitions). 1.3 Explain electronic transitions in terms of molecular orbital theory (p-p* and n-p*) 1.4 State wavelength in S.I. units. 1.5 State intensity of band as (E) 1.6 Explain that the wavelength of maximum absorption is called λmax and the intensity of absorption at λmax is Emax. 1.7 Give and be able to use the Beer-Lambert law relating absorbance to concentration.	Lecture and ask students theoretical questions. - do - " " " "	Teaching Tools - do - " " " "	Determine the concentration of a solution of a known compound at an unknown concentration by means of the Beer- Lambert Law (UV).	Students should be guided to determine the concentration of an unknown solution by means of Beer - Lambert's Law.	UV spectrophotometer and accessories solvents chemicals
2	1.8 Describe the relationships between structures and wavelength of maximum absorption 1.9 Explain the use of UV spectrum in identification of unsaturated linkages, chromophores and aromatic systems.			Use UV spectroscopy to identify unknown compounds given a list of possibilities	Select suitable compounds with characteristic UV spectra then guide students	UV spectrophotometer and accessories solvents chemicals

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
3	1.10 Explain the interaction of infra-red electromagnetic radiation with organic molecules. 1.11 Explain how the interaction of infra-red radiation with organic molecules gives rise to stretching, bending, vibration and wagging of the molecules. 1.12 Assign absorption frequencies to the following functional groups: - OH; -OR; -NH_2; -X-C; HC=0; C=O;			Characterise individual functional groups in the molecules by absorption bands in the frequency range of 4000 - 1450 cm^{-1}	Provide students with suitable compounds and guide students in obtaining their IR spectra	IR spectrophotometer
4	1.13 Assign absorption frequencies to the following functional groups: alkene, alkyne, nitrile, 1.14 Explain how the "finger print' region between 1450 - 650 cm^{-1} is unique for any compound. 1.15 Explain how the substituent groups attached to a functional group affects the absorption frequency of the functional group e.g. ketones, esters, amides, conjugated carbonyls, substituted aromatic compounds, etc. 1.16 Interpret the spectrum of a known compound.	Lecture " " " "	Classroom resources.	Use IR spectroscopy to identify unknown compounds given a list of possibilities	Select suitable compounds with characteristic IR spectra then guide students	IR spectrophotometer

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
5	1.17 Explain the effect of the interaction of radio frequency spectrum of electro magnetic waves on the nuclei of atoms. 1.18 Explain the concept of magnetic moments to the nuclei of the following atoms H^{1}_{1}; N^{15}_{7}; F^{19}_{9}; P^{39}_{15} and C^{13}_{6}. 1.19 Explain the theory of NMR. 1.20 Explain the term chemical shift with particular attention to chemical shift values for H^{1}. 1.21 Understand that chemical shift is affected by the electronic environment of the nucleus - deshielding and shielding effects.	" "		Students should carry out identification of chemical shifts for different types of protons e.g. -OH, $-CH_2$ etc.	Guide students	NMR spectrometer or a Library of H^{1} nmr spectra supplemented by a visit to an nmr facility
6	1.22 Identify chemical shifts for different types of protons e.g. -OH, $-CH_2$, -Ar-H, etc. 1.23 Know the characteristic chemical shift ranges for common functional groups. 1.24 Understand and be able to predict equivalence of hydrogen atoms in a molecule. 1.25 State the scales adopted for H^{1} nmr spectrum. 1.26 Explain the use of integration of	Lecture " Lecture		Obtain nmr spectra for relevant simple organic compounds by preparing a solution and running the samples in an nmr spectrometer.	Guide students	NMR spectrometer or a Library of H^{1} nmr spectra supplemented by a visit to an nmr facility

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	H^1 nmr signals. 1.27 Describe the following: (a) Use of TMS. (b) Spin-spin splitting. (c) Coupling constant in assigning structure to a compound.					
7	1.28 Be aware of some complications in spin-spin splitting: (a) second order effects (b) coupling to non-equivalent neighbours (c) exchangeable hydrogens (d) self-decoupling of halogen neighbours 1.29 Assign structures to compounds using nmr spectra.			Students should be able to read off integration, coupling patters and coupling constants from nmr spectra. Students should be asked to assign structures to compounds using nmr spectra.		NMR spectrometer or a Library of H^1 nmr spectra supplemented by a visit to an nmr facility
8	1.30 Explain how a mass spectrometer distinguishes between ions of different mass to charge (m/e ratio). 1.31 Explain the concept of mass	Students should identify fragmentation patterns of molecules e.g. for CH_4 as CH_3^+, CH_2^+, CH^+ and C^+ having m/e = 15,		Measure the relative abundance of each ionic species using mass spectrometer.	Students should identify mass spectrum of a compound as a series of lines of m/e values	Mass Spectrometer

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	spectrometry. 1.32 Identify fragmentation patterns of molecules e.g. for CH_4 as CH_3^+, CH_2^+, CH^+ and C^+ having m/e = 15, 14, 13 and 12. 1.33 Identify parent ion in the mass spectrum of a compound. 1.34 Write possible fragmentation pattern or simple organic compounds e.g. CH_3-CH_2-CH_3. 1.35 Describe the structure of a compound using fragmentation pattern and parent ion.	14, 13 and 12. Students should be asked to identify parent ion in the mass spectrum of a compound. Students should be asked to write possible fragmentation pattern for simple organic compounds e.g. CH_3-CH_2-CH_3.		Identify mass spectrum of a compound as a series of discrete lines indicating m/e values i.e. a series mass number.		
9	1.36 Explain X-ray diffraction technique as a means of determining the structures of crystalline complex organic molecules. 1.37 Describe the application of X-ray diffraction in the determination of structures of organic molecules. 1.38 State and use Bragg equation. 1.39 Understand the production of an X-ray diffraction pattern from a crystal 1.40 Understand the conversion of an X-ray diffraction pattern into a map of electron density	Lecture - do -		Students should be asked to apply the Bragg equation to a simple diffraction pattern and obtain the diffraction angle	Guide the students in obtaining a suitable X-ray diffraction pattern and measure the diffraction angle.	X-ray machine

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	1.41 Understand, in general terms, the interpretation of X-ray diffraction pattern to give a model of the organic molecule making up the crystal.					
	General Objective 2.0: Understand the chemistry of monosubstituted aromatic compounds and compare their reactions with those of their aliphatic analogues.					
10	2.1 State the general formulae for monosubstituted aromatic compounds. 2.2 Describe the physical and chemical properties of monosubstituted aromatic compounds. 2.3 State IUPAC names for monosubstituted aromatic compounds. 2.4 Know how to prepare monosubstituted aromatic compounds (by halogenation, nitration, sulphonation, alkylation, acylation) from non-substituted aromatic compounds 2.5 Compare reactions of monosubstituted aromatic compounds with non-aromatic compounds 2.6 List uses of monosubstituted aromatic compounds.	Lecture and ask theoretical questions to students.	Classroom resources	Electrophilic aromatic substitution - group effects. relative rates of bromination of substituted benzenes compared with benzene itself.	Guide students	Glassware and chemicals (Zanger and McKee book - see below)
	General Objective 3.0: Understand the principles of organic reaction mechanism applied to aromatic system.					
11	3.1 Describe the following types of reactions, encountered in organic chemistry - addition, elimination, substitution and re-arrangement reactions.	Lecture - do - "	Classroom resources.	Nitration: preparation of methyl m-nitrobenzoate from methyl benzoate.		Glassware and chemicals (Zanger and McKee book - see below)

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	3.2 Explain the following: (a) Inductive effects (b) Mesomeric and (c) Electromeric 3.3 Identify ortho, para and meta positions on a monosubstituted aromatic compound. 3.4 Explain the term electophiles and nucleophiles. 3.5 Describe the mechanism of electrophilic aromatic substitution and nucleophilic aromatic substitution.	" Lecture				
12	3.6 Explain the mechanism of aromatic electrophilic substitution with respect to the following: (a) Halogenation of benzene (b) Nitration of benzene (c) Sulphonation of benzene (d) Friedel craft reactions.	Lecture		Friedel-Crafts alkylation: synthesis of sec-butyltoluene		Glassware and chemicals (Zanger and McKee book - see below)

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
13	3.7 Draw diagrams of Energy against reaction co-ordinate for the above reactions and relate the shape of the Energy curves to the mechanism of the reaction (i.e. label the diagram) 3.8 List examples of ortho-para directing and meta directing groups. 3.9 List the differences between electrophilic aromatic substitution and nucleophilic aromatic substitution. 3.10 List other reactions of aromatic hydrocarbons like addition and oxidation reactions. 3.11 Describe SN^1 and intermediate complex mechanism to aromatic nucleophilic substitution.	Lecture - do - " "		Kolbe Synthesis - synthesis of 2,4 dihydroxybenzoic acid (Resorcylic acid) from Resorcinol	Guide students	Glassware and chemicals (Zanger and McKee book - see below)
14	3.12 Know selected reactions of arenes: (oxidation of alkyl side chains, reduction of benzylic alcohols and ketones, chlorination of toluene) 3.13 Know selected reactions of aromatic substituents (reduction of the nitro group, oxidation of amino)			Oxidation of aromatic side chains: synthesis and identification a chlorobenzoic acid (ortho meta or para) from the corresponding chlorotoluene		Glassware and chemicals (Zanger and McKee book - see below)
15				Diazotization - synthesis of methyl salycilate (oil of wintergreen) Alternatively acetlyation of salicylic acid to give aspirin would be a good follow on from the Kolbe reaction.	Guide students	Glassware and chemicals (Zanger and McKee book - see below) The aspirin reaction is not in this book but is widely available in others.

Assessment:

Continuous assessment 10%; Practical work 40%; Semester examination 50%.

Recommended Textbooks:

(1) Introduction to Organic Spectroscopy (Oxford Chemistry Primers) Laurence M. Harwood, Timothy D.W. Claridge published by Oxford University Press.

(2) Organic Chemistry by Vollhardt and Shore published by W.H.Freeman New York

(3) Small Scale Synthesis by M. Zanger and J. R. McKee published by McGraw-Hill Science, USA, 2002

Course: Analytical Chemistry I

Department/ Programme:			
Subject/Course: Analytical Chemistry I	**Course Code: STC 314**	**Credit Hours:**	**5**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Understand the principles of analytical separations and their applications

2. Understand the principles of spectrophotometric techniques and their applications

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1: 0 Understand the principles of analytical separations and their applications					
1	1.1 Describe the principles of extraction using partition coefficients and separate phases. 1.2 Discuss the effects of pH on extraction 1.3 Discuss the basic principles of chromatography 1.4 List the different types of chromatography: adsorption; partition, ion-exchange; molecular exclusion/gel permeation; affinity chromatography. 1.5 Understand the fundamental differences between the types of chromatography in 1.4 above. 1.6 Calculate the retention time of a solute from a chromatogram 1.7 Discuss the relationship between retention time and the partition coefficient 1.8 Calculate the average volume percent of a compound from the peak areas.	Explain and illustrate the activities with appropriate examples. Ask relevant question to the students.	Chalkboard chalk Textbooks Examples of chromatograms	Demonstration of the principles of separation	Demonstrate the separation of various compounds using e.g. TLC, separating funnels etc. Discuss effects of charge, molecular mass on elution	

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
2	1.9 Explain the basic principles of gas chromatography 1.10 Draw a schematic diagram of a gas chromatograph 1.11 Understand the differences between packed and open tubular columns and when they may be used. 1.12 Discuss the different types of detector used with GC, e.g. electron capture, flame ionization, flame photometric.	Lecture		Separate an unknown mixture of compounds by gas chromatography e.g. pentene, hexane and heptane.	Demonstrate and guide students to carry out a separation using GLC	Gas Chromatography
3	1.13 Discuss the basic principles of HPLC 1.14 Draw a schematic diagram of a HPLC 1.15 Discuss stationary phases: polar and non polar and understand the difference between normal and reverse phase chromatography 1.16 Discuss the different types of detector: spectrophotometric, refractive index, evaporative light-scattering, electrochemical. 1.17 Discuss the criteria used to optimise separation: capacity factor, resolution, peak shape, operating pressure			Separation of carbohydrates by HPLC		HPLC with UV detector, samples of common carbohydrates e.g. artificial sweeteners

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
4	1.18 Discuss the principles of ion-exchange chromatography 1.19 Describe different types of resins and their applications 1.20 Discuss selectivity coefficients of resins and how this aids selection for analyte 1.21 Discuss the Donnan equilibrium and its role in ion-exclusion chromatography 1.22 Discuss the principles of ion chromatography for anion analysis 1.23 Discuss the principles of molecular exclusion/gel permeation chromatography 1.24 Discuss the types of gels used 1.25 Discuss the effect of molecular mass and shape on elution			Determine concentration of ions using ion - exchange (H^+, Na^+, Mg^{2+}, Zn^{2+}) and compare with titration method		Ion-exchange column (cation-exchange resin), unknown sample, HCl, ammonia buffer, NaOH, Eriochrome Black T indicator, EDTA, methylene blue-methyl red mixed indicator, KCN
5	1.26 Discuss the principles of capillary electrophoresis 1.27 Draw a schematic diagram of the apparatus used for capillary electrophoresis 1.28 Discuss the basic principles of electroosmosis			Determine isoelectric point of a protein (e.g. bovine serum albumin) using electrophoresis		Electrophoresis kit, buffers pH 3,4,5,6,7, BSA, staining solution, acetic acid

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	1.29 Calculate the apparent mobility using the electrophoretic mobility and electroosmotic mobility					
6	1.30 Calculate the number of theoretical plates 1.31 Discuss experimental factors affecting the condition of the capillary wall 1.32 Discuss the type of sample injection: hydrodynamic and electrokinetic. 1.33 Discuss the process of stacking and its effect on the resulting chromatogram 1.34 Discuss the type of detectors used with CE and their application 1.35 Discuss the basic principles of Micellar electrokinetic chromatography			Determination of caffeine in beverages and pharmaceuticals using HPLC		HPLC, samples of tea coffee, cola, analgesic tablet containing caffeine
	General Objective 2:0 Understand the principles, applications of Flame photometry, Atomic absorption spectrometry, IR, UV-Visible spectroscopy					
7	2.1 Explain the principle involved in qualitative identification of substances using flame tests. 2.2 Describe the three types of emission spectrometry. 2.3 Draw a schematic diagram of a flame photometer.	Explain and illustrate the activities with appropriate examples.	Chalkboard chalk Textbooks	Prepare standard solutions. Construct a calibration curve from the measurement of a standard solution. Determine Na, K, Ca in natural samples applying	Students to prepare specific standard solutions. Students to construct calibration curve and determine Na, K, Ca in samples.	Volumetric apparatus Flame photometer

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	2.4 Describe the operation and working of a direct reading flame photometer. 2.5 Explain the error and interferences inherent in flame photometric analysis. 2.6 Describe the evaluation methods used in flame photometry. 2.7 Describe methods of preparing sample and stock solutions of standards in flame photometry. 2.8 Describe the general applications of flame photometry and its limitations in relation to AAS.			calibration curve method.		
8	2.9 Explain the working principles of Atomic Absorption Spectrophotometer (AAS). 2.10 Draw the schematic diagram of AAS instrument. 2.11 Explain the errors and interferences in AAS. 2.12 Explain the advantages and disadvantages of AAS over flame photometer. 2.13 Discuss the use of graphite furnaces and inductively couples plasmas as the method of atomisation			Prepare standard solutions. Construct a calibration curve determination of Ca, Fe, Mn, Mg etc in a given sample.	Students to prepare standard solutions and construct calibration curve	Atomic absorption spectrophotometry Analytical grade of chemical for standard

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	2.14 Discuss the effect of temperature on AAS including the Boltzmann distribution 2.15 Discuss the use of background correction 2.16 Discuss the types of interference that may occur: spectral, chemical, ionisation 2.17 Explain the evaluation methods used in AAS. 2.18 Describe the preparation of sample and stock solutions of standards. 2.19 List the applications of atomic absorption spectrometry.					
9	2.20 Explain the fundamental principles of infra-red spectroscopy (highlighting liberation of diatomic molecules and polyatomic molecules). 2.21 Classify molecular vibrations. 2.22 Describe the characteristic absorption frequency (group frequency) of certain groups in the molecules e.g. -OH; -COOH; $-NH_2$; CO. 2.23 Explain how CO group frequencies are independent of the	Students to be directed to use Nujol emulsion and KBr pellets in infrared analysis.		Preparation of samples for IR measurement in next lab		Materials for cholesterol extraction

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	nature of the rest of the molecule. 2.24 Describe the components of an infra-red spectrometer e.g. light source, detector, monochromater etc. 2.25 Describe diagrammatically the outlay of IR spectrophotometer (single and double beam spectrophotometer).					
10	2.26 Discuss the use of Fourier Transform (Michelson Interferometers) 2.27 Describe the preparation of substance for infra-red analysis using Nujol emulsion and KBr pellets etc. 2.28 Explain the use of infrared (IR) in elucidation of structure of molecules. 2.29 Explain the limitations of IR in analytical work. 2.30 Solve problems on IR spectroscopy.			IR analysis of samples e.g. cholesterol and interpreting the peaks		Infra-red spectrophotometer
11	2.31 Explain the fundamental principles of UV - Visible absorption spectrometry. 2.32 Classify electron transitions with relationship to UV-Visible absorption. 2.33 Explain the theory of light - absorption and transmission (Beer - Lambert's law)			Investigate absorption spectra, Beer's Law and analyse two component mixtures (2 weeks)		UV - Visible spectrophotometer, $Cr(NO_3)_3$ solution, $Co(NO_3)_2$ solution, $Ni(NO_3)_2$ solution

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	2.34 Apply the expression $E1\%_{1cm}$ = A/C for intensity of absorption 2.35 Describe the spectra of the main classes of organic compounds - alkenes, unsaturated compounds, nitrogen compounds, nitro-compounds, aromatic compounds and heterocyclics.					
12	2.36 Define the terms frequency used in the discussion of electronic spectra (e.g. chromophoresis, anxochromic shift, hypochromic shift, hyperchromic effect). 2.37 Illustrate diagrammatically the layout of UV - Visible spectrophotometer (power supply, light sources monochromators, detectors and measuring device). 2.38 Describe the optical layout of a double - beam UV - Visible spectrophotometer. 2.39 List the advantages of double beam over the single beam spectrophotometer. 2.40 Describe the operation of UV - Visible spectrophotometer. 2.41 Describe sample preparation for UV - Visible analysis.					

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
13	2.42 Record the spectra of a sample 2.43 Outline the main applications of colorimetric and spectrophotometric analysis: (a) spectrophotometric titration (b) determination of pKa (c) determination of pH of a given sample. 2.44 Explain the terms true fluorescence, phosphorescence, chemiluminescence and bioluminescence. 2.45 Differentiate between UV and fluorescence with respect to change in absorption maximum.			Determination of aspirin by fluorimetry (acetylsalicylic acid and salicylic acid).		Filter fluorimeter, ASA, SA, aspirin tablets, chloroform, acetic acid, benzoic acid
14	2.46 Explain how the intensity of fluorescence is proportional to the concentration of the substance in dilute solutions. 2.47 Explain the term "quantum yield". 2.48 Explain the tem "quenching". 2.49 Describe the various units of a spectrofluorimeter e.g. light source, photo-multiplier, recorder.			Evaluate the pK_a of an acid-base indicator using UV-Vis spectrophotometer		UV-Vis spectrophotometer, bromothymol blue, sodium phosphate, potassium phosphate, HCl, NaOH

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
15	2.50 Describe diagrammatically the outlay of a spectroflourimeter. 2.51 Describe methods of preparation of a sample for analysis by spectroflourimetry. 2.52 Describe the operation of a flourimeter. 2.53 Explain the applications of flourimetry and its limitation in analytical work.					

Assessment:

Course test 10%; Practical 40%; Examination 50%

Recommended Textbooks & References:

J.N. Miller and J.C. Miller. Statistics and Chemometrics for Analytical Chemistry. Fourth Edition. Prentice Hall. 2000.

D.C. Harris. "Quantitative Chemical Analysis", 6th Edition, Freeman, New York. 2002.

D.A. Skoog, D.M. West & F.J. Holler. "Fundamentals of Analytical Chemistry", 7th edition. Saunders and Holt, New York. 1996

R. Kellner, J.-M. Mermet, M. Otto & H.M. Widmer (eds.). "Analytical Chemistry" Wiley-VCH, Chichester. 1998

D.T. Sawyer, W.R. Heineman & J.M. Beebe. "Chemistry Experiments for Instrumental Methods". John Wiley & sons, New York. 1984.

Course: Laboratory Management

Department/ Programme: Higher National Diploma Chemistry			
Course: General Laboratory Techniques **Course: GLT Laboratory Management**	**Course Code: GLT 311**	**Credit Hours:**	**2**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **0 hours/week**

GENERAL OBJECTIVES:

1. Know types of laboratories, their furnishings and fittings
2. Understand laboratory layout
3. Understand the principles of designing laboratory stores
4. Know the correct methods and places of installing: (i) Balances (ii) Barometers, (iii) Galvanometer (iv) Water Still (v) Ion Exchanger
5. Understand the management of stores
6. Understand the principles of store keeping
7. Know the acquisition, storage and use of technical information
8. Understand record keeping in the laboratory
9. Understand the importance of discipline in the laboratory
10. Understand routine administrative function in the laboratory

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1: Know types of laboratory, their furnishings and fittings					
1	1.1 Explain the term 'laboratory'. 1.2 List different types of laboratories e.g. teaching laboratory, research laboratory etc. 1.3 State the features of different types of laboratories. 1.4 Explain the factors to be considered when designing a laboratory e.g. nature of work, space and funding etc. 1.5 Explain how funding affects the designing of laboratories	Lecture/Demonstration. Visit to various types of laboratories				
2	1.6 Draw sketches of typical laboratory layout. 1.7 Identify laboratory furniture e.g. benches, floors, sink and drainage etc. 1.8 List suitable materials for the laboratory (i) Bench tops (ii) Floors (iii) Seats. 1.9 List reasons for the choice of materials in 1.7 above 1.10 List essential laboratory fittings e.g. water, electricity, gas, vacuum lines, steam, etc. 1.11 Explain the importance of the fittings in 1.10 above.	Lecture with demonstration. Visit to various types of Laboratories to illustrate various types of floors, sick, furniture taps etc.				

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 2: Understand laboratory layout					
3-4	2.1 Describe the dimension of a standard laboratory work bench, specifying width, length, height and spacing, and types of arrangement e.g. island, peninsular etc. 2.2 Describe the services and fittings, obtainable on laboratory bench tops. 2.3 Describe the methods of providing lighting and ventilation in a laboratory. 2.4 Describe methods of evaluating illumination and efficiency of light fittings in a laboratory. 2.5 Explain the importance of lighting and ventilation in a laboratory. 2.6 Draw the layout of a typical laboratory, showing the essential services.	Lecture with charts to illustrate various types of benches e.g. island, peninsular, services etc.	Charts			
	General Objective 3: Understand the principles of designing laboratory stores					
5	3.1 List the factors that should be considered in the design of a laboratory store e.g. type of store, location, lighting, shelves etc. 3.2 Explain the importance of factors in 3.1 above. 3.3 Draw the layout of a typical laboratory store.	Lecture with illustration	Charts			

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 4: Know the correct method and places for installing (i) Balances (ii) Barometers, (iii) Galvanometer, (iv) Water Still (v) Ion Exchange resin.					
6	4.1 Describe the correct sitting of a balance room in the laboratory e.g. proximity to users. 4.2 List the essential features of a balance room 4.3 Explain the effect of vibration, temperature and dust on balance. 4.4 Explain how the effects in 4.3 above can be minimised.	Lecture with demonstration of equipments e.g. balances, barometers, galvanometers, distillers, Ion Exchange etc.	Resin balances barometers galvanometers distillers Ion Exchange resin			
7	4.5 Illustrate diagrammatically the methods of supporting balances to minimize vibration. 4.6 Support balances to minimize vibration. 4.7 Describe methods of transporting and installing mercury barometers. 4.8 Install mercury barometers.	Lecture with demonstration of equipments	Ion Exchange resin Resist. Balances barometers distillers			
8	4.9 Describe the effect of vibration on galvanometers. 4.10 Explain how the effect in 4.9 above is minimized. 4.11 List types of laboratory distillers and de-ionisers. 4.12 Describe the methods of installing distillers and de-ionisers as in 4.11 above. 4.13 Explain the uses of distillers and deionisers.	Lecture with demonstration of equipments Lecture with demonstration of equipment and illustrating with use of charts.	Barometers, Galvanometers, Distillers Ion Exchange resins. Balances, Barometer, Galvanometer			

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 5: Understand management of stores					
9	5.1 List types of stores e.g. control store, main store and dispensing store. 5.2 Explain the activities that take place in the stores listed in 5.1 above e.g. receiving, storing and issuing of materials etc. 5.3 State the features of stores in 5.1 above. 5.4 Explain the importance of the features stated in 5.3 above.	Lecture and demonstration with slide or overhead projector.	Slide projector or overhead projector.			
	General Objective 6: Understand the principles of storekeeping					
10	6.1 Explain the functions of store keeper. 6.2 Explain the legal liabilities of the storekeeper. 6.3 Explain the use of his/store cards inventory. 6.4 Explain government regulations relating to import. 6.5 Outline the procedure for the purchase of various materials for the store. 6.6 Identify the various types of documents for ordering receiving and paying for goods e.g. order form, invoice, and delivery note etc. 6.7 Explain the importance of the documents listed above.	Lecture and demonstration slide/or overhead projector.	Slide projector or overhead projector.			

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 7: Know the acquisition, storage and use of technical information					
11	7.1 List sources of information for the laboratory e.g. reference books, journals catalogue etc. 7.2 Explain the importance of the source in 7.1 above. 7.3 Describe different methods of storing technical information e.g. file, computer, micron film, tapes etc. 7.4 Explain the methods of retrieving, technical information e.g. film projector, video display, Book Borrowing etc. 7.5 Store and retrieve technical information for the laboratory. 7.6 Explain the use of technical information sources e.g. data and statistical books, trade catalogues etc.	Lecture, give assignments				
	General Objective 8: Understand record keeping in the laboratory					
12	8.1 List types of laboratory records e.g. equipment, loan book, accidents etc. 8.2 Explain the importance of each type of record.	Lecture, give assignments				
	General Objective 9: Understand the importance of discipline in the laboratory					
13	9.1 Explain the significance of hierarchy in staff structure. 9.2 Explain the need for discipline in the laboratory environment. 9.3 Explain qualities of leadership and good example as a basis for disciplinary practices.	Lecture with illustrations	Charts			

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
14	9.4 Evaluate methods of appreciation and criticism as they relate to discipline e.g. commendation for a good job, polite, correction etc. 9.5 Describe the methods of achieving good communication between staff and students. 9.6 Explain the importance of a good student/staff relationship.	Lecture with illustrations	Charts			
	General Objective 10: Understand routine administrative function in the laboratory					
15	10.1 List the minimum staff strength in the laboratory. 10.2 Explain the importance of good/poor staffing. 10.3 Determine the optimal staff/student ratio in a typical laboratory. 10.4 List basic staff of a laboratory. 10.5 List factors to be considered for asking at interviews for laboratory staff. 10.6 Explain how the factor listed in 10.5 above can be used in interviews for laboratory staff.	Lecture with illustrations	Charts			

Assessment:

Coursework/Assignments 10 %; Practical 40 %; Examination 50 %

Course: General Instrumentation

Department/ Programme: Higher National Diploma Chemistry			
Course: General Instrumentation	**Course Code: GLT 312**	**Credit Hours:**	**5**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours/week**

GENERAL OBJECTIVES:

1. Understand the operation, use and care of basic measuring instruments
2. Know the types of signal generators in the laboratory
3. Know the types of pressure measuring instruments
4. Know the types of recorders and reproducers
5. Know the types of power supply units in the laboratory
6. Understand the essentials of trouble-shooting techniques

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1: Understand the operation, use and care of basic measuring instruments					
1	1.1 Identify basic measuring instruments e.g. moving coil, moving Iron, thermocouple, oscilloscope, digital meters. 1.2 Classify measuring instruments e.g. analogue and digital meters. 1.3 List an example of each type in 1.2 above. 1.4 List precautions to be taken when using the instruments in 1.1 above.	Use question and answer techniques Lecture;	Analogue voltmeter Digital voltmeter Power supply(D.C.) Connecting wires Bread boards Resistors Signal generator Oscilloscope Ammeter Balances	Students recognise and use measuring instruments	Get students involved in classification of analogue and digital equipment.	See under theory content
2	1.5 Describe with the aid of diagrams the construction of instruments in 1.1 above 1.6 Describe with the principle of operation of the instruments in 1.1. above. 1.7 Explain the terms: (i) Multimeter (ii) Multirange (iii) Autoranging	Use question and answer techniques; Lecture	Classroom resources	Use multimeter to show the effect of terms stated in 1.5.		Multimeter (Digital) Avometer

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1: Understand the operation, use and care of basic measuring instruments					
3	1.7 Carry out set-zero and calibration adjustments in the instruments in instruments in 1.1 1.8 Measure: (i) Voltage (ii) Current (iii) Resistance using the appropriate instrument in 1.1 above. (iv) weights (v) temperatures 1.9 Measure frequency, amplitude, phase relationship of signals by using oscilloscope	Use question and answer techniques; Lecture with worked example	Analogue voltmeter; Digital voltmeter;	Measure voltage, Current parallel circuit of resistors multimeter and power supply.		Power supply (D.C.); Connecting wires; Bread boards; Resistors; Signal generator; Oscilloscope;
4	1.10 Construct measuring instruments e.g. thermocouple, potentiometer. 1.11 Carry out measurements using the instruments in 1.10 above. 1.12 Carry out routine care of the instruments in 1.11 above.	Lecture		Use different metals to construct thermocouple.	Get students involved in routine care of laboratory instruments	Thermocouple; Potentiometer; Digital meters; Bread board; Power supply

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 2: Know types of signal generators in the laboratory					
5	2.1 Classify signal generators e.g. low frequency, high frequency, variable frequency etc. 2.2 State the different types of waveforms produced by signal generators in 2.1 above e.g. sine wave, square wave, saw tooth etc. 2.3 Describe with the aid of suitable diagrams the operation of the signal generator listed in 2.1 above. 2.4 Describe a typical application of each type of signal generator listed in 2.1 above. 2.5 State the use of a signal generator in fault-finding, etc.	Lecture		Display and sketch types of waveform on oscilloscope. Measure amplitude and frequency of a sine wave. Measure and sketch a d.c. waveform.		Signal generator; Double beam; Oscilloscope; Power Supply
	General Objective 3: Know the types of pressure measuring instruments					
6-7	3.1 Identify the different types of instruments used in measuring pressure e.g. barometers, manometers, pressure gauges etc. 3.2 Classify the instruments in 3.1 above in relation their operating principles. 3.3 Describe the principle of operation of some pressure measuring instruments in 3.1 above. 3.4 Measure pressure using any of the instruments in 3.1 above.	Lecture/Demonstration		Measure pressure using manometer and Bourdon gauge		Manometer Barometer; Pressure gauges; Autoclaves

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 4: Know the types of recorders and reproducers					
8	4.1 Identify the different types of recorders and reproducers e.g. chart audio video projectors etc. 4.2 Describe the principle of operation of the recorders and reproducers commonly used in the laboratory.	Demonstration of principles using resources.	Tape recorder; Overhead projector; Slide projector; Compact Disk player; Video recorder.	Record and reproduce using the recorders and reproducers in 4.2 above.		
9	4.3 Describe typical applications of the recorders and reproducers in 4.2 above. 4.4 Describe routine care of the recorders and reproducers in 4.2 above.	Lecture/Demonstration	Overhead projector; Tape recorder; Slide projector; Compact Disk player.	Carry out routine care of the recorders and reproducers in 4.2 above.	Get students involved in recording	
	General Objective 5: Know the types of power supply units in the laboratory					
10	5.1 Identify types of power supply unit e.g. mains-derived, direct current, batteries etc. 5.2 Classify direct current supply e.g. low voltage, high voltage, stabilized voltage.	Lecture		Construct mains derived power supply and measure the output of a battery.		Power supply, Bread board; Transformer; Diodes;

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	5.3 Explain with the aid of diagrams how a.c. is converted to d.c. 5.4 Describe the construction of typical power supply units.					Multimeter; Oscilloscope.
11	5.5 Outline the precautions to be observed when using power supply units. 5.6 Describe the application of power supply units and their limitations			Use the constructed power supply to power a circuit		Transformer; Diodes; Bread board; Capacitors; Resistors; Regulators; Multimeter
	General Objective 6: Understand the essentials of trouble-shooting techniques					
12-13	6.1 Identify tools for trouble-shooting e.g. service manuals, multimeter, signal generators etc. 6.2 Obtain necessary information from the operator and from service manuals about a given instrument. 6.3 Check: (a) Continuity (b) Availability of power etc. in the instruments in 6.2 above.	Lecture	Service manual	Troubleshoot faults in equipment using service manuals, multimeters and oscilloscopes.		Multimeter; Screw driver; Allen keys; Oscilloscope

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
14	6.4 Trouble-shoot instruments such as overhead projector, PH meter etc. 6.5 Detect defective modules or pants e.g. by signal injection, pant substitution, etc. in instruments using the tools in 6.1 above.			isolate defective modules by the use of oscilloscopes/ multimeters.		pH meter; Overhead projector. Multimeter; Soldering iron;
15	6.6 Repair or replace the defective module pant in 6.4 above.			Replace defective component by the use of soldering iron.		Oscilloscope; Signal generator;

Assessment:

Coursework/ Assignments 10 %; Practical 40 %; Examination 50 %

Recommended Textbooks & References:

Course: Higher Technical English

Department/ Programme: HND Chemistry			
Subject/Course: Higher Technical English	**Course Code: STC 316**	**Credit Hours:**	**5**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

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

1. write good English paying particular attention to correct punctuation and grammar.
2. write, by using accepted conventions, References and Bibliographies for reports and papers
3. write a short scientific paper by using the third person passive tense.
4. write concise self-contained abstracts for scientific papers
5. write a newspaper article for the general public based upon the scientific paper in objective 3.
6. deliver a 30 minute lecture on a scientific topic
7. perform proficiently in a viva voce exam on a scientific topic.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1: write good English paying particular attention to correct punctuation and grammar					
1 - 3	1.1 Students know and are able to use: full stops, capital letters, commas and apostrophes. 1.2 Students know the variety of uses of the punctuation marks in 1.1 and deploy them correctly. 1.3 Students know and are able to use: colons, semi-colons, hyphens, brackets and parentheses. 1.4 Students understand and are able to deploy good grammar (sentence structure, prepositions, pronouns, relation between verb and subject, ending sentences, plural and collective nouns, nouns used as adjectives, unattached participles, double negatives, split infinitives) 1.5 Students recognise and are able to select the correct word to use from a set of confusing words (e.g. affect and effect, who and whom, less, fewer)	Give examples of good and bad punctuation and grammar. Prepare and distribute examples of poor English to be corrected by the students. Set assignments, mark and return assignments with the English corrected for the students.	Classroom resources and office resources	Students correct articles containing poor punctuation and grammar. Students write articles in good English.	Prepare and distribute assignments	Workshop resources (writing and library resources)
	General Objective 2: write, by using accepted conventions, References and Bibliographies for reports and papers					
4	1.6 Students understand how to write references and bibliographies by using the "Harvard" references style 1.7 Students understand how to write numerically based references 1.8 Students know and are able to	Explain the use of References and Bibliographies and how to write them in different styles. Distribute photocopies of the "Instructions for Authors" for the Journals given.	Classroom resources. Photocopier.	Students are provided with a scientific text (preferably electronic) which they complete by introducing references and a reference page. Students repeat the above exercise by using a variety	Construct and provide suitable text and distribute to students. Provide encouragement and feedback	Workshop resources (writing and library resources) Computer pool room.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	construct references in the correct styles for the following journals: Nature, Journal of the American Chemical Society, Chemical Communications, and Global Journal of Pure and Applied Sciences.			of reference styles.		
	General Objective 3: write a short scientific paper by using the third person passive tense.					
5 - 7	3.1 Students understand the use of, and are able to write in, the third person passive tense.	Explain the use of the third person passive.	Classroom resources	Students write a short scientific paper (Introduction, Methods, Results, Discussion and References) by using the third person passive tense (approximately 2000 words long).	Give assignment (e.g. a modern paper in first person active to be converted into third person passive)	Workshop resources
	General Objective 4: write concise self-contained abstracts for scientific papers					
8	4.1 Understand the need for self-contained (i.e. free standing) abstracts 4.2 Be able to write free standing abstracts	Explain need and give examples (both good and bad)	Classroom resources	write free standing abstracts for scientific papers including the paper from general Objective 3 above.	Distribute papers without abstracts and Guide and correct students.	workshop resources
	General Objective 5: write a newspaper article for the general public based upon the scientific paper in objective 3					
9 - 10	5.1 Students should understand the different requirements, and be able to move between writing for scientists and writing for the general public.	Explain the different requirements and give examples.	Classroom resources	students write a newspaper article for the general public based upon the scientific paper in objective 3	Guide students	workshop resources
	General Objective 6: deliver a 30 minute lecture on a scientific topic					
11 - 13	6.1 Understand how to prepare a lecture and speak in public	Provide advice	Classroom resources	Students prepare and give a 10 minute lecture on a scientific topic Students prepare and deliver a 30 minute lecture on a scientific topic	Help students select topics check their preparation (i.e. notes not text)	Workshop resources, preferably using overhead projector and/or PowerPoint

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 7 perform proficiently in a viva voce exam on a scientific topic					
14 - 15	7.1 Understand the procedure of a viva voce and know what makes for a good viva and a poor one 7.2 Know how to prepare for a viva voce exam 7.8 Be able to participate well in a formal viva on a scientific topic	Explain the rules and conventions of viva voce exams. Explain how to prepare and participate.	Classroom resources	students engage in a short (7 minute) viva voce students engage in a slightly longer (15 minute) viva voce	help students select suitable topics, conduct the viva and provide feedback	Office or conference room facilities.

Assessment:

Coursework/ Assignments 100%

Recommended Textbooks & References:

D. Collinson, G. Kirkup R. Kyd and L. Slocombe, Plain English 2nd Edition (1992), Open University Press

Communicating Chemistry published by The Royal Society of Chemistry (UK)

Sir Ernest Gowers, The Complete Plain Words, (1986) HMSO (UK)

FIRST YEAR - SECOND SEMESTER

Course: Polyfunctional Compounds

Department/ Programme: HND Chemistry			
Subject/Course: Polyfunctional Compounds	**Course Code: STC 321**	**Credit Hours:**	**5**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Understand the chemistry of dicarbonyl compounds.

2.Understand the chemistry of saturated dicarboxylic acids and their derivatives

3.Understand the chemistry of polyhydric alcohols.

4.Understand the chemistry of some physiological important amino acids.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1.0: Understand the chemistry of dicarbonyl compounds.					
1	1. Draw structures of 1, 2 - dicarbonyl compounds. 2. Write IUPAC names for 1.1 above. 3. List properties of ethanedial and diphenyl diketone 4. List common names of some 1,2-dicarbonyl compounds. 5. Describe properties and reactions of 1,2 -dicarbonyl compounds	Explain with illustrations - do - - do -	Classroom resources - do -	Prepare a named 1,2 - dicarbonyl compound in the laboratory e.g. 2,3 - butanedione	Guide students through the preparation of a named 1,2 - dicarbonyl compound.	Reagents, glassware
2	6. List examples of 1,3 - dicarbonyl compounds. 7. Draw structures of 1,3 - dicarbonyl compounds. 8. Write IUPAC names for 1,3 - dicarbonyl compounds. 9. List and describe properties of 2,4 - pentanedione as a representative of 1,3 - dicarbonyl compounds. 10. Draw tautomers of 2,4 - pentanedione. 11. List uses of 1,3 - dicarbonyl compounds.	Lecture and give assignment.	- do -	Prepare 1,3 - dicarbonyl compounds (e.g. 2,4 pentanedione).	Guide students through preparation of 1,3 - dicarbonyl compounds in the laboratory.	Glassware reagents

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
3	12. List examples of 1,4 - dicarbonyl compounds. 13. Draw structures of 1,4 - dicarbonyl compounds. 14. Write IUPAC names for a few 1,4 - dicarbonyl compounds. 15. List properties of 1,4 - carbonyl compounds. 16.List uses of 1,4 - dicarbonyl compounds.	Lecture and ask questions - do - - do -	Classroom resources. - do - - do -	Prepare 1,4 - dicarbonyl compounds (e.g. 2,5-hexanedione).	Guide students through the preparation of 2,5-hexanedione in the laboratory.	Glassware, reagents.
	General Objective 2.0: Understand the chemistry of saturated dicarboxylic acids and their derivatives					
4	1. Write the general formula for saturated dialkanoic acids as $C_nH_{2n}(COOH)_2$. 2. Write the structural formula of dialkanoic acids. 3. Describe the general methods of preparation of dialkanoic acids.	Lecture and ask questions	Classroom resources.	Prepare saturated dialkanoic acid and derivatives.	Guide students through the preparation of saturated diakanoic acids and derivatives.	Glassware, reagents
5	4. Describe properties and reactions of dialkanoic acids. 5. List uses of dialkanoic acids.	- do -	- do -	Carry out a Knovenagel reaction between malonic acid and an aromatic aldehyde	Guide students	

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
6	6. Write the structure of malonic ester 7. Write the two tautomeric forms of malonic ester. 8. Describe methods of preparation of malonic ester. 9. Describe the properties and reactions of malonic ester.	- do -	- do -	Prepare a named aceto-acetic ester.	Guide students through the preparation	
7	10. Explain the significance of the active methylene group in the reactions of malonic ester. 11. Describe the application of malonic ester in the synthesis of other acids.	Lecture and ask questions - do -	Classroom resources. - do -	Carry out a Malonic Ester synthesis (e.g. synthesis of the drug valproic acid or other named alkanoic acid)	Guide students through the preparation of a named alkanoic acid using malonic ester	Reagents, glassware.
8	12. Draw structure of aceto - acetic ester. 13. Describe methods of preparation of acetic ester. 14. Describe the properties and reactions of acetoacetic ester. 15. Explain the significance of the active methylene in the reactivity of acetoacetic ester. 16. Describe the applications of acetoacetic ester in the synthesis of other organic compounds (e.g. methyl ketones and alkanoic acids)	- do - - do - - do -	- do - - do - - do -	Prepare acetylcyclohexane via alkylation of ethyl acetoacetate with 1,5-dibromopentane		Reagents, glassware

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 3.0: Understand the chemistry of polyhydric alcohols.					
9	1. Define polyhydric alkanol. 2. Describe general method of preparation of polyhydric alkanols. 3. Describe the properties and reactions of polyhydric alkanols. 4. List uses of polyhydric alkanols.. 5. Describe a method of determining the number of OH groups in a polyhydric alkanol.	Lecture and questions - do - - do -	Classroom resources - do - - do -	Prepare polyhydric alkanol by oxidation of an unsaturated compound	Guide students through the preparation of polyhydric alkanols	Reagents, glassware
10				Prepare polyhydric alkanol by hydrolysis of 1,2 epoxides	Prepare polyhydric alkanol by using methods specified	
	General Objective 4.0: Understand the chemistry of some physiological important amino acids.					
11	1. Define an amino acid. 2. Write the general formula of amino acid. 3. List examples of amino acids. 4. List and explain essential amino acids.	Lecture and questions - do - - do -	Classroom resources - do - - do -	Prepare á - amino acids e.g. glycine using reactions of a 2-chloro acid with concentrated ammonia	Guide students through the preparation of á -amino acid	Reagents Glassware

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
12	5. Explain optical isomerism in amino acids. 6. Differentiate between basic and acidic amino acids. 7. List examples of both basic and acidic amino acids. 8. Explain isoelectric point of an amino acid.			Prepare phthalimido glycine via Gabriel Synthesis	Guide students	
13	9. Explain the biological importance of amino acids. 10. Describe the general method of synthesis of á - amino acid. 11. Describe the properties and reactions of á - amino acid as an acid.			Deprotect, by using hydrazine, the phthalimido glycine prepared above		Reagents, glassware
14-15				Characterise a named amino acid experimentally applying the following methods: a) nitrous acid reaction to detect primary, secondary and tertiary amino groups b) the ninhydrin colour test c) chromatography	Guide students through the characterization of a named amino acid	Reagents, glassware

Assessment:

Course test 10 %; Practical 40% Examination 50 %

Recommended Textbooks & References:

(1) Organic Chemistry by Vollhardt and Shore published by W.H.Freeman New York

(3) Small Scale Synthesis by M. Zanger and J. R. McKee published by McGraw-Hill Science, USA, 2002

Course: Physical Chemistry II - (Chemical Kinetics)

Department/ Programme: HND Chemistry			
Subject/Course: PHYSICAL CHEMISTRY II - (CHEMICAL KINETICS)	**Course Code: STC 322**	**Credit Hours:**	**5**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Understand the principles and applications of chemical kinetics

2.Understand the dynamics of molecular reactions

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objectives: 1.0 Understand the principles and applications of chemical kinetics					
1	1. Define true rate in terms of the advancement of a reaction. 2. Describe how rates are measured experimentally 3. Derive the first and second order rate laws. 4. Define the rate coefficient of a reaction. 5. Define the order of a reaction. 6. Describe how the concentrations of reactants and products are monitored in a chemical reaction.	Lecture - do - - do - - do -		Determine rate of reaction from a concentration - time curve experimentally	Students to be guided to determine rate of reaction	Stop clocks, thermo stated bath, thermometer glassware
2	7.Define pseudo-first order rate law. 8. Describe Ostwald's isolation method.			Determine the rate of first and second order reactions by measuring initial rates	Guide the students through the practical procedure for determining order from time dependence of concentration	Stop clocks, thermo stated bath, thermometer glassware
3	9. Define the half-life of a reaction. 10. Relate the half-life of a reaction to reaction order.	Lecture	Classroom resources.	Determination of the order of the reaction between bromate and bromide ions in acid solution. Investigation of the effects of conc. of reactants, on the hydrolysis of methyl acetate	Prepare and provide manual Prepare potassium bromide, potassium bromate sulphuric acid. sodium sulphate sodium thiosulphate solutions	Thermostat (25^0c) $250cm^3$ conical flasks and stopper Measuring cylinder Titration apparatus Distilled water Stop watch

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
4	11. Explain the terms molecularity of reaction, mechanism of reaction, simple reaction. 12. Distinguish between order and molecularity of reaction.			Determination of the rate constant of the hydrolysis of ethyl acetate by sodium hydroxide.	Prepare and provide the lab manual. Prepare 0.02mol/dm^3 sodium hydroxide (free from carbonates) .02mo1/dm^3	Thermostat 150 cm^3 and 1000cm^3 stoppered conical flasks Stop watch Phenolphthalein indicator hydrochloric acid 0.01mol/dm^3 ethyl acetate (using CO_2 free water)
5	13. Describe Arrhenius - type behaviour of simple reactions. 14. Explain the Arrhenius - type behaviour of bimolecular gas phase reactions.				Prepare and provide the lab. manual for the exp. 1mol/dm^3 hydrochloric acid 1mol/dm^3 sodium hydroxide	Chemicals Glassware
6	15. Derive the rate laws for reactions involving equilibria. 16. Relate equilibrium constant to the rate coefficient of simple reactions			Investigation of the effect of a catalyst on the reaction between permanganate and oxalic acid	Prepare and provide the lab. Manual for the exp. Prepare 0.05 mol/dm^3 potassium permanganate, 0.1mol/dm^3 oxalic acid, 1mol/dm^3 sulphuric acid	Dropping pipettes Measuring cylinder Distilled water Test tubes Stop watch Manganese chloride solution

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
7	17. Derive the rate law for parallel reactions. 18. Derive the rate law for consecutive reactions.			Determination of the specific rate constant for the hydrolysis of t-butyl chloride in 50:50 isopropanol: water	Prepare and provide the lab. Manual Prepare and provide distilled water; isopropanol, 0.1mol/dm^3 sodium hydroxide	Measuring cylinders volumetric flasks with stoppers Phenolphthalein Stop watch Burettes t-butyl chloride
8	19. Explain the steady - state approximation. 20. Define the rate - determining step of a reaction.			Determination of the activation energy for the reduction of peroxodisulphate (vi) ions by iodide ions in the absence of catalyst.	Prepare Lab. Manual. Prepare 0.02mol/dm^3 potassium peroxodisulphate (vi) 0.5m o1/dm^3 potassium iodide 0.01mol/dm^3 sodium thiosulphate	Safety spectacles 500cm^3 beakers Thermometers Bunsen burner Burettes Stands Funnels Boiling tubes Stop watch, tripod, gauze
9	21. Derive the rate laws for reactions involving a pre-equilibrium. 22. Define the terms catalysts, acid catalyst and base catalyst and explain their mode of operation			Determination of the activation energy for the oxidation of iodide ions by peroxodisulphate (vi) ions in the presence of iron (iii) ions.	Prepare and provide the Lab. Manual Prepare 0.02mol/dm^3 potassium peroxodisulphate (vi) 0.01mol/dm^3 sodium thiosulphate	Safety spectacles 500cm^3 beakers Thermometers Bunsen burner Burettes

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
					0.2% starch solution 0.5mol/dm^3 potassium iodide	Stands Funnels Boiling tubes Stop watch, tripod, gauze
	General Objectives 2.0 Understand the dynamics of molecular reactions					
10	2.1 State the collision theory of bimolecular gas-phase reactions. 2.2 Calculate the second - order rate coefficient from collision theory. 2.3 Define P-factor and the reactive cross-section. 2.4 Distinguish between diffusion - controlled and activation - controlled reactions in solution.	Lecture and give assignment. - do - - do - - do -	Classroom resources. - do - - do - - do -	Determination of the rate constant for hydrogen peroxide heterogeneous decomposition	Prepare and provide the Lab. Manual prepare 0.05mol/dm^3 potassium permanganate	Hydrogen peroxide manganese (iv) oxide Balance Titration apparatus Thermometer Stop watch Measuring Cylinder Ice Conical flasks (250cm^3)
11	2.5 Relate the second order rate coefficient to the diffusion coefficient. 2.6 Relate the second order rate coefficient to viscosity.	- do - - do - - do - - do -	- do - - do - - do - - do -	Determination of the rate equation for the reaction between iodine and propanone by determining the order of reaction with respect to each reactant and catalyst, using colorimetry.	Prepare and provide the lab. Manual. Prepare 0.02 mol/dm^3 iodine (in KI (aq)) 2mol/dm^3 propanone	Safety spectacles Colorimeter with filters Optically matched test tubes to fit colorimeter (with stoppers) Wash bottle of distilled

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
					2mol/dm^3 hydrochloric acid Assist the students to choose appropriate filter before	water Burettes, stands, filling funnels Beakers Stop watch Thermometer
12	2.7 Explain the terms - activated complex, reaction co-ordinate and transition state. 2.8 Describe the activated complex theory of reaction rates. 2.9 Define Gibb's function of activation, entropy of activation and enthalpy of activation.			Determination of the rate equation for the reaction between bromide and bromate(v) ions in aqueous solution, using methyl orange indicator.	Prepare and provide the lab. Manual. Prepare potassium bromated (v) potassium bromide phenol acidified methyl orange sulphuric acid solutions	Safety eye glass Wash bottle Burettes, stands Beakers, funnels Measuring cylinder (50cm^3) Thermometer White tiles Stop watch
13	2.10 Explain the basis of the kinetic salt effect. 2.11 Derive the magnitude of kinetic salt effect.			Determination of the rate constant and energy of activation of the reaction between hydrogen peroxide and hydrogen iodide	Prepare and provide manual for the exp. Guide students	Thermostat (15°C) - 500cm^3 conical flask sulphuric acid. sodium thiosulphate starch. potassium iodide Hydrogen peroxide burette, pipette Stop watch, thermometer

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
14	2.12 Explain how molecular beams are used to study reactive collisions. 2.13 Sketch the potential - energy surface of a simple reaction.			Determination of the rate and pre-exponential constants of the hydrolysis of methyl acetate, catalysed by hydrochloric acid	Prepare and provide the lab. Manual Prepare 0.1mol/dm^3 sodium hydroxide 0.5mol/dm^3 hydrochloric acid CO_2 free water	Thermostats 250cm^3 and 150cm^3 conical flasks. Stop clock or watch Test tubes with stoppers Measuring cylinder Ice - cold CO_2 free water Titration apparatus.
15	2.14 Distinguish between attractive and repulsive surfaces and explain how they control the energy requirements of a reaction.			Measure the P-factor and reactive cross section	Guide students and relate to 2.3 above	

Assessment:

Coursework/ Assignments 10 %; Practical 40 %; Examination 50 %

Recommended Textbooks & References:

Atkins' Physical Chemistry by Peter Atkins and Julio de Paul, published by Oxford University Press 7th Edition 2002

Vogel's textbook of quantitative chemical analysis. ELBS 5th Ed. Revised by Jeffery G.H; Bassett J; Mendham J & Denney R.C. Longman Singapore publishers pte Ltd. 1997

Advanced practical chemistry edited by Alec Thompson & Lambros Atteshlis. John Murray (publishers) Ltd. London. 1985

A Laboratory manual of physics. 5th Ed. by Tyler F. Published by Edward Arnold

Course: Industrial Chemistry

Department/ Programme: NHD Chemistry			
Subject/Course: Industrial Chemistry	**Course Code: STC 323**	**Credit Hours:**	**5**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Know the scope of the chemical industry
2. Understand the general principles involved in quality control in chemical industries
3. Understand the chemical principles involved in the manufacture of soap and detergent
4. Understand the chemical principles and process involved in the manufacture of fertilizers
5. Know the principles and processes of glass manufacture.
6. Understand the processes involved in the manufacture of cement
7. Understand the processes involved in the manufacture of leather
8. Understand the mechanism of polymerisation reactions and properties of polymers
9. Understand the chemistry of paints
10. Know the basic science of pulp and paper making

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1: Know the scope of the chemical industry					
1	1.1 Outline the scope of chemical technology and chemical process industry. 1.2 List the chemical process industries in the country. 1.3 List major raw materials and their sources for the use of the industries in 1.2 above. 1.4 Classify the raw materials in 1.3 above into organic and inorganic materials. 1.5 Define the word "chemical" as used in industry and classify them into "heavy and Fine" chemicals.	Explain and ask questions to students " " " "	Classroom resources " " " "			
	General Objective 2.0 Understand the general principles involved in Quality Control in Chemical Industries					
2	2.1 Define quality control and its significance in Industrial Processes. 2.2 Explain the following terms used in quality control process: (a) quality assurance (b) continuous process and batch process (c) specification (d) automation	Lecture " " Lecture and demonstrate Show and discuss various national quality control guidelines.	Classroom resources	Sample some common industrial products e.g. soap, vegetable oil, paints etc. Determine the relevant parameters in the products and analyse the results obtained above statistically using quality control format.		Hydrometer, Atomic absorption spectrophotometer. Titrimetric apparatus Balances Furnace Centrifuge Autoclave

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	2.3 List steps involved in quality control procedure (Raw materials, Intermediary, Finished Product). 2.4 Define sampling and describe sampling procedure in quality process. 2.5 Explain the role of regulatory bodies (e.g. NAFAC, SON etc) in quality control.					
	General Objectives: 3.0 Understand the chemical principles involved in the manufacture of soap and detergent					
3	3.1 Differentiate between soap and detergent. 3.2 Differentiate between soft (toilet) soap and hard (laundry) soap. 3.3 List the basic raw materials used industrially in soap making. 3.4 Describe the major methods used industrially in soap making (e.g. cold, coil systems). 3.5 Describe the methods of soap purification 3.6 List the basic raw materials and methods used in the manufacture of detergent.	Lecture	Classroom resources	Prepare soap in the laboratory using KOH and NaOH separately. Compare the quality of soaps prepared above using soap quality control parameters (e.g. leather volume and stability, % unsaponifiable matters). Purify the soap prepared above	Demonstrate and guide the students Demonstrate and guide the students	Glassware, chemicals, soxhlet quickfit apparatus.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objectives: 4.0 Understand the chemical principles and process involved in the manufacture of fertilizers					
4	4.1 List various types of fertilizers viz: nitrogen, phosphate, potassium etc. 4.2 Explain the principles involved in the production of a named fertilizer e.g. phosphate. 4.3 List the raw materials for the production of a named fertiliser. 4.4 Explain the various steps involved in the production of a named fertilizer, and write relevant equations for the reactions in each step. 4.5 Explain the main difference between chemical fertiliser and organic fertiliser.	Lecture and show samples of each type of commercial fertilizer	Classroom resources	Prepare a detergent and compare its cleansing activities with that of soap purified in 3.5 above.	The teacher should demonstrate the cleansing action of detergent and soap in the laboratory.	Chemicals and glassware
5		Lecture	Classroom resources	Prepare a named chemical fertiliser in the laboratory. Carryout a quality comparative analysis of the fertilizer prepared above and a commercial fertilizer of the same formula.	Guide the students to prepare fertiliser, and carry out comparative analysis of the fertiliser prepared and any other commercial fertiliser Give a pre-laboratory talk to guide the students	Chemicals, AAS, spectrophotometer and flame photometer
	General Objectives: 5.0 Know the principles and processes of glass manufacture.					
6	5.1 Define glass. 5.2 Describe the physical properties of glass e.g. light permeability, hardness, brittleness etc.	Explain with relevant examples "	Classroom resources Glass, hydrogen fluoride	Produce glass in the laboratory using necessary materials. Carry out elemental analysis to determine	Guide students though the production of glass Guide students through the procedure for the elemental analysis to determine the	Chemicals, sand, potassium crucibles. Chemicals, glass wares, flame photometer, atomic absorption

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	5.3 Explain the relevance of the following raw materials to the glass industry: (a) sand (b) oxides of potassium, sodium, calcium, lead, boric acid and phosphate. (c) Pigments, agents, discolouring agents, clearing agents. (d) BaO ($BaCO_3$), ZnO for thermometer glass, Al_2O_3 in the form of Kaolin. 5.4 Classify glass into the following: (a) soft glass (b) hard glass (1) monax (2) pyrex (3) firmssil (4) phoenix 5.5 Describe the different methods used in glass manufacture and classify the glasses based on each method e.g. cast, pressed, plate, hollow glass. 5.6 Demonstrate the only possible technique to bring glass into solution (dissolution in HF)	Describe and show different glass types to the class for classification. Lecture		the composition of each of the glass types listed	composition of each of the glass types listed in 5.5 above.	spectrophotometer.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objectives: 6.0 Understand the processes involved in the manufacture of cement					
7	6.1 Explain the term cement, and "Portland cement". 6.2 Describe the steps involved in cement manufacture. 6.3 Explain firing and the accompanying reactions: (a) decomposition of lime stone (b) dehydration of clay (c) Combination of CaO with Al_2O_3 to form $CaOAl_2O_3$ and with SiO_2 to form $2CaO.SiO_2.CaO.Al_2O_3$. 6.4 List the composition of a typical cement sample. 6.5 Explain the effects of the following, on the properties of the cement sample in 6.7 above (a) the fitness of ground raw material (b) the accurate determination of the ratio of the components (c) the temperature and firing time (d) the rate of cooling	Discuss and show different types of cement Lecture and give assignment	Classroom resources. Classroom resources	Determine the percentage composition of $CaCO_3$, MgO,SiO_2, K_2O,Na_2O in lime stone Determine the free CaO in clinker Determine the percentage composition of some cement samples	Guide the students to carry out the analysis Demonstrate and let the students determine the free lime Pre-laboratory talk on the analysis of cement	UV spectrophotometer, Glass ware, complexing agents platinum crucibles, Buchner funnel, ethylene glycol, Methanol, burette Glass wares, EDTA, UV spectrophotometer.+

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objectives: 7.0 Understand the processes involved in the manufacture of leather					
8	7.1 Define Leather in term of stabilized collagen. 7.2 Explain the constitution of animal skin/hide. 7.3 Describe the methods of preservation of hides and skins. 7.4 State the chemical reactions involved in the following process (a) soaking (b) unharing (c) pulping (d) neutralization (e) tanning (f) fertiliquoring (g) dyeing	Explain and illustrate with relevant examples	Classroom resources.	Produce leather using the processes described in 7.3 above.	Guide students in the production of leather	Chemicals, Vats, hides
9	7.5 Describe the methods of quality control in the leather industry. 7.6 Describe various physical and chemical tests carried out in leather to ascertain its quality. 7.7 State the grading patterns of leather and hides/skin. 7.8 Describe the various uses of leather in making belt, shoes, bags etc.			Carry out chemical and physical tests (e.g. % Cr_2O_3, hide substance - khejahl test, tensile strength, rubflashness, water proofness etc.	Guide students through chemical and physical test on leather.	Khejadah apparatus, instron tester,. rubfastness tester, water proof tester.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objectives: 8.0 Understand the mechanism of polymerization reactions and properties of polymers					
10	8.1 Define polymerization, monomers and initiators. 8.2 Explain the differences between addition and condensation polymerization. 8.3 Describe the mechanism for free radical addition polymerization viz: initiation, propagation and termination reactions. 8.4 Write mathematical equations for each of the stages in 1.5 above. 8.5 Derive the equation for rates of polymerization, $$Rp = Kp(M)\frac{fkd(I)^{1/2}}{kt}$$ Where, (M) = monomer concentration (I) = initiator concentration (Kp) = rate constant of polymerization f = efficiency of initiator kt = rate constant of termination	Lecture - do - - do - - do -	Classroom resources - do - - do - - do -	Prepare some polymers	Direct the students to prepare cellulose (polymer) in the laboratory, using pulp from locus bean seed.	Reagents, glassware

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
11	8.6 Define kinetic chain length v, average degree of polymerisation Dp, reciprocal degree of polymerisation. 8.7 Describe the effect of chain modifiers on kinetic chain length, average degree of polymerisation and reciprocal degree of polymerisation. 8.8 Describe the methods of relative molecular mass determination viz: (a) end group analysis method (b) osmometer method (c) viscometer method	Lectures and give assignments - do - - do -	Classroom resources - do - - do -	Determine the molecular mass of polymers using the methods in 8.8 above.	Guide the students to determine the polymer molecular mass	Viscometer, Osmometer, Glassware, stop watch, polymer samples and solvents
12	8.9 Describe polymer structure and isomerism 8.10 List factors affecting crystallization of polymer. 8.11 List the properties of crystalline and amorphous polymers. 8.12 Explain glass transition temperature (Tg) and melting temperature of amorphous and crystalline polymers. 8.13 List factors affecting melting temperature and glass transition temperatures of crystalline polymers.			Fractionate polymers. Characterise the fractionates using a Viscometer	Direct the students to carry out polymer fractionation and characterisation	Chemicals, Viscometer and Glass wares

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objectives: 9.0 Understand the Chemistry of Paints					
13	9.1 Define paints. 9.2 Classify paints as: (a) emulsion paints oil and alkyd paints (b) paints based on resins (c) epoxy coating (d) poly-urethare finishes (e) unsaturated polyester finishes 9.3 List the raw materials for the manufacture of paints: (a) pigments (b) solvents (c) paint additives 9.4 Explain the ratio of mixing the raw materials in paint manufacture. 9.5 State the temperature conditions for the manufacture of paints. 9.6 Explain the colouring processes involved in paint manufacture.	Lectures - do - - do - - do - - do - Lecture	Classroom resources - do - - do - - do - - do -	Prepare paint in the laboratory	Guide the students to prepare paints in the laboratory	Chemicals, mechanical mixers, glassware

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	9.7 Explain the uses of paints. 9.8 Explain the methods of storage of paints					
	General Objectives:10.0 Know the basic Science of Pulp and Paper making					
14	11.1 Identify materials for pulping. 11.2 Compare hardwood and soft wood. 11.3 Describe the pulping and paper characteristics of the types of woods in 4.2 above. 11.4 Describe the reactions of different constituents of wood with chemical reagents - acids, strong and weak bases. 11.5 Explain the general principles of pulping. 11.6 Classify the various pulping processes: mechanical, semi chemical and chemical. 11.7 Classify various chemical pulping processes e.g. sulphite, soda, kraft (sulphate). 11.8 Describe the following new trends and developments in chemical pulping processes - multistage pulping, organosolent pulping, introduction of anthra quinone (AQ).	Lectures and assignment - do - - do - - do - - do - - do -	Classroom resources - do - - do -	Produce chemical pulps in the laboratory using the autoclave. Define and determine chlorine numbers, kappa numbers, copper number and permanganate $KMNO_4$ number of pulps.	Students to produce pulp and carry out specified tests on them.	Autoclave, glassware and chemicals

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
15	11.9 Describe the various pulp purification; bleaching and finishing processes and state the aims of the various operations.. 11.10 Explain chemical recovery processes in pulping and bleaching operations. 11.11 Describe various methods used in stock preparation. 11.12 Describe the paper manufacturing unit 11.13 Describe quality control method in pulp and paper industry.	Lectures Lectures . - do - - do - - do -	Classroom resources	Purify, bleach and finish pulp Recover and analyse pulping liquor.	Students to be directed to purify, bleach and finish pulp Students to recover and analyse pulping liquor	Glassware, chemicals -do-

Assessment:

Coursework/ Assignments 10%; Practical 40%; Examination 50%

Recommended Textbooks & References:

Course: Analytical Chemistry II

Department/ Programme: HND Chemistry			
Subject/Course: Analytical Chemistry II	**Course Code: STC 324**	**Credit Hours:**	**5**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Understand the principle, operation and application of NMR Spectroscopy
2. Understand the principles, operations and applications of mass spectroscopy
3. Understand the principles, operations and applications of X-ray diffraction
4. Understand the principles, operations and applications of surface analysis techniques
5. Understand the basic principles and applications of Biosensors

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1: 0 Understand the principle, operation and application of NMR Spectroscopy					
1	1.1 Explain the fundamental principles of the NMR technique. 1.2 Draw a schematic diagram of the NMR Spectrometer. 1.3 Describe the basic principles of NMR spectrometer. 1.4 List the important nuclei used for NMR (spin-1/2 nuclei) 1.5 Explain the term: chemical shift. 1.6 Understand how to calculate intensity using the integral of the signal curve.	Lecture and questions Lecture	Teaching Tools Teaching Tools	Interpret NMR spectra. Assign structures to a given compound from an NMR spectrum.	Give students suitable space beginning with simple examples and gradually increasing complexity	Example NMR Spectra
2	1.7 Explain the terms: spin-spin coupling, spin-decoupling. 1.8 Discuss the use of fourier transform in NMR 1.9 Describe the chemical shifts from common organic compounds for ^{1}H nuclei		NMR Spectra			
3	1.10 Describe the chemical shifts from common organic compounds for ^{13}C nuclei 1.11 Discuss the type of information that can be gained from spin-spin coupling constants (J numbers) 1.12 Explain the applications of NMR spectroscopy.					

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 2: 0 Understand the principles, operations and applications of mass spectroscopy					
4	2.1 Draw a schematic diagram of a Mass Spectrometer. 2.2 Describe the working principle of a mass spectrometer. 2.3 Understand the differences between the three concepts of mass used in MS: average, nominal and exact molecular mass. 2.4 Discuss the types of ion sources used in MS: electron impact ionisation, chemical ionisation, atmospheric-pressure chemical ionisation, fast atom bombardment, thermospray, electrospray.	Lecture and questions	Teaching Tools	Interpret simple mass spectra.	Give an assignment to interpret mass spectra and assign structure to a given compound	Workshop
5	2.5 Discuss the types of analysers used in MS: single-focusing magnetic instruments, double-focusing instruments, quadrupole analysers, Time of Flight (ToF) analysers, ion-trap analysers 2.6 Discuss the use of an electron multiplier as a detector for MS and the conversion to detect negative ions 2.7 Describe the procedure for recording the mass spectrum of a sample.			Assign structure to a given compound from a mass spectrum.	Allow independent work	

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
6	2.8 Discuss the three type of data output that may be obtained using a MS: total-ion chromatogram, mass chromatogram, mass spectrum. 2.9 Describe other applications of mass spectroscopy. 2.10 Describe the use of mass spectra in qualitative analysis of a mixture. 2.11 Discuss the use of coupled MS techniques such as ICP-MS, GC-MS and LC-MS			Interpret the 3 type of data output (using slightly more complex mass spectra)	Allow independent work with some guidance	
	General Objective 3:0 Understand the principles, operations and applications of X-ray technique					
7	3.1 Describe the X-ray diffraction method. 3.2 Discuss the two classes of symmetry operations used to describe the internal arrangement of atoms or molecules in crystals: proper and improper 3.3 Discuss the seven crystal systems and their unit cells 3.4 Discuss the use of Bragg reflections and structure factors for structural analysis 3.5 Discuss the analytical applications of powder diffraction	Lecture		Using given examples analyse compounds using the criteria discussed in lectures	Students will require guidance through at least one example before progressing to work in pairs or individually	Crystal structure analysis for a series of compounds.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 4:0 Understand the principles, operations and applications of Surface Analysis techniques					
8	4.1 Discuss the characteristic surface features that can help determine the properties of a material: topology and morphology, elemental composition, chemical bonding of elements, structure (geometric and electronic) 4.2 Discuss the three main types of photon probe techniques: scattering, absorption and emission. Give examples for each at the different spectral ranges 4.3 Understand the principles of photoelectron spectroscopy including UPS and XPS 4.4 Draw a schematic of an XPS instrument 4.5 Discuss the major differences between UPS and XPS 4.6 Discuss the principles and applications of Laser Micro Mass Spectrometry (LAMMS)	Lectures	Classroom resource	Identify characteristics from example photoelectron spectra: chemical shifts, oxidation, chemical bonding	Guide students through examples and progress to individual or pair work	Example photoelectron spectra
9	4.7 Identify the main differences between photon probe and electron probe techniques 4.8 Discuss the fundamental principles of electron penetration of material and elastic and inelastic			Analysis of example SEM and TEM images, highlighting specific components (with help of example X-ray spectra) and differences between images and SEM imaging modes.	Guide students through examples and progress to individual or pair work	Example SEM, TEM and X-ray spectra

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	interaction with matter 4.9 Draw a simple diagram of the configuration of an scanning electron microprobe for secondary and back-scattered electron imaging and X-ray analysis 4.10 Discuss the use of secondary and back-scattered electron imaging and the differences between these two methods 4.11 Discuss the principles and applications of transmission electron microscopy					
10	4.12 Discuss the basic principles of ion probe techniques 4.13 Discuss the different ion probe techniques used for elastic and inelastic processes 4.14 Discuss the applications of scattering and sputtering ion probe techniques 4.15 Understand the three fundamental processes involved in field probe techniques: field ionisation, electron tunnelling, interatomic force interaction.			Evaluate RBS (Rutherford back-scattering spectrometry) spectra of thin-film systems to identify film thickness and the stoichiometry of the layer	Guide students through examples and progress to individual or pair work	Example RBS spectra

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
11	4.16 Understand the principles of scanning tunnelling microscopy (STM) 4.17 Discuss the type of information that can be gained from a STM image: topography, electronic structure 4.18 Discuss the different operational modes of STM identifying the differences in the information gained			Analyse STM images to discuss the topography and factors that may affect the images	Aid group discussion of images	Example STM images
12	4.19 Discuss the principles of Atomic Force Microscopy 4.20 Discuss the different operational modes of AFM (constant force and constant height) 4.21 Discuss the different information that can be obtained using the AFM: topography, deflection, phase lag, interactive forces, magnetic properties, conducting properties			Compare height and phase images for example samples and discuss the properties and characteristics apparent	Allow free discussion of images in small groups.	Example AFM height and phase images
13	4.22 Discuss the principles of force-distance curves using AFM 4.23 Discuss the principles of tapping mode for analysis of delicate samples 4.24 Understand the principles of phase lag imaging using tapping			Analyse several force-distance curves and choose from a selection of materials the expected sample	Discuss an example curve then allow individual or pair work	Example AFM force-distance curves for a variety of materials with different physical properties

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	mode AFM 4.25 Discuss the applications of AFM					
	General Objective 5:0 Understand the basic principles and applications of Biosensors					
14	5.1 Understand what separates a biosensor from any other chemical sensor 5.2 Discuss the use of a biorecognition agent to give selectivity for the analyte 5.3 Discuss the immobilisation of the biorecognition agent: physical adsorption, physical retention in polymer matrices, surface modification. Highlight issues with applying the immbolisation layer to the sensor surface 5.4 Discuss the principles of enzyme electrodes 5.5 Using the glucose oxidase enzyme as an example discuss the reaction pathways for amperometric measurement via a redox mediator	Lecture		Production of an immobilised enzyme electrode to be used in next lab (see Sadik, 1999)	Guide students through preparation of film	Pyrrole, b-D-glucose, Gox types II and VII, GC or Pt electrodes, Kcl, reference electrodes, H_2O_2, KI, phosphate buffer, $(NH_4)_6Mo_7O_{24}.4H_2O$, N_2 and O_2 gas, potentiostat, xy plotter.
15	5.6 Discuss the use of NAD-linked enzyme electrodes 5.7 Discuss the basic principles of optical biosensors; intrinsic and extrinsic			Calibration of electrode and analysis of glucose		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	5.8 Understand the principles of labelled assays for optical detection 5.9 Discuss techniques that can be used to amplify optical changes in unlabelled assays: interference techniques, grating couplers, surface plasmon resonance (SPR)					

Assessment:

Course test 10%; Practical 40%; Examination 50%

Recommended Textbooks & References:

J.N. Miller and J.C. Miller. Statistics and Chemometrics for Analytical Chemistry. Fourth Edition. Prentice Hall. 2000.

R. Kellner, J.-M. Mermet, M. Otto & H.M. Widmer (eds.). "Analytical Chemistry" Wiley-VCH, Chichester. 1998

R.F. Venn (ed). Principles and Practice of Bioanalysis. Taylor & Francis. 2000.

J. Cooper and T. Cass (eds.). Biosensors. Second Edition. Oxford University Press. 2004

O.A. Sadik, S. Brenda, P. Joasil, J. Lord. Electropolymerized Conducting Polymers as Glucose Sensors. Journal of Chemical Education. 76 (1999) 967-970

Course: Biochemistry for Chemists

Programme: HND Chemistry			
Course: Biochemistry for Chemists	**Course Code: STC 325**	**Credit Hours:**	**5**
Year: 1 Semester: 2	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Understand the phenomenon of intermediary metabolism
2. Understand the pathways of carbohydrate, protein and lipid metabolism
3. Understand proteins
4. Understand enzymes

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1: Understand the phenomenon of intermediary metabolism					
1	**<u>Intermediary metabolism</u>** 1.1 Explain that metabolism in a living cell constitutes catabolic (breakdown) and anabolic (synthesis) processes which occur simultaneously. 1.2 Explain intermediary metabolism as the interchange ability of derivatives (metabolites) of carbohydrates, proteins and fats (lipids) via reactions mediated by appropriate enzymes and coupled by relevant coenzymes/cofactors. 1.3 Illustrate and explain intermediary metabolism by simple schematic diagrams 1.4 Illustrate the central role of acetyl CoA in intermediary metabolism. 1.5 Describe how the energy for cellular metabolism is derived from the break down of acetyl COA 1.6 Explain how the energy from 1.5 above is captured in the form of ATP (adenosine triphosphate) which is reversible.	Illustrated lectures.	Charts and audio visuals.	Titrate acetic acid with sodium hydroxide, plot the titration and indicate the buffering region. Prepare a buffer of pH 4.75 by combining sodium acetate and acetic acid in distilled water. Repeat the above with sodium dihydrogen phosphate and prepare phosphate buffer pH 7.4	Guide and encourage students	acetic acid sodium acetate sodium hydroxide indicators pH meters, sodium dihydrogen phosphate, disodium hydrogen phosphate
2	1.7 Describe ATP as the universal energy currency in biological systems. 1.8 Explain how energy released from the degradation of some substrates may be	Lecture	Classroom	measurement of oxidative phosphorylation by using manometry and also by using the oxygen electrode and investigate the effects of inhibitors and decouplers	arrange for the FRESH preparation of rat liver mitochondria to be available at the start	homogeniser centrifuge reagents manometers pipettes reagents oxygen-electrode

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	utilized in the formation of other cellular components 1.9 Explain that the sum total of breakdown of carbohydrates, fats and proteins is a chain reaction involving transfer of reactions which lead to the final products of cellular respiration (CO_2 + H_2O) and ATP. 1.10 Describe the ATP cycle and explain how ATP forms the energy currency in biological system.				of the experiment. Guide and encourage students	
	General Objective 2: Understand the Pathways of carbohydrate, protein and lipid metabolism					
3	**<u>Nutrient metabolism</u>** 2.1 List the enzymes and products of digestion of carbohydrate. 2.2 Explain the term substrate level phosphorylation. 2.3 Define glycolysis as the pathway of breakdown of phosphorylated sugars to provide energy and lactate. 2.4 Describe the glycolytic pathway and the conversion of pyruvate to acetyl COA. 2.5 List the key enzymes of glycolysis. 2.6 Identify the steps that consume or yield energy in the glycolytic pathway.	Illustrate lectures	Classroom	continue with aspects of the above experiment - oxidative phosphorylation		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
4	2.7 Deduce the net energy yield of this glycolytic pathway. 2.8 Distinguish between aerobic and anaerobic glycolysis. 2.9 Describe the alternative pathway of glucose oxidation (pentose phosphate pathway/hexose monophosphate shunt) 2.10 State the biochemical importance of 2.9 above. 2.11 Describe glucogenesis, gluconeogenesis, glycogenesis and glycogenolysis. 2.12 Describe the Cori cycle.			Carbohydrates: characterisation of Glycogen and Amylopectin. Prepare a standard curve for Glucose and investigate the hydrolysis of Glycogen and Amylopectin		
5	2.13 Explain Pasteur effect. 2.14 Define oxidation of fatty acids. 2.15 Describe the processes occurring in fatty acid oxidation (activation dehydrogenation, hydration, further dehydrogenation and Thiaclastic cleavage). 2.16 Explain how all reactions of b-oxidation of fatty acid are reversible. 2.17 Explain how fatty acids undergo activation in the cytosol and enters the mitochondrion where it undergoes b-oxidation.	Lecture		Investigate the periodate oxidation of Glycogen and Amylopectin		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	2.18 Describe the b -oxidation of fatty acids to acetyl COA.					
6	2.19 Explain that the acetyl COA produced in fatty acid oxidation enters the TCA cycle for further degradation. 2.20 Describe the oxidation Via propionic acid of branched and odd-numbered fatty acids. 2.21 Explain that FADH2 and NADH + H+ produced in fatty acid oxidation are also oxidized through the electron transport system of the mitochondria eventually by molecular oxygen. 2.22 Compare the energy yield when one mole each of saturated and unsaturated fatty acids of equal chain length are completely oxidized. 2.23 Describe the formation and metabolism of ketone bodies (acetone, acetoacetate and p-hydroxy butyrate).	Illustrate lectures. Illustrate lectures.	Classroom	Investigate the digestion of Glycogen and Amylopectin by alpha-amylase and the effect of sodium chloride concentration on the activity of the enzyme. Determine degree of unsaturation and unsaponifiable fraction	Guide the student in the practical	Biochemical reagents and glass ware
7	2.24 Describe the biosynthesis of fatty acids. 2.25 Describe the two pathways of fatty acid biosynthesis (cytoplasmic, mitochondrial) 2.26 Explain that the cytoplasmic pathway is the major pathway of fatty acid synthesis.			Determine the energy yield in terms of ATP molecules for the complete degradation of a named fatty acid e.g. palmitic acid or oleic acid		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	2.27 Describe the biosynthesis of triglycerides and phosphatides (phospholipids). 2.28 Describe the biosynthesis of sterols from cholesterol. 2.29 List the enzymes and products of protein digestion. 2.30 Explain how amino acids can be a source of cellular energy (surplus amino acids).					
8	2.31 Explain how the carbon skeleton of amino acids are either converted into fatty acids and glucose or oxidized via the TCA cycle. 2.32 Explain the terms: ketogenic and glucogenic amino acids. 2.33 List ketogenic and glucogenic amino acids. 2.34 Explain transamination and oxidative deamination. 2.35 Write chemical equations to illustrate the process in 2.37 above. 2.36 Describe the formation of urea (urea cycle).	Lecture	Classroom	Test for urea in urine qualitatively and quantitatively	Guide the student in practical	Laboratory reagents and equipments.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 3 Understand proteins					
9	3.1 Know the structures of the common amino acids 3.2 Understand that amino acids are linked by peptide bonds to give polypeptide chains 3.3 Know that proteins consist of one or more polypeptide chains 3.4 Know the common conventions and be able to use shortened nomenclature to give the sequence of a polypeptide chain 3.4 Know the common techniques used to purify proteins 3.5 Know an experimental technique for sequence determination based upon degradation 3.6 Understand that the 3D shape of a protein may be obtained from single crystal X-ray diffraction experiments 3.7 Know the local folding (conformations) motifs for polypeptide chains 3.8 Understand primary, secondary, tertiary and quaternary structure. 3.9 Understand that the shape and function of the protein is defined by its primary sequence			Identify amino acids via titration which is monitored by a pH meter. Teacher provides list of amino acids and their pKa values.	Guide the student in practical	Laboratory reagents and equipment.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	3.10 Be familiar with models of some simple proteins (e.g. albumin, ribonuclease, etc) and relate structure with function.					
	General Objectives 4: Understand Enzymes					
10-15	4.1 Describe the distinctive features of enzymes e.g. active site specifically etc. 4.2 Explain enzymes specificity as the basis of classification. 4.3 Explain and determine enzymatic catalysis measurement by the rate of disappearance of substrate or formation of products. 4.4 Determine the effect of activators and inhibitors experimentally. 4.5 Define enzyme activity and specific enzyme activity in international units (I>U) and S>I unit. 4.6 Explain methods of enzyme assay. 4.7 Carry out enzymatic assay of a coloured substrate e.g. 4 nitropheny/phosphate by acid or alkaline phosphate. 4.8 Describe the assay for enzyme activity for a turbid substrate like milk e.g. xanthine oxidase in milk. 4.9 Explain coupled enzyme assays.	Lecture " " "	**Resources** Teaching tools - Enzymes di	Plot MM curve and determine kinetic parameters for alkaline phosphatase catalysed hydrolysis of 4-nitrophenylphosphate Carry out practical to determine Km and Vmax by using line Weaver Burke plots	Guide students in laboratory work.	Laboratory reagent pH Meter and glassware Spectrophotometer alkaline phosphatase wheatgerm reagents

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	4.10 Explain how an enzyme reversibly combines first with its substrate to form an enzyme substrate complex. 4.11 Explain why the process of product formation from 4.10 above is a slow process. 4.12 Explain the term Rapid Equilibrium in the above example 4.13 Explain steady state and Pre-steady state. 4.14 Explain and determine enzyme-catalysed reactions measurement under initial rate (Vo) conditions 4.15 Derive the Michealis-Menten equation from the expression: $E + S \underset{k2}{\overset{k1}{\rightleftharpoons}} ES \underset{k4}{\overset{k3}{\rightleftharpoons}} E + P$ 4.16 Explain the Kinetic constant, Km, Vmax, Kcat. 4.17 Explain the physiological significance of Km. 4.18 Describe the determination of Km and Vmax by using line weaver Buck plots. 4.19 Show that Km and Vmax can also determined by Eddie-Hoffsted plots. 4.20 Carry out calculations/plots based on 2.17-2.20 above. 4.21 Relate recognition of substrate to	Lecture		Determine and Alkaline phosphatase optimum pH. Purify (partial purification) of acid phosphatase from wheatgerm and measure kinetic parameters by using phenylphosphate as substrate Determine the effect of activators and inhibitors and classify inhibitors based upon their inhibition kinetics.	Guide the student in practical	Laboratory reagents and equipment.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	the structure (shape and electronic nature) of the substrate and the complementary structure of the active site on the protein surface of the enzyme. 4.22 Relate catalysis to the preferential binding of the enzyme to the transition state for the reaction in preference to substrates or products. 4.23 Show the above preferential binding by relating it to structural diagrams, curly arrow mechanisms, and Energy diagrams. 4.24 Define cofactors, activators, co-enzymes and prosthetic groups. 4.25 Explain how the rate of enzymatic catalysis can be affected by the presence of cofactors and inhibitors. 4.26 Define reversible inhibitors. 4.27 Distinguish 2.26 above using the line Weaver-Buck plots. 4.28 Distinguish between competitive, non uncompetitive inhibitors. 4.29 Describe transition state analogues as reversible inhibitors and relate this to chemical structure. 4.30 Discuss some transition state analogues that inhibit enzymes (e.g. pepstatin inhibition of pepsin and other carboxyl proteases) and relate the structure of the inhibitor to the transition state in the catalysed reaction					

Assessment:

Practicals 50% Exam 50%

Recommended Textbooks & References:

Biochemistry, 5th Edition, L. Stryer, Freeman 2002

Experiments in Biochemistry: A Manual for the Undergraduate Laboratory, S.O.Farrell and R.T.Ranallo, Thomson Learning, 1999

Experiments and Methods in Biochemistry, D.C.Wharton and R.E.McCarty, Macmillan, 1972

Course: Biological and Chemical Instrumentation

Department/ Programme: Higher National Diploma Chemistry			
Subject/Course: GLT Biological and Chemical Instrumentation	**Course Code: GLT 323**	**Credit Hours:**	**5**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Understand the principles and instrumentation of spectrophotometer and colorimetry.
2. Know the operation and care of flame photometer and Raman spectrometers.
3. Know the operation and care of Atomic absorption spectrophotometers (AAS).
4. Know the operation and care of the X-ray spectroscope.
5. Know the operation and care of electrolytic conductivity bridge; coulometer titration; PH meter; autotitrator; polarograph.
6. Know the operation and care of radioactive detectors and counters.
7. Understand the operation and care of gas chromatographic equipment, fluorimeter, polarimeter and refractometer.
8. Know the concept of hydrogen ion concentration.
9. Know the various types of electrodes used in measuring ions like fluoride, nitrate, etc.
10. Know use of microscopes.
11. Know the principles of autoradiography.
12. Know the use and maintenance of photomicrographic equipment.
13. Know the use and maintenance of colony counter.
14. Know the use and maintenance of autoclave, centrifuge and incubator.
15. Understand the principle of automation and its significance in chemical analysis.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1: Understand the principles and instrumentation of colorimetry and spectrophotometry					
1	1.1 State the wave length within the electromagnetic spectrum. 1.2 Distinguish between wavelength of light within the visible region and invisible region. 1.3 Explain the similarities in the working principle of the colorimeter and spectrophotometer. 1.4 Identify the various parts of a colorimeter. 1.5 Explain the functions of the parts in 1.4 above. 1.6 State basic similarities and differences between a colorimeter and spectrophotometer. 1.7 Explain the limitations of colorimeter in microbiological studies. 1.8 Explain the term spectrophotometry. 1.9 List the various sources of light for spectrophotometric determination.	Lecture and demonstration of the use of item listed under resources.		Carry out measurement using colorimeters. Carry out routine maintenance on the colorimeter e.g. care of filters and cuvettes.	Involve students in maintenance and care of instruments	Colorimeter; Spectrophotometer; Filters.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
2	1.10 Describe diffraction grating 1.11 Explain the functions of diffraction grating in spectrophotometry. 1.12 Explain the term interference filter. 1.13 State the function of optical filter in spectrophotometry. 1.14 State the basic laws of spectrophotometry viz: Bonger Lambert's law, Beer's law. 1.15 Explain the working principles of the spectrophotometer. 1.16 List the functions of the parts in the optical system of a spectrophotometer. 1.17 List the different types of detections used in spectrophotometry. 1.18 List the functions of parts in the optical system of a spectrophotometer. 1.19 List the different types of detection used in spectrophotometry.	Use diagrams and sketches. Use question and answer techniques. Illustrate with sketches	Relevant transparencies; Overhead projector.	Determine concentration of samples applying Beer - Lambert's Law and using spectrophotometer. Carry out minor maintenance work on the spectrophotometer e.g. dusting, replacement of lamps etc.	Show students how to: Determine concentration using spectrophotometer. Change bulbs and clean dust deposited in the monochrometer using bellows	Spectrophotometer samples solvents Screw driver; Fine brush; Bellow brush; Lens tissue.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 2: Know the operation and care of flame photometers and Raman spectrophotometers					
3	2.1 Explain the principle of operation of the flame photometer. 2.2 Identify the various parts of a photometer. 2.3 State the functions of the various parts of atomizer, e.g. carbon rod. 2.4 State the similarities and differences between the spectrophotometer and flame photometer. 2.5 List the errors inherent in practical flame photometry and how they can be corrected particularly as applied to biology. 2.6 Explain how to correct the errors in 2.5 above.	Lecture and demonstration.	Classroom resources	Determine sodium, potassium and calcium using flame photometer omission spectrum. Clean atomiser using cleaning probe.	Guide students	flame photometer Atomiser cleaning device. Lomp knose plier; Star screwdriver Calibrator.
4	2.7 Describe and carry out typical maintenance routines for the flame photometer e.g. clearing deposits from the atomizer. 2.8 Identify parts of the Raman Spectrometers. 2.9 Explain the functions of the parts in 2.9 above.	Lecture and Demonstration.		Record spectra of known compound using Raman Spectrophotometer. Carry out routine maintenance on Raman Spectrophotometer.	Show students how to: Use lens tissue on the optics. Clean dust deposited in the monochrometer.	Service manual; Atomiser cleaning device; Lens tissue.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 3: Know the operation and care of Atomic Absorption Spectrophotometers (AAS)					
	3.1 Draw a schematic labelled diagram of the AAS. 3.2 Identify the parts of an AAS e.g. extension sources. 3.3 Describe the working principle of each of the component parts of the AAS (especially the hollow cathode lamp). 3.4 Outline the steps for operating the AAS.	Lecture and Demonstration.	Classroom resources	Measure the absorbance of a sample of known concentration using the AAS. Carry out routine maintenance on an AAS		AAS
	General Objective 4: Know the operation and care of the X-ray spectroscope					
5	4.1 Identify the parts of the X-ray spectroscope. 4.2 Describe the parts listed in 4.1 above. 4.3 Draw a block diagram of an X-ray spectroscope. 4.4 Describe the operation and working principles of the units such as collimation, filters, analyzing crystals and detectors. 4.5 Draw non-dispersive X-ray absorption meter. 4.6 List the parts of an X-ray fluorescence spectrometer. 4.7 Identify and describe parts of an X-ray fluorescence spectrometer.	Lecture/Demonstration.		Measure the absorption of a given sample using the X-ray instrument and also by varying the filters. Analyse given samples using the x-ray fluorescence spectrometer. Carry out routine care of the instrument e.g. cleaning of filters, verification of optical instruments.	Get students involved in measuring samples and cleaning of filters and optics.	X-ray fluorescence spectrometer; Filters Lens tissue

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 5: Know the operation and care of analytical instruments					
6	5.1 List the component parts of: (i) Electrolytic conductivity bridge (ii) Coulometric titration (iii) Autotitration (iv) PH meter (v) Polarograph. 5.2 Identify and describe the various parts of the instruments in 5.1 above. 5.3 Explain the principle of operation of the instruments in 5.1 above.	Lecture and Demonstration		Carry out various measurements using the instruments in 5.1 Carry out routine care of the instruments in 5.1	Get students involved in measurements using items stated in the Resources column.	Conductivity Bridge; Coulometric Titriatry; Autotitrator; pH meter; Polarograph
	General Objective 6: Know the operation and care of radioactive detectors and counters					
7	6.1 List the various radioactive detectors and counters with photographic envision, ionization chambers and proportional counters, scintillation counters, semi-conductor detectors, Geiger-Muller counter. 6.2 Explain the operation of each detector and counter in 6.1 above.	Lecture and Demonstration. Emphasise importance of routine maintenance.		Obtain accurately the counts per second of a radioactive source (emitter) using a gas counter. Measure counter per sec of a beta emitter using scintillating counter. Measure counts per sec for an emitter using proportional counters. Carry out routine care of detectors and counters in 6.1 above.	Get students involved in measurements using items stated in the Resources column.	Radioactive sources; Geiger Muller counter; Conisation counter; Proportional counter; Semiconductor detector

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 7: Understand the operation and care of gas chromatographic equipment fluorimeter, polarimeter and refractometer					
8	7.1 Explain gas chromatography 7.2 Identify the parts of: (i) Gas chromatograph (ii) Fluorimeter (iii) Polarimeter (iv) Refractometer 7.3 Explain the working principles of each instrument in 7.1 above.	Lecture and Demonstration		Carry out measurements using instruments in 7.1 above. Carry out routine care and maintenance contains of instruments in 7.1	Show e.g. cleaning of prism with lens tissue, ensuring that the polarimeter, tube are clean and do not touch with bare hands, etc	Gas chromatograph Fluorimeter Polarimeter Refractometer.
	General Objective 8: Know the concept of hydrogen in concentration					
9	8.1 Explain the term pH 8.2 Explain why the pH scale ranges from 0 to 14. 8.3 State Bronsted-Lowry theory of acid and base. 8.4 Calculate the pH of an acid and a base applying the theory in 8.3 above. 8.5 Explain the functions of buffer with example. 8.6 Enumerate the main problems involved in pH measurement. 8.7 Explain how the problems in	Lecture/Demonstration Use sketches for illustration.		Determine the pH of solutions by using a pH meter. Carry out routine maintenance of pH-meter e.g. cleaning and reactivation of the electrodes.	Measure pH of different solutions. Allow students to repent measurements Reactivate pH electrode and clean as required.	pH meter; Buffer tablets.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	8.10 above are overcome. 8.8 Describe the potentiometric method of determination of pH.					
	General Objective 9: Know the various types of electrodes used in measuring ions like fluoride, nitrate, etc.					
10	9.1 Identify ion - selective electrodes 9.2 State the uses of ion - selective electrodes 9.3 Explain the basic principles of operations of an ion-selective electrode. 9.4 Explain the relationship between activity and concentration of an ion. 9.5 List the various types of gas measuring electrodes. 9.6 Identify an oxygen electrode. 9.7 Identify the various uses of an oxygen electrode. 9.8 List and describe electrodes for pH measurement e.g. glass, combination 9.9 Describe the routine maintenance of electrodes e.g. in store in distilled water, use correct concentration of reactivator.	Lecture and Demonstration	Classroom resources	Measure accurately oxygen concentration using the gas measuring electrodes. Carry out maintenance of electrode including recharging.	Emphasise the importance of routine maintenance.	Fluoride electrode; Ion-selective electrode; Oxygen electrode Glass electrode; Combination electrode

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 10: Know the use of microscopes					
11	10.1 Define microscopy 10.2 List various techniques of microscopy e.g. bright field, dark field etc. 10.3 Explain the techniques in 10.2 above. 10.4 Identify various types of microscopes. 10.5 Identify the parts of the microscopes in 10.4 above. 10.6 Explain the principles of operation of the microscopes in 10.4 above (elementary treatment only).	Lecture and Demonstration	Demonstrate use of various types of microscope. View objects under the microscope. Clean microscopes using large tissue.	View objects under the microscope Carry out routine maintenance of microscope e.g. cleaning and lubrication.		Binocular microscope; Phase contrast accessories; Allen key set; Grease; Lens tissue.
	General Objective 11: Know the principle of autoradiography					
12	11.1 Explain autoradiography 11.2 Identify the components used in autoradiography 11.3 Describe the applications of autoradiography 11.4 Demonstrate the techniques of autoradiography.	Lecture and Demonstration. Illustrate with sketches				

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 12: Know the use and maintenance of photomicrographic equipment					
	12.1 List the applications of photomicrography equipment. 12.2 Explain the working principles of photomicrography equipment. 12.3 Describe the working parts of photomicrography equipment.	Lecture and demonstrate techniques by the use of camera mounted on microscope	Photomicrography equipment	Maintenance and carry out minor repairs of photomicrography equipment.		
	General Objective 13: Know the use and maintenance of colony counters					
13	13.1 Identify types of bacterial colony counters. 13.2 Identify the parts of the counter in 13.1 above. 13.3 Explain the function of each part in 13.2 above. 13.4 Describe the principle of operation of the colony counter.			Count bacteria colonies using colony counter. Carry out routine maintenance and repair of colony counters.		Colony counter.
	General Objective 14: Know the use and maintenance of autoclave, centrifuge and incubator					
14	14.1 State the functions of: (a) Autoclave (b) Centrifuge (c) Incubator. 14.2 Identify the parts of the instruments in 14.1 above. 14.3 Explain the functions of the parts in 14.2 above.	Lecture and Demonstration.		Sterilise, centrifuge and incubate using autoclave, centrifuge and incubator. Carry out routine maintenance of the instruments in 14.1.	Show the use of the autoclave with materials & control. Use centrifuge for separation. Grow organism using incubator.	Autoclaves; Centrifuge; Incubators.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 15: Understand the principle of automation and its significance in chemical analysis					
15	15.1 Know the importance of automation. 15.2 Explain the following terms as they relate to automation: (i) Precision (ii) Reliability (iii) Speed (iv) Accuracy 15.3 Know the tasks involved in automation e.g. dispensing of samples and reagent in precise, predetermined volume (i) Mixing of samples with reagent (ii) Incubation (iii) Recording of absorbance (iv) Calculation and determine results (v) Printing the results. 15.4 Differentiate between semi automated and fully automated analysers e.g. batch analyzer, semi automated, random access. 15.5 Know the terminologies used in automation.	Lecture and Demonstration		Analyse samples by using (a) Semi automated machine (b) Batch analyser (c) Random access analyser		Automated Chemistry Analyser.

Assessment:

Coursework/ Assignments 10 %; Practical 40 %; Examination 50 %

Recommended Textbooks & References:

Course: Research Methods

PROGRAMME: HND Chemistry			
Course: Research Methods	**Code: STC 326**	**Credit Hours:**	**4 hours**
Semester: 2	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week - 50 %** **2 hours/week - 50%**

Course main Aim/Goal

This course is intended to equip the student with research techniques (emphasis on survey techniques) and their application in chemistry (e.g. research in chemical education, marketing research for chemical products, public perception of chemical issues).

GENERAL OBJECTIVES:

1. Understand research and its process
2. Understand scientific approach to research
3. Know how to design research
4. Understand research problem
5. Understand formulation and validation of hypothesis
6. Understand variables in research work
7. Know sample and sampling techniques
8. Know how to review literature
9. Know the tools and techniques of data collection
10. Understand data analysis techniques.
11. Know how to report research findings.

Theoretical Content				Practical Content		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**
	General Objective 1: Understand research and its process					
1-2	1.1 Define research 1.2 Identify types of research 1.3 Explain the problems of research - conceptualization, control, generalization etc. 1.4 Explain steps in research process. 1.5 Explain characteristics of research process. 1.6 Identify ethical considerations in research.	Explain research, its types and problems. ii. Explain the characteristics of research process and its steps. iii. Explain ethical considerations in research	Textbooks - Journals	Explain the problems of research - conceptualization, control, generalization etc. Explain steps in research process. Explain characteristics of research process.	Guide students on research issues - conceptualization and conducting searches on the internet. Also use question and answers to examine the steps in conducting research.	Internet and relevant websites
	General Objective 2: Understand scientific approach to research					
3	2.1 Explain the methods of science. 2.2 State the aims of science. 2.3 Explain the functions of science. 2.4 Compare science and common sense.	Explain the methods, aims and functions of science. ii. Explain the differences between science and common science	Textbooks - Journals	State the aims of science. Explain the functions of science. Compare science and common	Advise students re- experiments and testing - use of research techniques. Question and Answer.	Internet and relevant websites

Theoretical Content				Practical Content		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**
	General Objective 3: Know how to design research					
4-5	3.1 Explain research design. 3.2 Explain the purpose of research design. 3.3 Explain the principles of research design. 3.4 Identify design criteria. 3.5 Write research proposal	Explain the meaning, purpose and principles of research design. ii. Explain design criteria. iii. Guide students to write research proposals Give assignment	Textbooks - Journals	Prepare a research proposal for a science research project.	Guide students to prepare a research proposal Write a research proposal and complete the assignment	Internet and relevant websites
	General Objective 4: Understand research problem					
6	4.1 Define research problem. 4.2 Identify sampling problems. 4.3 Formulate research questions. 4.4 Identify the steps in the evaluation of a research problem. 4.5 State features of researchable problem. 4.6 Critique sample research problem.	Explain research problem. ii. Describe sample problems. iii. Describe the formulation of research questions. iv. Explain the steps in the evaluation of research problem. v. Explain researchable problem and its features	- Textbooks - Journals	Formulate research question. Critique sample research problem.	Guide students to formulate and critique sample research problem.	Internet and relevant websites

Theoretical Content				Practical Content		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**
	General Objective 5: Understand formulation and validation of hypothesis					
7-8	5.1 Define hypothesis. 5.2 Define validation. 5.3 Explain specific and general hypothesis. 5.4 Relate hypothesis to problem statement. 5.5 Distinguish between null and alternate hypothesis. 5.6 Explain problem of validation in research	Explain hypothesis and its characteristics. ii. Explain validation and its problem in research. iii. Distinguish among specific, general null and alternate hypothesis. iv. Describe the relationship between hypothesis and problem statement.	Textbooks - Journals	Explain specific and general hypothesis. Relate hypothesis to problem statement. Distinguish between null and alternate hypothesis. Explain problem of validation in research	Advise students about hypothesis testing and the use of relevant research techniques. Reference to a case study and to examples of research methodology.	Internet and relevant websites
	General Objective 6: Understand variables in research work					
9	6.1 Define variables 6.2 Explain types of variables. 6.3 Explain consideration for choice of variables. 6.4 List control problems of variables 6.5 Explain the relevance of variables to research.	Explain variables, their types and relevance. ii. Explain consideration in the choice of variables. iii. Explain control problems of variables.	Textbooks - Journals	Explain consideration for choice of variables. List control problems of variables	Use of examples and questions and answers. Set problems for students	Internet and relevant websites

Theoretical Content				Practical Content		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**
	General Objective 7: Know sample and sampling techniques					
10	7.1 Define population. 7.2 Define sample. 7.3 Define representativeness 7.4 Explain types of sampling methods. 7.5 Explain the need for samples	Explain population, sample and representativeness. ii. Describe types of sampling methods. iii. Explain need for samples.	Textbooks - Journals	Define sample. Define representativeness Explain types of sampling methods.	Advise students re - sampling techniques. Use of a case study from the internet. Information gathering on statistics from relevant websites	Internet and relevant websites
	General Objective 8: Know how to review literature					
11	8.1 State the relevance of literature review in research. 8.2 State the sources of literature. 8.3 Explain organization and referencing of literature	Explain the relevance of literature review in research. ii. Explain the sources of literature. iii. Describe the organization and referencing of literature. iv. Give assignment	Textbooks - Journals	State the relevance of literature review in research. State the sources of literature. Explain organization and referencing of literature	Guidance for students using examples of good literature reviews. Reference to exercises to review relevant literature etc	Internet and relevant websites
	General Objective 9: Know the tools and techniques of data collection					
12	9.1 Define research instrument. 9.2 Identify types of research instruments.	Explain the following research instruments: 1. Questionnaire 2. Observation 3. Interview	Textbooks - Journals	Prepare a questionnaire to elucidate data for research on a hypothetical topic. Conduct a mock interview to generate data.	Guide students to prepare questionnaire and administer	Internet and relevant websites

Theoretical Content				Practical Content		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**
	9.3 List characteristics of research instruments. 9.4 List pitfalls of various research instruments.	4. Ratings, etc. ii. Describe pitfalls of each instrument in above.				
	General Objective 10: Understand data analysis techniques					
13	10.1 Define data analysis. 10.2 Explain the tools for data analysis - qualitative and quantitative. 10.3 Explain limitations in each of 10.2 above.	Explain data analysis, its tools and limitations	Textbooks - Journals			Internet and relevant websites
	General Objective 11: Know how to report research findings					
14-15	Define research report. 11.2 Identify the contents of research report. 5. Introduction 6. Methods 7. Analysis 8. Results 9. Discussion 10. Reference 11.3 Explain the importance of accurate presentation of research report.	Explain research report and its contents. ii. Conduct test	Textbooks - Journals	Identify the contents of research report. • Introduction • Methods • Analysis • Results • Discussion • Reference	Guidance for students using examples of good reports. Reference to exercises to review relevant literature etc	Internet and relevant websites

ASSESSMENT CRITERIA			
Coursework **50%**	**Course test** **25%**	**Practical** **25%**	**Other** (Examination/project/portfolio) **%**
Competency: On completing the course, the student should be able to understand/estimate/define/etc….			

SECOND YEAR - FIRST SEMESTER

Course: Inorganic Chemistry II

Department/ Programme: HND Chemistry			
Subject/Course: Inorganic Chemistry II	**Course Code: STC 411**	**Credit Hours:**	**5**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**
GENERAL OBJECTIVES: 1. Understand the chemistry and uses of non-aqueous system 2. Understand the chemistry and application of silicates 3. Understand the production of silicones by the hydrolysis of alkyl substituted chlorosilanes 4. Understand supramolecular chemistry and binding of metal ions by macrocyclic molecules 5. Understand the chemistry of the inert (noble) gases			

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1:0 Understand the chemistry and uses of non-aqueous system					
1	1.1 Describe aqueous and non-aqueous solvents. 1.2 Classify solvents as aqueous and non-aqueous. 1.3 State the Arrhenius definitions of acids and bases. 1.4 Describe the autoionization of non-aqueous acids and bases. 1.5 Describe liquid ammonia as a non-aqueous solvents and the behaviour of metals in liquid ammonia. 1.6 List the chemical properties of metal-ammonia solutions. 1.7 List the uses of metal ammonia solutions.	Lectures	Classroom resources	Prepare some metal-ammonia solutions and characterize them.	Guide and encourage students throughout the time of the laboratory	Glass ware and chemicals
2	1.8 Compare the acidic strength of the hydrogen halides. 1.9 Compare the physical properties of the hydrogen halides along the following parameters - melting points, boiling points, specific conductivity, dielectric constant. 1.10 Explain the behaviour of anhydrous tetraoxosulphate (vi) acid.			Illustrate the behaviour of anhydrous tetraoxosulphate (vi) acid in the laboratory		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
3	1.11 Describe the preparation of glacial ethanoic acid and explain its use as a non-aqueous solvent. 1.12 Describe the structure of dinitrogen tetraoxide. 1.13 Explain the use of dinitrogen tetraoxide as a solvent	Lecture	Classroom	Prepare glacial ethanoic acid in the laboratory	Guide students through the preparation of glacial ethanoic acid	Glass ware and chemicals
4	1.14 Compare the electrical conductivity of a range of univalent electrolytes in liquid sulphur (iv) oxide. 1.15 State the boiling point, melting point and the dielectric constant of sulphur(iv)oxide at $0^{o}C$.			Demonstrate the behaviour of glacial ethanoic acid in the laboratory.		
	General Objective 2:0 Understand the chemistry and application of silicates					
5	2.1 Define a silicate. 2.2 Describe simple methods o preparation of silicates. 2.3 Classify silicates. 2.4 Explain bonding patterns in silicates.	Explain and illustrate with specific examples and diagrams. "	Chalkboard, chalk. Models	Prepare silicon (iv) oxide in the laboratory.	guide students through the preparation of silicon (i chemicals and glass wares	glass wares
6	2.5 Draw and describe the structure of orthosilicates giving specific examples 2.6 Describe the structure and composition of a pyrosilicate. 2.7 Draw the structure of pyrosilicates giving specific examples. 2.8 Draw the structure of cyclic silicate and describe its composition.			Prepare and characterize the different silicates listed in 2.5 - 2.9	Guide the students through the preparation and characterization of silicates	

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
7	2.9 Explain the structure of both chain and sheet silicates and draw the structure of each of them. 2.10 Differentiate between the various forms of silicates.			Carry out qualitative tests on the silicates prepared in 2.12 above.		
8	2.11 List the properties and uses of silicates.			Carry out gravimetric determination of silicates in a rock or soil sample	Guide the students through gravimetric determination of silicates in rocks or soil samples	Chemicals; crucibles, weighing balance, oven, muffle furnace
	General Objective 3:0 Understand the production of silicones by the hydrolysis of alkyl substituted chlorosilanes					
9	3.1 List the starting materials for the manufacture of silicones. 3.2 Describe the synthesis of silanes and their derivatives. 3.3 Describe the hydrolysis of trialkylmonochlorosilane to yield hexaalkylsiloxane. 3.4 Describe the hydrolysis of dialkyldichlorosilane to yield straight chain polymers. 3.5 Describe the hydrolysis of alkyltrichlorosilane to yield a very complex crosslinked polymer. 3.6 Write equations to illustrate the processes in 3.3, 3.4 and 3.5 above.	Explain and illustrate with relevant examples and diagrams.	Chalkboard, chalk.	Prepare silicones and carry out experiments to illustrate their characteristics.	Guide the students through preparation of silicones and their characterization.	Glassware's. Chemicals

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
10	3.7 Describe what happens when mixtures of trialkylmonochlorosilane and dialkyldichlorosilane are hydrolysed. 3.8 List the products obtained in 3.7 above. 3.9 Describe what happens when silicones are heated in the presence of air to 350^{o}C - 400^{o}C. 3.10 Describe what happens when silicones are heated to higher temperature in the absence of air. 3.11 List the properties and uses of silicones.			Continue with the above experiment		
	General Objective 4:0 Understand supramolecular chemistry and binding of metal ions by macrocyclic molecules					
11	4.1 Describe supramolecular chemistry in general terms 4.2 Be familiar with supramolecular terminology such as host-guest systems 4.3 Describe some selected examples from biochemistry 4.4 Discuss the non-covalent interactions at the disposal of supramolecular systems 4.5 Discuss design principles including chelate and macrocyclic effects			Synthesis of [18]crown-6 from tetra-ethyleneglycol ditosylate	Guide and encourage students	Chemicals glassware etc

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
12	4.6 Describe methods used to characterise supramolecular systems 4.7 Discuss structural, kinetic and thermodynamic aspects of supramolecular systems 4.8 Justify the investigation of cation binding macrocycles 4.9 Discuss the chemical synthesis of suitable macrocycles 4.10 Discuss co-ordination and template effects 4.11 Describe Crown ethers			Investigation of the host-guest chemistry of Crown Ethers		
13	4.12 Discuss the Host-Guest chemistry of Crown Ethers 4.13 Describe Cryptands, Spherands, Calixarenes, Sepulchrates, Siderophores, and compare their supramolecular chemistries 4.14 Discuss present and future applications: phase transfer reagents, separating systems, electrochemical sensors, switches and molecular machinery, supramolecular catalysis, drugs etc.			Preparation of calix[4]arene from 4-t-bytylcalix[4]arene		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 5:0 Understand the chemistry of the inert (noble) gases					
14	1 List the inert gases. 2 Write the electron configuration of the inert gases. 3 Explain the significance of the electron configuration of the inert gases. 4 List the general properties of inert gases. 5 Relate the general properties to the electron configuration of the inert gases.	Explain with examples and diagrams	Chalkboard, chalk. " " " "	Synthesis of sulphonatocalix[4]arene from calix[4]arene and investigation of their host-guest chemistry with cations, anions, amino acids, etc.		
15	6 Describe the following reactions: reaction of helium under excited condition, formation of clathrate compounds by the inert gases, formation of co-ordination compounds by the inert gases 7 List the uses of inert gases.			Synthesis of N,N'-bis (salicylidene)-4,4'-methylenedianiline and investigation of its transition metal complexes		

Assessment:

Practical 40%, Continuous assessment 10%, Examination 50%.

Recommended Textbooks:

Inorganic Chemistry by Shriver and Atkins, published by Oxford University Press, UK

Supramolecular Chemistry, P.D.Beer et al., Oxford Chemistry Primers (Oxford University Press)1999

A Practical Guide to Supramlecular Chemistry, Peter J. Cragg, in press J. Wiley & Sons Ltd., 2005

Course: Physical Chemistry III (Chemical Thermodynamics)

Department/ Programme: HND Chemistry			
Subject/Course: Physical Chemistry III (Chemical Thermodynamics)	**Course Code: STC 412**	**Credit Hours:**	**5**
Year: 2 Semester: 1st	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Understand the basic concepts of thermodynamics
2. Understand the heat changes in reactions
3. Understand the concepts and applications of the second law of thermodynamics

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1.0: Understand the basic concepts of thermodynamics					
1	1.1 Explain the scope of thermodynamics. 1.2 Define universe, system and surroundings. 1.3 Classify thermodynamic systems as open, closed and isolated. 1.4 Define internal energy, heat and work. 1.5 State the first law of thermodynamics. 1.6 Calculate the work done when gas expands against an external pressure.	Lecture Conduct tutorials and give out assignments	Classroom resources - do - - do -	Determination of the standard free energy change, enthalpy change and entropy change for the reaction between ferrous and silver ions.	Prepare and provide the Lab Manual. Prepare 0.2mol/dm^{3}arium nitrate - Fresh 0.2mol/dm^3 iron (ii) sulphate in 0.005 mol/dm^3 Nitric acid 0.1mol/dm^3 silver nitrate 0.1mol/dm^3 ammonium thiocyanate Ferric alum solution	Volumetric flasks Burette Measuring cylinder conical flasks Thermostat Stoppers Stop watch Gooch filter crucible Distilled water, conc. Nitric acid
2	1.7 Explain thermodynamic reversibility. 1.8 Define isothermal process and adiabatic process. 1.9 Calculate the work done during the isothermal expansion of an ideal gas.	Lecture - do - Conduct tutorials and give out assignment	- do -	Determination of the equilibrium constant and free energy for the reaction between silver solution and calcium sulphate	Prepare and provide the Lab. Manual 0.35mol/dm^3 silver nitrate - 0.1mol/dm^3 ammonium thiocyanate - 0.1mol/dm^3 ammonium oxalate 0.02mol/dm^3 potassium permanganate 0.25mol/dm^3 potassium sulphate	Stoppered bottles Thermostat (25^{0}c) No 3 sintered glass crucible Titration apparatus Conical flasks (250cm^3) Distilled water Thermometer

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
					Saturated solution of ammonium iron (III) sulphate as indicator	
3	1.10 Calculate the change in internal energy during the isothermal reversible expansion of an ideal gas 1.11 Define heat capacity. 1.12 Define enthalpy. 1.13 Relate changes of enthalpy in a system to the heat transferred at constant pressure.	Lecture - do - - do - - do - - do -	Classroom resources	Determination of the solubility and enthalpy of solution of benzoic acid	Prepare and provide the lab manual for the exp Prepare 0.05mol/dm^3 sodium hydroxide Benzoic acid	Thermostat Boiling tubes Pipette Extension tubes Glass wool Rubber tubing, 250cm^3 Conical flasks Balance Titration Phenolphthalein Thermometer
4	1.14 Define extensive and intensive properties. 1.15 Define state function and path dependent function. 1.16 Explain the terms: exact differentials and in-exact differentials. 1.17 Relate changes of internal energy to changes in volume and temperature.	- do - - do -	- do - - do -	Thermodynamic investigation of the changes in boiling point and heat content for the acetone / trichloromethane system, with respect to change in intermolecular forces in the mixture.	Provide the lab. Manual Provide acetone Trichloromethane - Emphasise the danger associated with the two volatile and flammable liquids	Burettes Boiling point apparatus Ice water Solvent recovery bottle Measuring cylinder

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
5	1.18 Deduce expressions for the dependence of the internal energy on the temperature at constant pressure using the properties of partial derivatives. 1.19 Deduce expressions for he dependence of the enthalpy on the temperature at constant volume using the properties of partial derivatives. 1.20 Define isobaric expansivity and isothermal compressibility.	Lecture Conduct tutorials and give out assignments	Classroom resources	Investigation of the enthalpy changes in a Non ideal solution	Provide the lab manual Provide acetone trichlormethane Remind the students about the toxicity and flammability	Boiling tubes 500cm^3 beaker, insulating materials or calorimeter Test tube rack Thermometer Burettes
6	1.21 Derive the relation between heat capacities at constant volume and constant pressure. 1.22 Calculate the work one by an ideal gas during adiabatic change. 1.23 Calculate the final volume, pressure and temperature of an ideal gas after a reversible, adiabatic change of volume.			Qualitative investigation of the nature of the intermolecular bonding in non ideal solutions.	Provide the lab. Manual for the exp. Move around to caution the students against fire hazard.	Acetone Dichloromethane Trichloromethane Hexane
	General Objective 2.0: Understand the heat changes in reactions					
7	2.1 Define the terms endothermic reaction, exothermic reaction and reaction enthalpy. 2.2 Define standard state. 2.3 State Hess's law of constant heat summation.	Lecture - do - - do - - do -	Classroom resources. - do -	Determination of heat of solution of ethanol in water.	Provide the manual for the exp. Assemble the calorimeter Monitor the students not to drink out of the ethanol	Ethanol Distilled water Burettes Thermometer

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	2.4 Use Hess's law to calculate the various heats of reaction.					Calorimeter
8	2.5 Relate reaction enthalpy to change in internal energy. 2.6 Define enthalpy of sublimation, enthalpy of combustion, enthalpy of solution and enthalpy of neutralization. 2.7 Calculate the various enthalpies in 2. 6 above. 2.8 Define enthalpy of hydrogenation, bond enthalpy, enthalpy of atomization and enthalpy of phase transition. 2.9 Construct the Born-Haber cycle and use it to determine enthalpies from other data.	Conduct tutorials and give assignment. Lecture - do -	- do - - do - - do -	Determination of heat of neutralisation of sodium hydroxide by hydrochloric acid	Provide the manual for the exp. Prepare 2mol/dm^3 sodium hydroxide 2mol/dm^3 hydrochloric acid.	Thermometers 500cm^3 beakers Distilled water Stop watch 50cm^3 measuring cylinder Calorimeter
	General Objective 3.0: Understand the concepts and applications of the second law of thermodynamics					
9	3.1 State the criteria for the direction of spontaneous change. 3.2 Define thermodynamic entropy. 3.3 Derive the expression for the change of the entropy on isothermal expansion of an ideal gas. 3.4 State the second law of	Lecture - do - - do - - do - Conduct tutorials and give assignment.	Classroom resources. - do - - do - - do - - do - - do -	Determination of enthalpy change of solution and volume change on forming solutions of salts.	Provide the Lab. Manual sodium chloride, Potassium chloride Calcium chloride Iron (III) chloride Students to weigh the salts quickly to prevent absorbing moisture	Gloves Burettes Stands Stoppers Distilled water Wash bottle

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	thermodynamics. 3.5 Calculate the change of entropy when a system is heated.	Lecture				Thermometer Polystyrene cup Spatula Weighing bottles with stoppers Balance
10	3.6 Calculate the entropy change during a phase transition. 3.7 Calculate the entropy change during irreversible processes.	Lecture - do -	- do - - do -	Determination of the strength of the hydrogen bond formed between trichloromethane and methyl ethanoate.	Provide the lab. Manual Provide tricholomethane, methylethanoate, ethanol, cyclohexane, propen-l-ol, propan-2-ol Caution against fire	Safety spectacles Cotton wool 250cm^3 beakers Boiling tubes 10cm^{3}measuring cylinder Funnels Thermometer
11	3.8 Calculate the changes of entropy in the surroundings of a system. 3.9 Define the Helmholtz function. 3.10 Define the Gibb's function.			Determination of the enthalpy change for the displacement of copper by zinc	Provide the manual for the experiment. Prepare 1mol/dm^3 copper sulphate	Safety spectacles Pipette Polystyrene cup Weighing bottles Spatula Balance

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
						Thermometer Stop watch - Zinc powder
12	3.11 Relate the Helmhotz function to the maximum amount of work available from a changing system. 3.12 Relate the Gibb's function to the maximum amount of non-pV work available from a changing system 3.13 Evaluate the entropy of a system from thermo chemical data. 3.14 State the third law of thermodynamics. 3.15 State how the internal energy changes when the entropy changes. 3.16 State how the internal energy changes when the volume changes.	Lecture - do - - do - - do - - do - - do -	Classroom resources - do - - do - - do - - do - - do -	Determination of the heat of solution of ammonium chloride.	Provide the lab. Manual for the experiment Assemble materials to improvise a calorimeter if not available	Calorimeter Thermometer Beakers Distilled water Ammonium chloride
13	3.17 Indicate mathematically how the Gibb's function depends on the pressure and temperature. 3.18 Derive the Gibb's -	- do - - do -	- do - - do -	Measure ΔU and ΔH using calorimetric methods.	Demonstrate and ask students to measure ΔU and ΔH using calorimeter	Joules, Calorimeter, Thermometer,

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	Helmholtz equation. 3.19 Use 3.18 above in calculations.					Glassware
14	3.20 State how the Gibb's function of solids and liquids varies with pressure. 3.21 Derive an expression for the pressure dependence of the Gibb's function and the chemical potential of an ideal gas. 3.22 Define the fugacity of a gas. 3.23 Relate the fugacity of a gas to the pressure of the gas.	Lecture - do - - do - - do -	Classroom resources. - do - - do - - do -	Determine the enthalpy of dissolution of potassium nitrate (KNO_3) in water		Calorimeter Thermometer Beakers Distilled water (KNO_3)
15	3.24 Define the standard state of a real gas. 3.25 State how the Gibb's function changes when the composition of a system changes.	- do - - do -	- do - - do -			

Recommended Textbooks:

(1) P.W. Atkins "Physical Chemistry"
(2) Findlay's Physical Chemistry practical.

Assessment:

Coursework/ Assignments 10 %; Practical 40 %; Examination 50 %

Course: Organic and Heterocyclic Chemistryh

Department/ Programme: HND Chemistry			
Subject/Course: Organic and Heterocyclic Chemistryh	**Course Code: STC 413**	**Credit Hours:**	**5**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Know the sources, preparations, properties and uses of heterocyclic aromatic compounds
2. Know some named organic reactions involved in synthesis degradation and re-arrangement of organic compounds
3. Know some synthetic methods and reagents
4. Understand the chemistry of organometallic compounds

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objectives: 1. Know the sources, preparations, properties and uses of heterocyclic aromatic compounds					
1	1.1 Define a heterocyclic compound. 1.2 List the main hetero atoms as N, O and S. 1.3 List examples of 5 membered non aromatic monoheteocyclic compounds: tetrahydrofuran, tetrahtdrothiophene and pyrolidine 1.4 List examples of 5 membered aromatic monoheteocyclic compounds - furan, pyrrole and thiophene. 1.5 Give an example of 6 membered monoheterocyclic compounds - pyridine. 1.6 Draw the structures of furan, thiophene, pyrrole and pyridine. 1.7 State Hantzch Widman rules for naming heterocyclic compounds 1.8 Name heterocyclic compounds applying the rules above.	Lecture and ask questions to students - do -	Teaching Tools - do -			
2	1.9 Explain the basicity of pyridine, pyrrole and pyrolidine 1.10 Explain why aromaticity increases in the order: furan pyrrole, thiophene, benzene, pyridine.			Prepare furan, pyrrole and thiophene e.g. by By heating ammonium salts of saccharic acid or treating the product of the reaction of ethyne (acetylene) and	Guide students in preparation of pyrrole from ethylacetoacetate and ask them to prepare it	3-necked (2500 ml) flask, rubber-sleeved or mercury-sealed stirrer, separating-funnel, reflux-condenser, thermometer, suction pump

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	1.11 Describe the Paal Knorr synthesis of furan, pyrrole, and thiophene. 1.12 Describe the mechanism for Paal Knorr synthesis. 1.13 Describe the physical properties of furan, pyrrole and thiophene. 1.14 Describe the Hantzsch synthesis of pyridine 1.15 Describe the mechanism of the Hantzsch synthesis			formaldehyde with ammonia or The Knorr pyrrole synthesis - condensation of â-keto ester with an amino ketone		
3	1.16 Describe the following for 5 and 6 membered monoheterocyles: (a) Electrophilic substitution at carbon atoms - Nitration, sulphonation, halogenation, acylation, diazocoupling, nitrosation and mercuration. (b) mechanism of the above reactions and explanation of the regioselectivity (c) Reactions with acids - ring opening, polymerization, picrate - formation and oxidation.	Lecture		Prepare a substituted pyridine via the Hantzsch procedure	Guide students in the lab	ethyl acetoacetate formaldehyde ammonium acetate ethanol DDQ
4	1.17 List examples of 5 membered polyheterocyclics like imidazole thiazole, pyrazole, oxazole and examples of 6 membered poly			Synthesis of Coumarin		salicylaldehyde acetic anhydride anhydrous potassium acetate distillation apparatus thermometer

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	heterocyclics as pyrazine, pyrimidine and pyridazine. 1.18 List polycyclic derivatives of 5 membered ring systems like indole, benzo-furan, benzathiphene carbazole and 6 membered polycyclic derivatives like acridine.					
5 - 6	1.19 Describe the occurrence of indole, and the indole alkaloids 1.20 Describe the methods of synthesis of indoles: (a) the Fisher indole synthesis (ii) the Bishchier indole synthesis (iii) the Madelling indole synthesis 1.21 Explain the chemical properties of indole - oxidation, addition reaction, substitution reaction, reduction reaction, Erlich test. 1.22 State the sources of quinoline. 1.23 Describe the Skramp's synthesis of quinoline from amylamines and â-unsaturated carbonyl compounds. 1.24 Explain the chemical properties of quinoline - notration, sulphonation,	- do -		Carry out a synthesis of 4-methyl-2-quinilone Carry out a synthesis of Indigo		Acetoacetanilide sulphuric acid ethanol ortho nitro-benzaldehyde ethanol ether acetone NaOH

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	halogenation, oxidation, reduction. 1.25 Describe the relationship between quinoline and quinine, and the use of quinine to treat malaria					
	General Objective 2: Know some named organic reactions involved in synthesis degradation and re-arrangement of organic compounds					
7	2.1 Describe Gabriels' synthesis off primary amines. 2.2 Describe Arndt-Eistert, and Baeyer - Villiger reaction for the synthesis of carboxylic acids. 2.3 List examples of peracids as oxidizing agents in the Baeyer Villiger reaction such as perbenzoic acid, peracetic acid. 2.4 Explain why Baeyer-Villiger reaction is applicable to aliphatic and aryl ketones without double bonds.	Lecture " - do -		Prepare benzylamine through Gabriel's method	Guide the students in the preparation of benzylamine.	Round bottom flask (750 or 1000 ml), 30cm double surface condenser, dropping funnel, glass mortar, round bottom flask, reflux condenser, suction pump, Buckner funnel rotary evaporation
8	2.5 Describe Aldol, Claisen, Beckmann and Perkin condensation reactions. 2.6 Explain the Sandmeyer and Gattermann's reaction of the displacement of diazomium groups.			Carry out a Baeyer-Villiger reaction		
9	2.7 Describe Friedel-crafts alkylation and acylation; Haller-Bauer alkylation. 2.8 Describe Wittig reaction.	- do - " " "	Teaching Tools " "	Carry out a Wittigs reaction e.g. synthesis of 4-vinyl benzoic acid		4-bromomethyl- benzoic acid triphenyl phosphine NaOH HCl water

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	2.9 Describe Diels-Alder reaction 2.10 Describe Walden inversion in the reaction of bases with alkylhalides.		"			
10	2.11 Describe Reformatsky reaction (see Organometallic compounds). 2.12 Describe Wohl-Ziegler bromination of alkenes. 2.13 Describe Michael's addition reaction. 2.14 Describe Williamson's synthesis of ethers. 2.15 Describe Kiliani-Fisher synthesis of cyanohyin like Rosemund Wolff-Kischner and Clemmenson's reactions.	" " " "	- do - - do -	Carry out a Diels-Alder reaction		
11	2.16 Describe the following degradation rearrangements reactions: (a) Ruff's degradation (b) Curtis degradation (c) Schmidth degradation (d) Wagner-Meerwein degradation (e) Beckmann degradation (f) Wohl's degradation (g) Hoffman's degradation			Carry out a Hoffman degradation e.g. degradation of phthalimide to give anthranillic acid		Phthalimide acetic acid NaOH bromine decolourising charcoal glassware etc

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 3: Know some synthetic methods and reagents					
12	3.1 Describe methods of formation of c-c bonds by the use of Organometallic reagents, base catalysed and acid catalysed condensation reactions. 3.2 List reagents for organic synthesis such as Grignard reagents (RMgBr), strong bases (e.g. NaOH, $NaNH_2$ etc), acetoacetic ester, diethyl malonate, phosphonium and sulphorium ylids, peracids. 3.3 Describe the use of enamines and protecting groups for organic synthesis.	Lecture " "		Ruff Degradation of calcium gluconate to give arabinose		
	General Objective 4: Understand the chemistry of Organometallic compounds					
13 - 14	4.1 Define an organometallic compound. 4.2 List examples of organometallic compounds. 4.3 List and describe physical and chemical properties of organometallic compounds. 4.4 Describe the preparation of organometallic compounds (Grignard reagent RMgBr). 4.5 Apply Grgnard reagent to organic synthesis.	Lecture " " " " Lecture " " "		Carry out a Williamson's synthesis of ethers e.g. synthesis of neonerolin (2-ethoxy-naphthaline) Cary out a Grignard reaction e.g. synthesis of 2-phenylethyl magnesium bromide and reaction with (i) acetonitrile (ii) DMF (iii) acetone	Guide the students in the synthesis	ethyl iodide 2-naphthol NaOH 1-phenyl-2-bromoethane Magnesium dry ether acetonitrile DMF acetone

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	4.6 Describe the reactions of Grignard reagents with organic halides (both alkyl and benzyl halides, alcohols, ketones, acid chlorides, esters, epoxides, and amides). 4.7 Describe the preparation of organosodium, organolithium and organocadmium compounds. 4.8 List properties of the compounds in 4.7 above. 4.9 Compare the reactivities of compounds in 4.7 above with Grignard reagents.					
15	4.10 Describe the preparation of zinc-alkyls. 4.11 List the properties of zinc-alkyls. 4.12 Discuss the use of zinc-alkyls in synthesis by using appropriate examples			Synthesise of ethyl 3-phenyl-hydroxypropanoate by the Reformatsky reaction.	Guide the students in the synthesis	Ethyl bromoacetate zinc benzaldehyde Fume cupboard Goggles gloves Dry Glassware

Assessment:

Coursework/ Assignments 10 %; Practical 40%, Examination 50%

Recommended Textbooks & References:

Organic Chemistry by McMurray. 6th edition. Thompson/Brooks-Cole.

Small scale synthesis by M. Zanger and J. R. McKee published by McGraw-Hill Science, USA, 2002

Vogel's Textbook of Practical Organic Chemistry, A. I. Vogel, B. S. Furniss et al, 5th edition Prentice Hall, 1989

Course: Analytical Chemistry III

Department/ Programme: HND Chemistry			
Subject/Course: Analytical Chemistry III	**Course Code: STC 414**	**Credit Hours:**	**5**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Understand the principles, design, operation and applications of immunoassays
2. Understand the basic principles and applications of automation in the laboratory
3. Understand the general principles, operation and applications of electroanalytical methods.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1:0 Understand the principles, design, operation and applications of immunoassays					
1	1.1. Understand the principles of immunoassays 1.2. Discuss the types of labels used in immunoassays: radiolabels, enzymes, fluorescence. 1.3. Discuss the different separation techniques used to separate bound analyte from free: dextran-coated charcoal, second antibody, immobilisation 1.4. Understand the practical aspects of immunoassays including: preparation of hapten-carrier conjugates, immunisation, antibody detection, antibody titres, calibration, matrix effects	Lecture		Perform a qualitative enzyme linked immunoassay (ELISA). (see Anderson, 1998 below)	Demonstrate the principles and assist students in performing the assay	PBS buffer, phosphate citrate buffer, BSA, biotinylated BSA, antibiotin peroxidase conjugate, TMB tablet, Hydrogen peroxide, ELISA plates, humid box
2	1.5. Discuss the shape and precision of standard calibration curves, including precision profiles 1.6. Discuss the advantages and disadvantages of immunoassays in terms of time, sensitivity, selectivity etc. 1.7. Discuss the factors involved in developing an immunoassay	Lecture and aid discussion		Repeat above but students prepare their own reagents (antibody-peroxidase conjugate, coat the ELISA plate etc)		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
3	1.8. Discuss the use of affinity chromatography as an immunoassay. 1.9. Discuss immobilisation and elution techniques used with affinity chromatography 1.10. Briefly discuss possible future directions for immunoassay	Lecture, and aid discussion		Continue with above experiment		
	General Objective 2:0 Understand the basic principles and applications of automation in the laboratory					
4	2.1. Discuss the processes occurring in an analysis that may have automation possibility 2.2. Discuss the difference between discrete analysers and continuous flow analysers 2.3. Understand the principles of flow injection analysis (FIA) 2.4. Draw a simple schematic of an FIA system 2.5. Discuss the effects of convection and diffusion on the concentration profile of analytes	Lecture and aid discussion		Visit a laboratory that is using automated equipment (E.G. Hospital pathology lab or quality control in an industrial lab)		
5	2.6. Discuss applications of FIA including limited-dispersion and medium-dispersion applications, stopped-flow methods and flow-injection titrations 2.7. Discuss principles and applications of automatic samplers	Lecture and aid discussion		Visit a second laboratory		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	2.8. Discuss the use of laboratory robots for sample preparation 2.9. Discuss the advantages and disadvantages of using automated systems for analysis					
	General Objective 3:0 Understand the general principles, operation and applications of electroanalytical methods.					
6	3.1 Draw a two-electrode cell for use in potentiometry 3.2 Discuss the basic principles of ion selective electrodes 3.3 Identify the terms in the Nernst equation 3.4 Describe the relationship between activity and concentration 3.5 Discuss the use of Total Ionic Strength Adjustment Buffer so that concentration is equivalent to activity 3.6 Discuss the effects of interfering ions using the potentiometric selectivity coefficient and the Nickolsky-Eisenmann equation	Lecture		Calculate the concentration of fluoride in samples of toothpaste and fluoride supplement tablet	F^- ISE (with reference electrode), voltmeter, toothpaste, fluoride tablets	
7	3.7 Calculate the percentage error of the ISE due to interference 3.8 Discuss the types of ISE with examples: glass membrane (pH); solid state membrane; ion exchange and liquid membrane	Lecture; use worked examples and questions to familiarise students with calculations	Classroom	Potentiometric titration (e.g. determination of Fe(III) by titration with EDTA or determination of halides by titration with Ag+)		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	3.9 Discuss the use of standard additions and working curves to calibrate ISEs 3.10 Calculate the concentration of samples using the calibration methods in 3.8 above 3.11 Discuss the use of potentiometry in titration					
8	3.12 Discuss the principles of amperometry and amperometric titration 3.13 Draw a diagram of the equipment used for an amperometric titration 3.14 Discuss the advantages of membrane and membrane-covered electrodes with examples 3.15 Discuss the use of modified electrodes with examples	Lecture		Clark oxygen electrode to measure dissolved oxygen in solution		
9	3.16 Discuss the principles of voltammetry 3.17 Draw a schematic of a system for potentiostatic three-electrode linear-scan voltammetry 3.18 Discuss the principles of the electric double-layer	Lecture		Using a reversible redox couple (e.g. ferro/ferricyanide) examine the shape of cyclic voltammogram and the key features. Investigate the effect of concentration	Demonstrate and aid discussion of basic principles	

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	3.19 Describe the shape of the voltammetric curve for reversible and irreversible reactions 3.20 Understand the effect of charging current on the measurement and how to compensate for this 3.21 Explain the term diffusion current 3.22 List factors that affect the diffusion current 3.23 Understand the terms peak potential, half-wave potential, residual current					
10	3.24 Discuss the use of square wave voltammetry and describe the waveform used 3.25 Discuss the principles of stripping voltammetry 3.26 Understand the principles of the electrodeposition step 3.27 Understand the difference between anodic, cathodic and adsorptive stripping voltammetry 3.28 Discuss the advantages of using stripping voltammetry	Lecture. Using examples of voltammograms aid calculations		Using the same redox couple as above investigate the effects of scan rate	Assist students and aid discussion	

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	3.29 Explain the differences between using the peak height and peak area for calculation of a concentration. 3.30 Calculate the concentration of a sample, using working curve and standard addition methods, analysed using stripping voltammetry (peak height and peak area)					
11	3.31 Discuss the principles of polarography 3.32 Understand the terms in the Ilkovic equation and how this affects diffusion current 3.33 Discuss the two main types of pulse polarography techniques: differential pulse polarography and square-wave polarography 3.34 Discuss the organic and inorganic applications of polarography	Lecture		Analyse standards and an unknown mixture of metals at low concentrations using stripping voltammetry.		
12	3.35 Discuss the use of hydrodynamic electrodes 3.36 Discuss the types of hydrodynamic electrode including rotating disk (RDE), wall jet, dropping mercury electrode (DME), tube and channel	Lecture		Determination of cadmium in solution using calibration curve and standard additions		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	3.37 Draw schematic profiles of streamlines at these electrodes 3.38 Understand the relationship between the limiting current and diffusion layer thickness using the equation $I_L = \frac{nFAD}{\delta}$					
13	3.39 Describe the characteristics of the DME 3.40 Draw a diagram of the apparatus for a DME 3.41 Understand the terms used in the Cottrell equation 3.42 Discuss the advantages and disadvantages of the DME 3.43 Discuss applications of the DME 3.44 Discuss the use of RDEs to investigate the kinetics of reactions	Lecture		Reduction of Pb2+ and Cu2+ using DME		
14	3.45 Discuss the types of double hydrodynamic electrodes including rotating ring disk electrode (RRDE), wall jet ring-disc electrode (WJRDE) and the tube/channel double electrode (TDE/CDE). 3.46 Discuss the use of double electrodes to investigate electron transfer	Lecture		Using the redox couple encountered in previous voltammetry experiments determine the voltammetric response of a microelectrode.		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
15	3.47 Discuss the principles of microelectrodes 3.48 Understand the difference in diffusion to a microelectrode when compared with a macroelectrode 3.49 Compare the voltammetric response of a microelectrode with that of a standard macroelectrode 3.50 Discuss the types of microelectrode configuration including disk, cylindrical, band, and ring. 3.51 Discuss factors involved with the construction of microelectrodes	Lecture		Investigate the effects of concentration and scan rate on the voltammogram and compare with the equivalent responses of the macroelectrode (2 weeks)		

Assessment:

Coursework/ Assignments Course test 10%; Practical 40%; Examination 50%

Recommended Textbooks & References:

J.N. Miller and J.C. Miller. Statistics and Chemometrics for Analytical Chemistry. Fourth Edition. Prentice Hall. 2000.
D.C. Harris. "Quantitative Chemical Analysis", 6th Edition, Freeman, New York. 2002.
D.A. Skoog, D.M. West & F.J. Holler. "Fundamentals of Analytical Chemistry", 7th edition. Saunders and Holt, New York. 1996
R. Kellner, J.-M. Mermet, M. Otto & H.M. Widmer (eds.). "Analytical Chemistry" Wiley-VCH, Chichester. 1998
D.T. Sawyer, W.R. Heineman & J.M. Beebe. ÒChemistry Experiments for Instrumental MethodsÓ. John Wiley & sons, New York. 1984.
R.F. Venn (ed). Principles and Practice of Bioanalysis. Taylor & Francis. 2000.
G.L. Anderson, L.A. McNellis. Enzyme-Linked Antibodies: A Laboratory Introduction to the ELISA. Journal of Chemical Education, 1998. 75, 1275-1277.

Course: Petroleum and Petrochemicals

Department/ Programme: HND Chemistry			
Subject/Course: Petroleum and Petrochemicals	**Course Code: STC 415**	**Credit Hours:**	**5**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Know the primary raw materials for petrochemicals, treatment processes and properties
2. Know the hydrocarbon intermediates (secondary raw materials) for the production of petrochemicals
3. Understand crude oil processing and the production of hydrocarbons
4. Know the extraction and uses of non-hydrocarbon intermediates
5. Describe petrochemicals based on methane
6. Describe petrochemicals based on ethane and higher paraffins
7. Describe petrochemicals based on ethylene
8. Describe petrochemicals based on propylene
9. Describe petrochemicals based on C4 Olefins and Diolefins
10. Describe petrochemicals based on benzene, toluene and xylene
11. Be familiar with synthetic petroleum based polymers

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1: Know the primary raw materials for petrochemicals, treatment processes and properties					
1-2	Students should be able to 1. Discuss the origin of petroleum raw materials 2. Know the composition of Natural Gas 3. Describe treatment processes for Natural Gas 4. Discuss Natural Gas Liquids (NGL) 5. Describe properties of Natural Gas 6. Know the composition of crude oils 7. Describe properties of crude oils 8. Understand crude oil classification	Research material, prepare presentations, give lectures	Classroom resources	measure the enthalpy of combustion of different liquid fuels e.g. methanol, hexane, octane, petrol, diesel etc	research experiments, prepare students and then guide them in the laboratory	spirit burner, liquid fuels, clamps, copper calorimeter, thermometer, draught excluders, water
	General Objective 2: Know the hydrocarbon intermediates (secondary raw materials) for the production of petrochemicals					
3	1. Know the paraffinic hydrocarbons (methane, ethane, propane, and butanes) and their role as secondary raw materials 2. Know the olefinic hydrocarbons (ethylene, propylene, butylenes) and their role as secondary raw materials 3. Discuss the dienes: butadiene and isoprene 4. Describe the extraction of aromatics			continue with the above experiment and compare the results with reference values and reference values for alternative fuels such as; Hydrogen, methane, LPG etc.		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	and discuss their role as secondary raw materials 5. Discuss Liquid Petroleum Fractions and Residues: Naphtha, Kerosine, Gas Oil, Residual Fuel oil					
	General Objective 3: Understand crude oil processing and the production of hydrocarbons					
4	1. Physical separation processes: atmospheric and vacuum distillation, absorption, adsorption, and solvent extraction 2. Conversion processes: thermal processes (cocking, cracking, delayed cockingfluid cocking viscocity breaking) and catalytic conversion processes (reforming, cracking, deep cracking, hydrocracking) alkylation processes, isomeriasation processes etc 3. Production of olefins: steam cracking 4. Production of diolefins			Students demonstrate the analysis of an oil fraction - Separation of the components of the waxy distillate fraction of crude oil using column chromatography	Provide the manual Prepare the column by using silica gel Assemble the distillation apparatus	Silica -gel column Separation funnel Apparatus for Distillation under reduce pressure Waxy distillate samples heptane Toluene Ethylacetate
	General Objective 4: Know the extraction and uses of non-hydrocarbon intermediates					
5	1. Know the extraction and uses of hydrogen 2. Know the extraction and uses of sulphur 3. Know the extraction and uses of carbon black 4. Discuss the production and uses of synthesis gas			Fractional distillation of crude oil	Provide the manual for the exp. Assemble fractional distillation apparatus	Crude oil samples Fractional distillation apparatus 250ml conical flasks Heating mantle

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 5: Describe petrochemicals based on methane					
6-7	1. Discuss the direct conversion of methane into: carbon disulphide, hydrogen cyanide, chloromethanes. 2. describe the production of methanol from synthesis gas 3. Discuss the uses of methanol as a fuel 4. Describe the uses of methanol as a feedstock (for formaldehyde, methyl chlorides, acetic acid, methyl tertiary butyl ether, dimethyl carbonate, methylamines, etc) 5. Discuss the production of hydrocarbons from methanol 6. Know the MTG process (methanol to Gasoline) 7. Know the production of ethylene glycol (anti-freeze) from synthesis gas.			Gas Chromatographic analysis of petrol sample	Provide the lab.manual f Warm the G.C for 30 minutes Prepare standards OR Provide G.C-MS	G.C machine Petrol samples Hypodermic syringe (2.5ul) Pink support Squalene. Air/Acetylene gases
	General Objective 6: Describe petrochemicals based on ethane and higher paraffins					
8	1. Describe the isolation and uses of ethane 2. Describe the isolation and uses of propane 3. Discuss reactions of propane (oxidation, chlorination, dehydrogenation, and nitration) and			Catalytic cracking of a mixture of alkanes	research experiment prepare and guide students throughout the excercise	safety glasses fume hood petroleum jelly, or similar source alkanes, aluminium oxide, pumice or zeolite test ubes, glass rods beakers water etc

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	uses of the resulting products 4. Describe the isolation and uses of butanes 5. Discuss reactions of butanes (oxidation, isomeriasation, production of aromatics) 6. Discuss petrochemicals from high molecular weight n-parafins (oxidation, chlorination, sulphonation, etc)					
	General Objective 7: Describe petrochemicals based on ethylene					
9-10	1. Describe the production and isolation of ethylene 2. Know the importance of ethylene in the petrochemical industry 3. Discuss the production of ethylene oxide and its uses as a feedstock in the production of derivatives 4. Know the carbonylation, chlorination, hydration, and oligomerisation of ethylene 5. Discuss alkylation using ethylene			Workshop on blending petrol	research and prepare students for excercises on blending petrochemicals to produce petrol	tables of ingredients, octane numbers, volatility, cost and availability
	General Objective 8: Describe petrochemicals based on propylene					
11	1. Describe the production and isolation of propylene 2. Discuss the oxidation of propylene			Determination of flash point of engine oil.	Provide the manual for the exp. Prepare Cleveland's flash point apparatus	Sample of engine oil Cleveland's apparatus

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	3. Know the oxyacylation of propylene 4. Discuss the hydration of propylene and the uses of isopropanol 5. Describe the hydroformylation of propene					Thermometer Heating mantle
	General Objective 9: Describe petrochemicals based on C4 Olefins and Diolefins					
12	1. Describe the isolation of n-butene, isobutene and butadienes 2. Discuss the oxidation of n-butenes and uses of the resulting petrochemicals 3. Discuss the production and uses of petrochemicals from isobutylene: oxidation, epoxidation, addition of alcohols, hydration, carbonylation, and dimerisation 4. Discuss the production of petrochemicals from butadiene: adiponitrile, hexamethylene diamine, adipic acid, and butanediol			Determination of acid value of engine oil and Determination of saponification value of engine oil	Prepare 0.1N KOH Prepare neutral ethyl alcohol 0.5N sodium carbonate, 0.5N alcoholic KOH, 0.5N HCl	engine oil 250ml and 500 ml conical flasks Phenolphthalein Titration apparatus Weighing balance
	General Objective 10: Describe petrochemicals based on benzene, toluene and xylenes					
13	1. Describe the isolation of benzene, toluene and xylene 2. Describe the reactions of benzene (alkylation, chlorination, nitration, oxidation, and hydrogenation) and uses of the resulting products 3. Describe the reactions of toluene (dealkylation, disproportionation,			Visit to oil processing plants	organise trips and relate visit to lectures	oil processing plants

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	oxidation and carbonylation) 4. Know the production of terephthalic acid, Phthalic anhydride and isophthalic acid from xylenes.					
	General Objective 11: Be familiar with synthetic petroleum based polymers					
14-15	1. Discuss the importance of synthetic petroleum based polymers 2. Discuss thermoplastics (polyethylene, polypropylene, PVC, polystyrene, Nylon resins and thermoplastic polyesters 3. Discuss thermosetting plastics: polyurethanes, epoxy resins, unsaturated polyesters 4. Discuss synthetic rubbers: butadiene polymers and copolymers, nitrile rubbers, polisoprene and butyl rubber 5. Discuss synthetic fibres: polyester fibres, polyamides, acrylic and modacrylic fibres, carbon fibres and polypropylene fibres.			Visit polymer production plants	Organise trips and relate visit to lectures	Polymer production plants

Assessment:

Coursework/ Assignments 20%; Practical 40% Examination 40%

Recommended Textbooks & References:

Chemistry of Petrochemical Processes (2nd Edition) S.Matar and L.F.Hatch, Gulf Professional Publishing, 2001

For the Experiments

Salters Advanced Chemistry Activities and Assessment Pack G.Burton et al, Heinemann 2000

Course: Computer Applications in Chemistry

Department/ Programme: HND Chemistry			
Subject/Course: Computer Applications in Chemistry	**Course Code: STC 416**	**Credit Hours:**	**4**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**1 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Be able to use chemistry drawing packages such as "ChemDraw" or "ISIS Draw".
2. Be able to use molecular modelling packages such as "Chem3D" or similar
3. Be able to use specialist graph plotting and analysis software packages such as "Origin", "Sigmaplot", "Igor" or similar.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1: Be able to use chemistry drawing packages such as ChemDraw or ISIS Draw					
1 - 4	Students should be able to: 1. launch the drawing package, create new documents, save documents and open existing documents. 2. use menus to set or select drawing preferences such as bond length, bond angles, line width, page set up, etc. 3. select drawing tools from the menus to draw new bonds, add new bonds, and construct drawings of very simple organic molecules 4. print the drawing. 5. draw double and triple bonds 6. draw rings by using the appropriate ring tool or template from the menus 7. draw fused rings by using the same ring tools as above 8. add atom labels to drawings/repeat atom labels	Give introductory lectures explaining concepts and showing examples.	Classroom resources. Computer linked to display or projection equipment. (or overhead projector and photocopies from the manual or "screen dumps")	Students use a drawing package to draw and print out a variety of open chain organic compounds. including: alcohols, ketones, aldehydes, amines, esters, amides, nitriles, alkenes, alkynes (internal and terminal) and carboxylic acids. students draw and print out molecules containing two functional groups students draw and print out cyclic examples corresponding to the acyclic examples above. students draw out a variety of simple heterocyclic compounds and substituted heterocyclic compounds. students draw and print out a variety of chemical reaction beginning with the ionisation of a carboxylic acid and then as many reactions as they are familiar with from ND and/or STC 313. students practice selecting, duplicating, resizing rotating and aligning molecules and print out a page with examples of a single molecule treated in this way. students draw and print out complex natural products such as: steroids, prostaglandins, sugars (cyclic and ring opened) penicillins, cephalosporins, cocaine, morphine, codeine, and other alkaloids.	Give examples of molecules for the students to draw. Ensure that sufficient examples are given to allow the students to gain as much experience as possible in the time available. Walk among the students advising them and answering questions.	Computer pool room Chemistry drawing software

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	and delete atom labels 9. add captions to drawings 10. Format text 11. use orbital tools to select and draw orbitals 12. use chemical symbol tools to select and draw lone pairs, radicals, and charges. 13. select and use the appropriate tools to draw: reaction arrows, arcs, and other shapes. 14. use the eraser tool to delete individual bonds, charges, arrows, etc. 15. select objects by using the selection tool 16. select objects by using the mouse buttons 17. add to the selection and delete the selection 18. select and move objects 19. select and duplicate					

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	objects 20. select and rotate objects 21. select and resize objects 22. select and group objects 23. select and align objects 24. use the crosshair 25. cut and paste within the package 26. cut and paste from the package into other packages such as word processing packages					
	General Objective 2: Be able to use molecular modelling packages such as "Chem3D" or similar					
5 - 10	Students should be able to: 1. Explain the reasons for modelling molecules and reaction intermediates on computers 2. Understand the general concepts involved in computer molecular modelling 3. Understand the mathematical principles underlying modelling	Give introductory lectures explaining concepts and showing examples.	Classroom resources. Computer linked to display or projection equipment. (or overhead projector and photocopies from the manual or "screen dumps")	Students use a modelling package to build, import, manipulate, print out and export [in various formats] a variety of simple open chain organic compounds, concentrating initially on butane and moving on to include: alcohols, ketones, aldehydes, amines, esters, amides, nitriles, alkenes, alkynes (internal and terminal) and carboxylic acids. students build and import cyclic organic molecules with two or three substituents, manipulate and inspect them, and energy minimise by using MM2 and MOPAC calculations (or similar). Suitable examples	Give examples of molecules for the students to model. Ensure that sufficient examples are given to allow the students to gain as much experience as possible in the time available. Walk among the students advising them and answering questions.	Computer pool room Chemistry modelling software

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	procedures (Newtonian Mechanics [e.g. MM2], semi-empirical [e.g. MOPAC] and quantum mechanical methods. 4. Discuss the relative merits of the different methods of modelling given above. 5. launch a modelling programme and create an empty model page or window 6. select a pre-existing model from a template menu 7. use rotation tools to rotate and examine the molecule 8. save the new rotation and print the new view 9. open an existing file 10. import a model created by the same or a different modelling programme 11. build a new molecule by using the tools available in menus 12. build a new model by using a drawing programme and importing the resulting			are: aspirin, paracetamol, ibuprofen. Students obtain DH_f values for the above molecules. Students draw and minimise the hexapeptide GHGGCG and coment upon the resulting conformation		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	file into the modelling programme 13. change an atom to another element 14. change bonds 15. add fragments 16. delete atoms and bonds 17. set charges 18. change stereochemistry 19. select atoms, bonds or groups of atoms and bonds by using the selection tools from menus 20. select atoms, bonds and features by using the mouse buttons 21. move atoms or models 22. rotate fragments of models 23. change orientations of fragments 24. resize models					

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	25. change the appearance of a model (wire frame, sticks, ball and stick, space filling, dot surfaces, ribbons, etc) 26. change colours 27. change atom and bond sizes 28. change element symbols 29. display stereo views 30. display model data (atoms and serial numbers, bond angles, dihedral angles, distance between two atoms, etc) 31. dock models 32. compare models by overlaying 33. export using different file formats 34. export by using the clipboard 35. use the modelling programme to compute the stability of different					

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	conformations of the same simple molecule 36. use the modelling programme to minimise the energy of molecules 37. use the modelling programme to find the lowest energy conformation of simple and more complex molecules e.g. aspirin 38. use the semi-empirical functions [MOPAC] of the programme to determine ΔH_f.					
	General Objective 3: Be able to use specialist graph plotting and analysis software packages such as "Origin" or "Sigmaplot" or "Igor" or similar					
11 - 15	Students should be able to: 1. Explain the relationship between a specialist graph plotting and analysis programme and a spreadsheet programme such as Excel. 2. launch the specialist graph plotting and analysis programme 3. input data directly into the programme's worksheet 4. import data into the worksheet from a	Give introductory lectures explaining concepts and showing examples.	Classroom resources. Computer linked to display or projection equipment. (or overhead projector and photocopies from the manual or "screen dumps")	Use HPLC to separate a 5 component mixture and obtain relative concentrations. Repeat separation 5 times and input data into worksheet. Perform statistical analyses (find population means and perform T-tests, carry out T-test for each mixture against 100%, etc). Obtain means and SD and generate scatter plot with error bars, pie chart etc. print graphs. Export data into Excel. Measure absorbance for a range of concentrations of potassium chromate, input data, perform linear regression and construct standard curve. Plot graph and print. Determine concentrations of unknowns.	Prepare experiments and supervise students. Or prepare data to give to students. Ensure that sufficient examples are given to allow the students to gain as much experience as possible in the time available. Walk among the students advising them and answering questions.	Computer pool room. Graph plotting and analysis software

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	spreadsheet package such as Excel 5. use menu commands to plot a graph of the data contained in the worksheet 6. use menu and or mouse commands to edit the resulting graph (change: axes, labels, symbols, text, resizing, etc) 7. save graphs and data files 8. save files in different formats (e.g. "standard formats such as TIF files) 9. export data files and graphs into other programmes such as spreadsheets and word processors 10. use menu commands to analyse data in the worksheet 11. obtain basic statistical from the data in the worksheet (statistics on rows and columns, t-tests, ANOVA, etc) 12. use the curve fitting functions e.g. exponential,			Investigate a selection of enzyme catalysed reactions (e.g. chymotrypsin catalysed hydrolysis of nitrophenyl acetate) by measuring initial rates for a range of substrate concentrations. Obtain kinetic parameters from both saturation curves and Line Weaver Burke transformations. Print out graphs.		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	linear regression, sigmoidal, hyperbolic, etc. 13. use the hyperbolic functions to analyse Michaelis Menten kinetics and obtain the kinetic parameters for suitable enzyme catalysed reactions					

Assessment:

100% Practical

Recommended Textbooks & References:

Computational Chemistry by G.H. Grant and W.G. Richards published by Oxford University Press Relevant Computer Software Manuals

Course: Small Business Management II

Programme: Statistics (Higher National Diploma)			
Course: Small Business Management II	**Course Code: STA 418**	**Total Hours:**	**2**
Year: 2 Semester: 1	**Pre-requisite:**	**Theoretical:** **Practical:**	**1 hour /week** **1 hour /week**

Goal:

This course is designed to provide the student with further basic knowledge on the various tools used in the management of small-scale businesses.

GENERAL OBJECTIVES:

On completion of this course, the diplomate will be able to:

1. Understand the financing of small business enterprises
2. Understand financial management in a small business enterprise
3. Understand credit control in small business enterprises.
4. Understand the organization, and its structure for a small-scale enterprise.
5. Understand a small-scale enterprise information system.
6. Understand marketing management for a small-scale enterprise.
7. Produce a business plan for a small-scale enterprise.
8. Be able to give a presentation on a business plan for a small-scale enterprise.

Theoretical Content				Practical Content		
Week	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1 (STA 418): Understand the financing of small business enterprises.					
1	1.1 Estimate the capital needs of a selected small business. 1.2 State sources of finance for small business. 1.3 Explain the roles of specialized institutions in financing small businesses. 1.4 Explain how to source short-term and long-term credits	Explain sources of capital and how to estimate needed capital for a small business. Explain short-term and long term credits and their sources. Explain the roles of specialized institutions in financing small businesses in the areas of: a) Provision of SME equity. b) Provision of term loan opportunities for SMEs investment schemes. c) Provision of working capital facility for SMEs d) Financing SMEs through leasing. e) Financing SMEs for non-oil export. f) Financing SMEs through the capital market. g) General requirements/conditions for market financial assistance to SMEs	Text Books Journals Publications	Apply all the theoretical contexts to come from the rest of the course to the assigned business. Prepare a financing plan. Identify various sources of funds and their costs. The group will meet together in all practical sessions and each group will have to submit a project about their assigned business at the end of the course.	From one the beneficiaries of the institutions handling SME, describe the learning outcomes. The teacher to set up student groups of (3-4) students each and assign a type of business for each group.	Internet and relevant websites

Theoretical Content				Practical Content		
Week	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
2	1.5 Explain the various reasons for borrowing. 1.6 Describe costs of borrowing with some examples. 1.7 Explain how to approach lenders. 1.8 Explain reasons for financial plans.	Explain various reasons for borrowing. With some examples, explain cost of borrowing. Explain reasons for financial plan and how to approach a lender	Text Books Journals Publications	Prepare a financing plan for their assigned business. Identify various sources of funds and their costs. Describe how to approach lenders.	From one the beneficiaries of the institutions handling SME, describe the learning outcomes.	Internet and relevant websites
	General Objective 2 (STA 418): Understand financial management in a small business enterprise					
3	2.1 Explain the need for sound financial management in small business. 2.2 Prepare the basic financial records required for small business enterprises and their operation. 2.3 Explain preparation of key financial statements - cash flow, profit and loss account and balance sheet. 2.4 Explain preparation of depreciation schedule.	Explain the need for sound financial management in small businesses Explain basic financial records Explain key financial statements. Explain depreciation.	Text Books Journals Publications Formats of prime books of accounts.	Describe the various records require to operate their assigned SME Describe key financial statements and how to prepare a depreciation schedule.	Guide students to prepare the records, extract key financial statements to determine BEP, loss or gain.	Internet and relevant websites

Theoretical Content				Practical Content		
Week	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
4	2.5 Explain how to determine gross margin and net profit. 2.6 Explain preparation of loan repayment schedule (AMORTIZATION) 2.7 Explain how to determine break-even-point (BEP). 2.8 Explain problem of financial management in small enterprises.	Explain gross margin and net profit and break-even-point (BEP). Explain the various types of loan repayment and their application. Guide students to prepare a depreciation schedule for a selected business, extract its cash flow, profit and loss and balance sheet to determine its break -even- point, gross margin and net profit. Explain problems of financial management in small enterprises.	Text Books Journals Publications Formats of prime books of accounts.	Describe key financial statements and how to prepare a depreciation schedule. Use appropriate application packages to do amortization.	Guide students to prepare the records, extract key financial statements to determine BEP, loss or gain.	Internet and relevant websites
	General Objective 3 (STA 418): Understand credit control in small business enterprises.					
5	3.1 Explain credit control 3.2 Explain the various steps in extending credits to customers. 3.3 Identify sources of information on credits.	Explain credit control Explain the 3c's of credit (character, capacity and condition). Explain where and how to get information on credits.	Text Books Journals Publications	Identify how credits can be extended to their assigned small business, sources and costs of the credits	Identify the CS of credit. Use internet to get information on credits	Internet and relevant websites
6	3.4 Explain consumer credit and credit cards. 3.5 Explain reasons for credits to small business enterprises. 3.6 Identify cost of credit	Explain consumer credit and credit card. Explain reasons for credit to small business enterprises and their costs.	Text Books Journals Publications	Identify credit cards and reasons for credit	Identify the CS of credit. Use internet to get information on credits	Internet and relevant websites

Theoretical Content				Practical Content		
Week	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 4 (STA 418): Understand the organization, and its structure for a small-scale enterprise.					
7	4.1 Understand organization charts for small-scale enterprises. 4.2 Understand span of supervision.	Explain Demonstrate.	Textbook Handouts Charts	Know how to set staffing requirements for their assigned small business. Know how to develop job description of jobs required.	Guide students to develop organization charts, job description and job specification and to identify different functions of their assigned business.	Sample forms Charts
8	4.3 Understand formal communication structure for a small business. 4.4 Developing job-know how to set specifications for the operation of small business.	Explain Demonstrate.	Textbook Handouts Charts	Know how to develop job description of jobs required for their assigned business. Know how to develop job specification	Guide students to develop organization charts, job description and job specification and to identify different functions of their assigned business.	Sample forms Charts
	General Objective 5 (STA 418): Understand a small-scale enterprise information system.					
9	5.1 Understand management information system. 5.2 Understand accounting information system. 5.3 Underastand production information system.	Explain & demonstrate sample systems. Demonstrate the need of each system for the small business.	Textbook Handouts	Know the important information required for each system within the context of their assigned business.	Guide students with their assigned study Guide on use of appropriate software	Appropriate computer software
10	5.4 Understand financial information system. 5.5 Understand marketing information system. 5.6 Understand inventory information system.	Explain & demonstrate sample systems. Demonstrate the need of each system for the small business.	Textbook Handouts	Know the important information required for each system within the context of their assigned business.	Guide students with their assigned study Guide on use of appropriate software	Appropriate computer software

Theoretical Content				Practical Content		
Week	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 6 (STA 418): Understand marketing management for a small-scale enterprise.					
11	6.1 Know how to identify markets for different products. 6.2 Know the steps in conducting a market survey to determine demand and supply for a particular product. 6.3 Appreciate the need for product development for satisfying consumer needs.	Explain and give examples of certain products. Demonstrate steps. Explain why product development is important and is an on going process. Explain different pricing strategies and conditions and circumstances for choosing a particular strategy	Textbook Handouts	Identify markets and conduct survey applied to their assigned business. Explain channels of distribution for sample products. Explain different pricing methods and determinants of methods.	Guide students with their assigned study	Textbook Handouts
12	6.4 Understand channels of distribution for products and services. 6.5 Understand pricing strategies.	Explain and give examples of certain products. Demonstrate steps. Explain why product development is important and is an on going process. Explain different pricing strategies and conditions and circumstances for choosing a particular strategy	Textbook Handouts	Identify markets and conducts survey within the context of their assigned business. Explain channels of distribution for sample products. Explain different pricing methods and determinants of methods.	Guide students with their assigned study	Textbook Handouts
13	6.6 Understand promotion and sales activities for small-scale enterprises. 6.7 Ability to analyse consumer behaviour and anticipation of demand. 6.8 Ability to analyse competitors and developing market SWOT analysis.	Explain elements of promotion. Identify advantages & disadvantages and usage of promotion elements at different stages of product life cycle. Explain SWOT analysis and how to identify and assess strengths, weaknesses, opportunities and threats.	Textbook Handouts	Appreciate the importance of promotional activities for a small business. Understand the process of SWOT analysis.	Guide students with the application of promotion and sales activities on the assigned businesses Guide students to develop SWOT for the assigned businesses given present trends and marketing environment	Samples of Promotional materials SWOT analysis form

Theoretical Content				Practical Content		
Week	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 7 (STA 418): Produce a business plan for a small-scale enterprise.					
14	7.1 Assimilate the previous aspects of the course to produce a complete business plan for the assigned small business.	Oversee and support the production of the business plan	Textbook Handouts	Be able to contribute to the preparation of a business plan as a member of a group	Oversee and support the production of the business plan	Textbook Handouts
	General Objective 8 (STA 418): Be able to give a presentation on a business plan for a small-scale enterprise					
15	8.1 Prepare a presentation on a business plan for the assigned small-scale enterprise. 8.2 Give a presentation on a business plan for the assigned small-scale enterprise.	Evaluate presentations and give feedback	Presentation materials	Be able to be part of a group presentation and have responsibility for part of that presentation.	Evaluate presentations and give feedback	Presentation materials

Assessment:

Give details of assignments to be used:
Coursework/ Assignments %; Course test %; Practical %; Examination %

Type of Assessment	Purpose and Nature of Assessment (STA 418)	Weighting (%)
Examination	Final Examination (written) to assess knowledge and understanding	0
Test	At least 1 progress test for feed back.	25
Practical / Project	Project with group (25%) and individual (50%) components to be assessed by the teacher	75
Total		100

Recommended Textbooks & References:

SECOND YEAR - SECOND SEMESTER

Course: Medicinal Chemistry

Department/ Programme: HND Chemistry			
Subject/Course: Medicinal Chemistry	**Course Code: STC 421**	**Credit Hours:**	**5**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Understand some of the historical background to the discovery and use of drugs
2. Understand basic concepts in the study of drugs and medicines
3. Understand drug action at enzymes
4. Understand drug action at receptors
5. Understand drug action at nuceic acids (DNA and RNA)
6. Understand drug discovery and development
7. Understand pharmacokinetics
8. Describe opium analgesics and their interaction with opiate receptors
9. Describe the discovery and development of transition state inhibitors of HIV-1 protease

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1: Understand some of the historical background to the discovery and use of drugs					
1-2	Students should be able to: 1. describe, briefly, the history of opium and its use in medicine 2. describe the isolation and initial medical uses of morphine 3. discuss the elucidation of the structure of morphine 4. understand the simple lock and key mechanism for morphine binding to receptors on the surface of nerve cells 5. discuss the structures and properties of 6-acetyl morphine, 3,6-diacetyl morphine, codeine and dihydrocodeine 6. know the history of some antibacterial agents 7. know that bacteria were first identified by van Leeuwenhoek, associated with disease by Pasteur and Lister and confirmed by Koch 8. understand that Ehrlich initiated chemotherapy 9. describe the discovery of Salvarsan, proflavine and prontosil 10. describe the history of penicillin 11. Know the parts played by Flemming, Florey, Chain and Hodgkins.	lectures and tutorials	classroom resources	Synthesis of aspirin Synthesis of Paracetamol	guide students	salicylic acid acetic anhydride hydrochloric acid glassware aminophenolacetic anhydride chemicals glassware

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	12. draw the structure of penicillin 13. explain the lability of penicillin 14. use curly arrows to draw the mechanism of the base promoted hydrolysis of penicillin 15. use curly arrows to draw the mechanism of the acid catalysed hydrolysis of penicillin 16. know that penicillin inhibits an enzyme involved in constructing the cell wall of bacteria					
	General Objective 2: Understand basic concepts in the study of drugs and medicines					
3	1. Understand that drugs may be classified (a) by their phamocological effect, (b) by their chemical structure, (c) by their intended target or (c) by their site of action 2. Know basic cell structure 3. know that drugs produce their effects by interacting with proteins (receptors, enzymes, etc) nucleic acids (DNA) lipids (cell membranes) and structural carbohydrates. 4. Understand (revise) the structure of proteins and discuss the interaction of drugs with receptor binding sites. 5. Describe receptor recognition and binding of drugs in terms of: specificity, complementarity of shape, complementarity of electronic nature and the types of binding forces available 6. Explain stereospecificity in drug-receptor binding			Synthesis of Barbituric acid		Chemicals Glassware

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 3: Understand drug action at enzymes					
4 - 5	1. Understand (revise) chemical catalysts and catalysis 2. Understand (revise) enzymes as catalysts 3. Understand (revise) enzyme kinetics 4. Describe substrate binding by enzymes 5. describe molecular mechanism of catalysis for an enzyme 6. discuss competitive inhibitors 7. discuss non-competitive (irreversible) inhibitors 8. understand non-competitive, reversible (allosteric) inhibitors 9. discuss the catalytic role of enzymes in terms of substrate binding, molecular mechanisms of catalysis (general acid/base, nucleophilic groups, transition state stabilisation) 10. Give examples of enzyme inhibitors as antibacterial drugs 11. Give examples of enzyme inhibitors as antiviral drugs 12. Give examples of enzyme inhibitors against the body's own enzymes			Synthesis of Sulphanilamide (2 week project)		Chemicals Glassware

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 4: Understand drug action at receptors					
6	1. Students should be able to: understand what receptors are and what they do 2. describe some neurotransmitters and hormones 3. know that receptor binding induces conformational change which brings about a biological effect 4. describe ion channels and their control 5. describe the activation of membrane bound enzymes describe how a receptor may change its shape upon binding its ligand 6. discuss the design of agonists as drugs 7. describe the binding of agonists in terms of structure, shape and electronic nature 8. discuss the design of antagonists 9. describe antagonists acting at the binding site 10. describe antagonists acting outwith the binding site 11. discuss partial agonists and inverse agonists 12. describe desensitisation and sensitisation 13. discuss tolerance and dependence 14. know that there are cytoplasmic receptors 15. understand receptor types and subtypes			Synthesis of Benzocaine		chemicals Glassware

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 5: Understand drug action at Nucleic acids (DNA and RNA)					
7	1. Understand (revise) the primary secondary and tertiary structure of DNA 2. describe the action of intercalating agents 3. describe the action of alkylating agents 4. draw the structures of: nitrogen mustard and outline its cross-linking of DNA 5. draw the structure of cisplatin and outline its cross linking of DNA strands 6. describe the action of "cutting" agents 7. understand the structures of t-RNA, m-RNA and r-RNA 8. describe the action of drugs on RNA 9. discuss drugs related to nucleic acid building blocks 10. draw the structures of acyclovir and AZT and briefly describe their mechanisms of action			Synthesis of Oil of Wintergreen		Salicylic acid methanol etc
	General Objective 6: Understand drug discovery and development					
8 - 9	1. Discuss the screening of natural products to find new drugs 2. describe the exploitation of medical folklore 3. describe the screening of synthetic "banks" of compounds 4. discuss starting from a known ligand such as a			Resolution of alpha-phenethylamine		racemic alpha-phenethylamine (+)-tartaric acid etc

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	hormone 5. discuss the role of serendipity and the prepared mind 6. understand the saying that "drugs are discovered in the clinic" 7. discuss structure-activity relationships and the binding role of: hydroxyl groups, amino groups, aromatic rings, double bonds, carbonyl groups, and amides 8. define isosteres and give examples 9. discuss drug design to: increase activity, reduce side-effects, improve pharmacokinetics (absorption, metabolism and excretion), improve synthesis and factory production 10. discuss the variation of substituents in drug development 11. discuss chain extensions and contractions 12. discuss ring expansions and contractions 13. discuss isosteric replacements, discuss rigidification of the structure					
	General Objective 7: Understand pharmacokinetics					
10 - 11	1. Outline how drug uptake, distribution, metabolism and excretion affect the ability of a drug to reach its target 2. discuss the design of drugs to influence their: chemical stability and metabolic stability 3. discuss drug design to optimise distribution by			Synthesis of a variety of semi-synthetic penicillins		6-amino penicillanic acid a variety of acyl chlorides etc

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	changing the balance of: hydrophobicity, hydrophilicity, charge, polarity 4. discuss the design of drugs to confer resistance to chemical hydrolysis and metabolic transformations 5. describe some methods of targeting drugs to their ste of action 6. describe some examples of prodrugs and how they work 7. discuss common methods of administration of drugs 8. discuss the formulation of drugs					
	General Objective 8: Describe opium analgesics and their interaction with opiate receptors					
12 -13	1. Describe the development of narcotic analgesics as an example of traditional medicinal chemistry 2. describe the isolation of morphine 3. discuss the structure and properties of morphine 4. discuss structure-activity relationships of morphine 5. discuss variation of substituents 6. discuss simplification and dissection 7. describe rigidification 8. discuss extension of the molecule 9. Discuss receptor theories of the opium analgesics			thiamine catalysed formation of benzoin from benzaldehyde		thiamine benzaldehyde, other chemicals Glassware

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	(Beckett-Casy Hypothesis and multiple receptor theories) 10. describe agonists and antagonists 11. describe the discovery of enkephalins and endorphins.					
	General Objective 9: Describe the discovery and development of transition state inhibitors of HIV-1 protease					
14 - 15	1. Understand (revise) the mechanism of pepsin catalysed hydrolysis of peptide bonds. 2. Understand (revise) the mechanism of pepstatin inhibition of the catalysed hydrolysis 4. Describe the extensions of these results to the design and investigation of transition state analogue inhibitors for other aspartyl proteases such as Renin 5. Describe the appearance of a new disease, AIDS, in the late 1970 - early 1980s 6. Describe the discovery of the HIV virus in Paris by Luc Montagnier in 1983 7. Describe the discovery of the enzyme HIV-1 protease, its function and mechanism of action describe the design of transition state analogue inhibitors for HIV-1, their structures, mechanism of action, advantages and disadvantages 8. describe the development of improved analogues leading up to the drugs used in the clinic such as: Saquinavir, ritonavir, Indinavir, nelfinavir and Amprenavir.	lectures and tutorials	Classroom resources	Inhibition of enzyme catalysis by small molecule inhibitors	Guide students	suitable enzymes e.g. pepsin, chymotrypsin, phosphotase and their substrates and inhibitors

Assessment:

10% Test 40% Practical, 50% Exam

Textbooks:

Graham L. Patrick, An introduction to medicinal chemistry (3rd edition) Oxford University Press, 2005

A. Wlodawer and J. Vondrasek, Inhibitors of HIV-1 protease: a major success of structure assisted drug design. Annu Rev Bioph Biom vol 27 (1998) pages 249-284.

Course: Physical Chemistry IV (Electrochemistry and Photochemistry)

Department/ Programme: HND Chemistry			
Subject/Course: Physical Chemistry IV (Electrochemistry and Photochemistry)	**Course Code: STC 422**	**Credit Hours:**	**5**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Understand the behaviours of ions in solution

2. Understand the nature of electrochemical cells

3.Understand the phenomenon of ion transport and molecular diffusion.

4.Understand photochemical reactions

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1:0 Understand the behaviours of ions in solution.					
1	1.1 Define the following - activity, activity coefficient and the mean activity coefficient of ions in solution. 1.2 Describe the ionic atmosphere. 1.3 State the role of ionic atmosphere in determining the value of the mean activity coefficient. 1.4 State the form of a shielded coulomb potential.	Explain and illustrate with relevant examples.	Classrooms resources " " "	Determination of thermodynamic solubility product and mean activity coefficient of silver acetate	Provide the laboratory manual - Prepare 40cm^3 0,0.1, 0.3,0.5, 0.75 1mol/dm^3 potassium nitrate. - Provide silver acetate salt, standard ammonium thiocyanate solution for titration - Iron (iii) ammonium sulphate as indicator	Boiling tubes Weighing balance Stoppers for the tubes Thermometer Filtration apparatus Pipettes Burettes Beakers
2	1.5 Define ionic strength. 1.6 State and derive the Debye-Huckel limiting law for the mean activity coefficient. 1.7 Explain how the Debye-Huckel limiting law may be extended to more concentrated solutions. 1.8 Define the electrochemical potential of an ion.	Derive the Debye-Huckel limiting law and ask students to do so. Lecture "	Classroom resources " " "	Measurement of potential difference generated by electrochemical cells.	Provide the manual Prepare 1 mol/dm^3 copper sulphate, 1mol/dm^3 zinc sulphate 0.1/mol/dm^3 silver nitrate Saturated 3mol/dm^{3}potassium nitrate	Safety spectacles, copper foil zinc foil Silver wire Emery paper 50cm^3 beakers Connecting leads Crocodile clips Filter paper Voltmeter

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
3-4	1.9 Derive an expression for the potential difference across an interface in terms of the standard potential difference and the activity of ions. 1.10 Derive an expression for the potential difference across a gas/inert metal electrode. 1.11 Derive an expression for the potential difference across a metal/insoluble salt/ion electrode. 1.12 Describe the construction of metal/insoluble salt/ion electrode. 1.13 Derive an expression for the potential difference at a redox electrode (oxidation potential). 1.14 Obtain Ecell from data using the expression in 1.14 above.	Lecture and give assignment. " " " "	" " " "	Determination of transport number of ions by molar conductivity measurements	Provide the laboratory manual - Prepare 1mol/dm^3 potassium hydroxide {to be diluted by students to 0.35,0.5, 0.6,0.8 mol/dm^3)	100cm^3 volumetric flasks De-ionised water Pipettes Burettes Conductivity meter Beakers
5-6	1.15 Describe the formation of a liquid junction potential. 1.16 Derive an expression for the potential difference across a membrane. 1.17 Describe the construction of a cell with a liquid junction and a cell without a liquid junction.	" " "		Determination of dissociation constant and Gibbs free energy by conductivity measurement	Provide the laboratory manual - Prepare 1mol/dm^3 potassium hydroxide to be diluted by students to different concs. 0.8 - 0.1mol/dm^3	100cm^3 volumetric flasks Do ionised water Measuring cylinder Conductivity meter Beakers -Pipette

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 2:0 Understand the nature of electrochemical cells.					
7	2.1 Define thermodynamic reversibility of an electrochemical cell. 2.2 Define electrode potential and describe the sign convention. 2.3 Relate the e.m.f of a cell to the spontaneous direction of change of the cell reaction. 2.4 Define the term standard e.m.f. 2.5 Derive the Nernst equation for the concentration dependence of the e.m.f. of a cell.	Explain and illustrate with relevant examples. Ask students relevant questions to determine their learning outcome. " " "	Classroom resources " " "	Investigation of the effect of changes in silver ion concentration on the potential of the silver electrode	Provide the lab. Manual Prepare 3mol/dm^3 potassium nitrate imol/dm^3 copper sulphate silver nitrate solutions (0.1 - 0.000 1mol/dm^3 apparatus for the cell: Cu(s) /cu^{+2} 1.0mol/dm^3: Ag^+ xmol/dm^3/Ag(s)	safety spectacles Copper foil Silver wire Beakers (50cm^3), strips of filter paper Voltmeter (high resistance) Connecting leads Crocodile clips
8	2.6 Relate the standard e.m.f. to the equilibrium constant of the cell reaction. 2.7 Describe the method of measuring standard electrode potentials. 2.8 Describe the measurement of activity coefficients.	"		Determination of the corrosion profile and susceptibility of Aluminium in two types of environment (NaCl and $H_2 S0_4$)	Provide the lab manual Demonstrate the experiment -Provide sodium chloride solution, sulphuric acid.	Ammeter Aluminium plates -1000cm^3 beaker Nitrogen gas Delivery tubes electrodes Potentiometer
9	2.9 Relate the temperature dependence of the e.m.f. to the entropy of a cell reaction. 2.10 Define solubility product and	Lecture "	Classroom resources	Determination of the rate constant and energy of activation of the saponification of ethyl acetate by conductivity	Provide the manual Prepare 0.02 mol/dm^3 of ethyl	100m/volumetric flask

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	deduce its value from e.m.f. data. 2.11 Describe the electrochemical basis of a potentiometric titration. 2.12 List the applications of electrochemistry e.g. corrosion, protection etc.	" "		measurement.	acetate. 0.02mol/dm^3 of sodium hydroxide	Thermostat (30^0c) Stopwatch Conductivity mater Measuring cylinder Beakers ($250cm^3$) Conical flasks ($250cm^3$) Thermometer
	General Objective 3:0 Understand the phenomenon of ion transport and molecular diffusion.					
10	3.1 Define conductivity and molar conductivity of solutions. 3.2 Explain how conductivity and molar conductivity of solutions can be measured. 3.3 State Kohlransch's law of independent migration of ions. 3.4 Calculate the molar conductivity of a solution using 3.4 above. 3.5 State Oswald's dilution law. 3.6 Use 3.6 to calculate the molar conductivity of weak electrolytes	Lecture " " Lecture and conduct tutorials " " " "	Classroom resources " " " " " " "	Investigation of the replacement of metallic copper by silver ions	Prepare and provide manual for the exp. - Prepare 0.1mol/dm^3 silver nitrate solution	$100cm^3$ beaker Copper wire Sand paper Test tubes Balance Stop watch Filter paper Watch glass Wash bottle

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	using Oswald's dilution law. 3.7 Define the drift velocity and the mobility of ions. 3.8 Relate molar conductivity to ion mobility. 3.9 Define the transport number of an ion.					Bunsen 250cm^3 Conical flasks
11	3.10 3. List the factors that affect the mobility of ions. 3.11 State the basis of the Debye-Huckel - Onsager equation. 3.12 Define a thermodynamic force. 3.13 Derive the diffusion equation and use it to describe the diffusion of a solute into a solvent.	Explain and illustrate with appropriate examples. " "	Classroom resource " "	Measure the transport number of an ion.	provide lab manual Guide students during the laboratory	Conductimiter
	General Objective 4:0 Understand photochemical reactions.					
12	4.1 Explain the influence of light on chemical system. 4.2 Define quantum yield efficiency. 4.3 Calculate the quantum yield efficiency of a photochemical reaction from a given data.	Lecture " "	Classroom resources "	Construction of a calibration curve for quinine	Provide: 0.05mol/dm^3 sulphuric acid standard solutions of quinine Demonstrate the operation of the fluorimeter	Fluorimeter or spectro-fluorimeter Balance volumetric flasks Measuring cylinder Burette 100cm^3 Beakers

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
13	4.4 Derive rate laws for a given photochemical reaction.	" "	" "	Determination of the amount of quinine in samples of tonic water	As above Prepare 1mol/dm^3 of sulphuric acid	As above Bottles of tonic water
14	4.5 Define photo stationary state. 4.6 Define fluorescence, phosphorescence and chemiluminiscence. 4.7 State the importance of photosensitized reactions.			Determination of cadmium in drinking water by fluorimetry	varying concs. of cadmium 0.5mol/dm^3 sodium hydroxide Glacial acetic acid.	Balance 95% ethanol 2-(2-hydroxy-phenyl) benzoxazole Hydrated cadmium sulphate Conical flasks (250cm^3) Thermometer
15				Determination of codeine and morphine in dilute sulphuric acid and dilute sodium hydroxide	Provide the lab. Manual 0.05mol/dm^3 sulphuric acid 0.1mol/dm^3 sodium hydroxide - Codeine/ morphine mixture in 0.05mol/dm^3 sodium hydroxide	Sintered glass crucible Buffers Oven Fluorimeter Sodium tartarate Stop watch Ammonium tartarate

Assessment:

Practical work 40%, Continuous Assessment 10%, Semester Examination 50%.

Recommended Textbooks:

Atkins' Physical Chemistry by Peter Atkins and Julio de Paul, published by Oxford University Press 7th Edition 2002

Course: Natural Products and Stereochemistry

Department/ Programme: HND Chemistry			
Subject/Course: Natural Products and Stereochemistry	**Course Code: STC 423**	**Credit Hours:**	**5**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Understand the different forms of spatial arrangement of atoms in molecules and differentiate between the various types of stereoisomers
2. Understand the sources and chemistry of some natural products.
3. Discuss the extraction of steroids" from yams and their conversion by partial synthesis into medically important steroid drugs

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1:0 Understand the different forms of spatial arrangement of atoms in molecules and differentiate between the stereoisomer					
1	1.1 Explain the concept off isomerism. 1.2 Explain the following forms of stereoisomerism: (a) conformational isomerism (b) cis-trans isomerism in alkenes (c) enantiomorphism 1.3 Define chirality. 1.4 Explain the interconvertability of conformers and the non-interconvertability of enantiomers (except via chemical reactions)	Lecture and demonstrate to students the various isomers of a compound using molecular models	Chalkboard, chalk. Molecular models	Measure angle of rotation of an optically active compound experimentally.	Direct students to measure the angle of an optically active compound.	Polarimeter, optically active substance.
2	1.5 Explain optical activity of enantiomers. 1.6 Define specific rotation. 1.7 Write equation for calculating specific rotation. 1.8 Describe parameters that affect specific rotation.			Interconversion of Geometric isomers: Isomerisation of maleic acid to fumaric acid		maleic acid, hydrochloric acid, reflux and filtration apparatus melting point apparatus

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	1.9 Define absolute configuration. 1.10 List notations used in absolute configuration.					
3	1.11 Define racemic mixture. 1.12 Explain racemic resolution. 1.13 Explain diastereisomerism. 1.14 Write the equation for the number of stereoisomers in a given compound.			Isolation of limonene from orange peel		orange peel apparatus for steam distillation water
4	1.15 Describe meso forms. 1.16 List example of meso forms. 1.17 Know that chiral compounds can not be synthesised from achiral compounds 1.18 Know that reaction of a pure enantiomer with an achiral reagent may give rise to a mixture of diastereoisomers in which one diastereoisomer predominates 1.19 Understand that the process involved above may result from steric effects as the reagents interact.			Perform a chemical reaction with retention of stereochemistry: Conversion of L-phenylalanine into L-3-phenyllactic acid.		Fume hood L-phenylalanine $NaNO_2$, sulphuric acid ether hexane glassware etc

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
5	1.20 Discuss the phenethanolamines, their extraction from "Ma Huang" and other species of Ephedra 1.21 Discuss the stereochemistries of the various phenethanolamines and their medical uses.			Demonstrate that the syn addition of bromine to a substituted alkene has stereochemical consequences	Guide students in the Reaction of fumarate with bromine and use the melting point of the product to establish that the addition was syn	Fumaric acid, sodium hydroxide, bromine, dichloromethane, hydrochloric acid glassware etc.
	General Objective 2:0 Understand the sources and chemistry of some natural products.					
6	2.1 Discuss what chemists mean by the term "Natural Products" 2.2 Describe, in brief outline, the history of the exploitation of natural products. 2.3 Discuss primary and secondary metabolites 2.4 Discuss some of the more important reactions used by nature in constructing natural products (e.g. oxidation, reduction, carbon-carbon bond forming reactions)	Explain and ask relevant questions	Chalkboard, chalk. "	Extract natural products from a named plant.	Guide collection of plants from immediate environment and guide extraction	Wheaton soxhlet extractor.
7	2.5 Describe the role of cofactors in the biosynthesis of natural products 2.6 Discuss the elucidation of biosynthetic pathways and the use of labelled precursors and metabolites 2.7 Describe the biosynthesis of fatty acids 2.8 Describe the biosynthesis and importance of prostaglandins and leukotrienes			Characterise the products from above by simple instrumental analysis		Infra-red spectrophotometer, UV spectrophotometer, nuclear magnetic, resonance spectrophotometer, mass spectrophotometer.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
8	2.9 Explain the meaning of alkaloids. 2.10 List alkaloids formed from plants and animal tissues. 2.11 Design a plan for the extraction of alkaloids from plant sources. 2.12 Describe the source, chemical structure, physiological activity and biosynthesis of ephedrine 2.13 Discuss the biosynthesis of selected alkaloids from ornithine and lysine	" "		Extract caffeine from tealeaves (or similar experiment)		
9	2.14 Discuss the biosynthesis and importance of nicotine 2.15 Discuss the biosynthesis and importance of the tropane alkaloids and cocaine			Extract alkaloids from cinchona bark (or other source) and identify by using tlc		solvents NaCO3 mineral acids solvents tlc reagents: Mayer's, Dragendorf's Hager's etc
10	2.16 Discuss the biosynthesis of selected alkaloids from phenylalanine and tyrosine 2.17 Discuss the biosynthesis and importance of:reticulene, thebaine, codeine and morphine 2.18 Describe the source, chemical structure, physiological activity and biosynthesis of quinine			Continue above experiment		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
11	2.19 Explain the meaning of Terpenes. 2.20 List broad classes of terpenes. 2.21 Outline the sources of terpenes. 2.22 Discuss the biosynthesis of monoterpenes from mevalonic acid and isopentenyl pyrophosphate 2.23 Discuss the import monoterpenes: alpha pinene, and thujone 2.24 Discuss the biosynthesis of: Sesquitrpenes, C_{15}; Diterpenes, C_{20}; Triterpenes, C_{30} and Steroids			Extract terpenes from a named plant.	Ask students to carry out extraction of terpenes from a named plant	Wheaton, soxhlet extractor.
12	2.25 Explain the meaning of steroids. 2.26 List the sources of steroids. 2.27 Explain the importance of steroids in the synthesis of sex hormones 2.28 Describe the characterisation of steroids with reference to dicyclic acetal side chain. 2.29 Describe the synthesis of sex hormones from a named steroid.	Lecture	Teaching Tools	Characterise the extracts above by spectroscopic methods - IR, NMR, UV, and Mass Spectrophotometer etc.	Guide students	Spectroscopic methods - IR, Nmr, UV, MS etc.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
13	2.30 Draw the structures of the following: Testosterone, Progesterone, Estrone, Stillbestrol, Cortocisterone, Aldosterone, Cortisone etc. 2.31 Explain the uses of steroids. 2.32 Synthesise sex hormones from named steroids	Lecture " "		Carry out of partial synthetic reactions on steroids starting from cholesterol or other inexpensive "steroid" E.g. oxidation of cholesterol to cholesterone and/or epoxidation of cholesterol etc		
	General Objective:3.0 Discuss the extraction of sapogenins from yams and their conversion by partial synthesis into medically important steroid drugs					
14	3.1 Discuss the expense of producing steroid drugs by total synthesis 3.2 Describe the search for natural sources of steroids from plants (to be used as raw materials for the synthesis of drugs) 3.3 Describe the discovery in yams of sapogenins with a "steroid-like" structure			Carry out partial synthetic pathways such as: Bromination cholesterol to give the dibromide followed by conversion into the delta-5-cholestene-3-one and then isomerisation to the delta-4-isomer. etc		
15	3.4 Describe the conversion of diosgenin, by partial syntheses, into progesterone and androstenedione 3.5 Describe the conversion of androstenedione into estrone. 3.6 Discuss the stereochemistry resulting at centres produced by the above reactions and introduce the concept of stereospecific and					

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	stereoselective reactions. 3.7 Give examples of stereoselective reactions in the organic chemistry of steroids					

Assessment:

Practical work 40%, Continuous assessment 10%, Assessment Examination 50%

Recommended Textbooks:

Chemical Aspects of Biosynthesis, John Mann, Oxford Chemistry primer - Oxford University Press 1994

Organic Chemistry of Drug Synthesis Volume 1, D.Lednicer and L.Mitscher, Wiley, 1977

Course: Food Chemistry and Brewing

Department/ Programme: HND Chemistry			
Subject/Course: Food Chemistry and Brewing	**Course Code: STC 424**	**Credit Hours:**	**4**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**2 hours/week** **2 hours /week**

GENERAL OBJECTIVES:

1. Understand the major classification of food and food preservation techniques
2. Know some basic biotechnology of food
3. Understand the chemical principles and processes involved in beer brewing

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1: Understand the major classification of food and food preservation techniques					
1	1.1 Classify Foodstuff In terms of origin of raw materials i.e. plant and animal sources. 1.2 List the raw material sources e.g. meat, fish and vegetables. 1.3 Describe some industries based on 1.2 above. 1.4 Describe some industrial processes of Food preservation i.e. freezing, sterilization, curing, canning, drying etc. 1.5 Describe industries based on further processing of products above: bread, confectionary, beverages, margarine, dairy products etc. 1.6 List some common food additives.	Lecture	Teaching Tools	Apply techniques in the preservation of food.	Guide the students through the preservation techniques	
2	1.7 Classify 1.6 above as colourants, flavours, preservatives, gelling and emulsifying agents, sweeteners etc. 1.8 Describe the significance of food additives. 1.9 List causes of food spoilage - bacterial, fugicidal via insects and enzyme activity. 1.10 Describe ways of prevention of food spoilage freezing, sterilization, drying etc.			Apply methods in controlling browning of foods	Assist the students to carry out the practical	Salts Hot, water

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
3	1.11 Explain the occurrence and significance of browning reactions in 1.12 Distinguish between enzymic and non- enzymic browning in foods 1.13 Describe the mechanism of browning reactions 1.14 Explain the various methods of controlling or inhibiting browning in foodsExplain the occurrence of carbohydrates in plant foods			Prepare jam and jelly from different fruits Measure jelly strength		Fruits (Mango, Pawpaw, Pineapple, Guava etc) Sugar
4	1.15 classify the different carbohydrates found in food 1.16 Explain the preparation of syrup from invert sugar 1.17 Explain the various types of polysaccharides - starch, celluloses, pectic substances, gums and mucilages and their significance in the food industry 1.18 Describe the use of carbohydrates as sweeteners and functional ingredients 1.19 List the factors influencing the choice of sweetners in the confectionery industry			Determine the gelatinisation temperatures of different carbohydrate foods	Assist the students to carry out the practical	Citric acid Lime Pectin, Juice extractor/ Pulper Refractometer PH meter Gelo meter

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
5	1.20 List & explain the properties of starches 1.21 Explain the phenomenon of starch gelatinisation and retro gradation 1.22 Explain the significance of starch gelatinisation and retro gradation in food processing 1.23 List and explain the properties of carbohydrates			Isolate and identify different amino acids using chromatography		
6	1.24 List and explain the significant properties of amino acids and proteins 1.25 Classify proteins found in plant and animal foods 1.26 List the main limiting amino acids found in plant and animal foods 1.27 Determination of proteins in food 1.28 Explain the role of proteins in food processing 1.29 List and classify naturally occurring lipids 1.30 distinguish between fats and oils			Fractionate and isolate proteins in foods (milk egg, meat, flour, soybeans etc)		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
7	1.31 Explain the physical and chemical properties of edible fats and oils 1.32 Explain the determination of fats and oils in foods 1.33 Describe the processing of fats and oils into different foods products 1.34 Explain the mechanism of fat rancidity 1.35 Explain the causes of fat rancidity and its effect on food quality 1.36 Explain the prevention and inhibition of fat rancidity in the food industry 1.37 Explain the term reversion of fats and oil and its significance in the food industry			Determine the physical and chemical properties of fats and oils Density, Refractive index, melting point, colour Peroxide value, saponification value, iodine value, TBA value		
8	1.38 Explain the importance of colour in the quality evaluation of foods 1.39 Classify various colouring pigments found in food 1.40 List permitted colouring matter 1.41 Describe the changes in food pigments during cooking and processing 1.42 Describe the different methods of measuring colour of foods (Hunter, Munsell and CIE SYSTEMS)			Determine the value of colour from different foods using CIE L* a* b* system	Demonstrate to the students how to read L* a* b* value from the instrument	Colour meter spectro photometer

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
9	1.43 Explain the role of NAFDAC in regulating the food industry. 1.44 List the quality control methods applicable to the industry as mostly in-process.			Apply the quality control methods to determine the following in food: Carbohydrates Moisture Fat Protein Trace elements Water soluble vitamins Fibre	Guide the students through the Practical/laboratory application by the listed food	Deep freezer Autoclave Cabinet drier Can seamer Oven Soxhlet apparatus Kjeldahl apparatus Atomic absorption spectrophotometer Spectroflourimeter Muffle furnace
	General Objective 2 Know some basic biotechnology of food					
10	1 Explain the term biotechnology 2 Give a brief history of biotechnology 3 Explain the significance of biotechnology in the food industry 4 List the major enzymes used in food and in the food industry 5 Classify the enzymes listed in 6.4			Chemically conjugate enzymes to solid phase and apply to examples from the food industry		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
11	6 Explain the significance of the various classes of enzymes in the production of food products 7 Explain enzyme immobilization 8 Explain the application of immobilized enzymes in food industry 9 Explain the importance of enzymes in food analysis.					
	General Objective 3: Understand the chemical principles and processes involved in beer brewing					
12	3.1 List raw materials use in beer brewing. 3.2 State why starch is the useful chemical constituent of the raw materials above. 3.3 List local sources of starch for beer brewing. 3.4 Describe methods of extraction of starch from the raw materials listed above. 3.5 Explain how starch based glucose syrup is produced by the methods above.	Lecture	Teaching Tools	Extract, in the laboratory, starch from a readily available raw material.		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
13	3.6 Define the term "fermentation". 3.7 List enzymes used in brewing of beer. 3.8 Explain how fermentation of glucose syrup leads to the production of beer. 3.9 Describe limited and complete fermentation reactions.			Prepare, in the laboratory, glucose syrup from starch	Guide the students through the Laboratory production of beer using local raw materials	Starch, yeast, glass ware Fermentation trough Fermenter
14	3.10 List industrial applications of 2.8 above. 3.11 Describe commercial extraction, purification, storage and recovery of enzymes/yeast. 3.12 Outline the processes of production of beer.			Produce beer in the laboratory		
15	3.13 Describe the chemical and biochemical techniques in the quality control of beer.	Laboratory application of the quality control techniques in the laboratory		Apply chemical and biochemical techniques in the quality control of beer	Assist students to carry out laboratory application of the quality control techniques in the laboratory	Refractmeter Hydrometer pH meter

Assessment:

Coursework/ Assignments 10%; Practical 40 %; Examination 50%

Recommended Textbooks & References:

Food: The Chemistry of Its Components (3rd Edition), T.P.Coultate, Royal Society of Chemistry, 1996

Ihekoronye, A.I and Ngoddy, P.O. "Integrated Food Science and Technology for the Tropics" Macmillan Publishers, London and Basingstok.

Course: Forensic Biochemistry

Department/ Programme: HND Chemistry			
Subject/Course: Forensic Biochemistry	**Course Code: STH 422**	**Credit Hours:**	**4 Hours**
Year: 2 Semester: 2	**Pre-requisite:**	**Theoretical:** **Practical:**	**1 hour/week** **3 hours /week**

GENERAL OBJECTIVES:

1. Understand the metabolism of foreign compounds (Xenobiotics) in the body.

2. Understand the analysis of materials of forensic interest.

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1.0: Understand the metabolism of foreign compounds (Xenobiotics) antibody.					
1 - 3	Metabolism of foreign compounds in the blood. 1.1 Describe drugs as foreign chemical compounds in the system. 1.2 Classify drugs as acidic, basic and neutral. 1.3 Explain the role of the liver enzymes in foreign compound metabolism. 1.4 Describe the characteristics of foreign compound metabolizing enzymes. 1.5 Explain the role of the smooth Endoplasmic recticulum in foreign compound metabolism. 1.6 Explain the two phases in the metabolism of foreign compounds (phase I and II). 1.7 Explain phase I as involving the modification of the drug via oxidation and reduction reactions.	Illustrative lectures. " " " " "	Teaching tools. " " " " "	Identify drugs using TLC, U.V. & I.R. spectroscopy. Carry out qualitative tests on different drugs.	Assist students to carry out practicals. Guide students to Carry out analysis of drugs using TLC, UV, and IR.	Chemicals drugs solvents tlc equipment spectrometers synthetic urine etc
4 - 6	1.8 Explain Phase II as dealing with the conjugation of Phase I products mainly into water extractable products e.g. glucoronides, sulphates, etc. 1.9 Explain how metabolism of a drug may enhance or lower the harmful effect of a drug or make an innocuous compound harmful. 1.10 Explain how the effect (metabolism) of a drug in the system depends on such factors as the structure of the compound route of administration, sex and strain and species of animal, presence of other chemicals, diet etc. 1.11 Explain the terms: toxicity, carcinogenicity, mutagenicity teratogenicity etc.	Illustrative lectures. " " " "	Teaching tools. " " " " Audio visual	Carry out Urine analyses after administration of different drugs	Urine analysis practical/ extraction.	

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	1.12 Explain the effects of drugs on tissues in terms of 1.11 above. 1.13 Describe the various routes of excretion of drugs and their metabolites (breakdown products) e.g exhaled air, sweat, saliva, urine, bile and other body fluids. 1.14 Explain the importance of the study of rate of urinary excretion of drugs in forensic science. 1.15 Explain drug-drug interactions in the body.	Illustrate lecture " " "	Teaching tools " "	Extract drugs from biological tissues and identify by tlc etc		.
	General Objective 2.0: Understand Analysis of Materials of forensic interest.					
7 - 9	**<u>Materials of Forensic interest</u>** 2.1 Explain forensic science. 2.2 Describe the collection, preservation and forwarding of materials of forensic interest to the laboratory. 2.3 Explain the need for proper storage of materials for forensic analysis. 2.4 Explain the importance of preserving some portions of a sample for further reference. 2.5 Describe the duties of the toxicologist. 2.6 Describe the various groups of poisons. 2.7 Explain the methods of extraction and identification of compounds of forensic interest. 2.8 Describe the extraction and identification of poison and drugs. 2.9 Explain metallic poisoning, indicating where they are deposited in the body.	Illustrate lectures. " " " "	Teaching tools. " " " "	Practical extraction. Food test. Monitor contaminants in foods and beverages. Extract poison from a formulated sample Practical spot tests on metallic poisoning.		Contaminated food and beverages, testing materials

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
10	2.10 Describe the methods of extraction and specific identification of 2.9 above. 2.11 Describe blood groups and rhesus factors. 2.12 Explain blood group typing.	Lecture.		Carry out blood group typing tests	Practical blood group test.	
11 - 12	2.13 Explain parentage dispute. 2.14 Describe the use of blood group in 2.13 above. 2.15 Describe the various types of body fluids. 2.16 Describe qualitative methods of identification of blood strains, urine and saliva. 2.17 Describe various presumptive (preliminary) tests employed on body fluids (e.g. blood; saliva, serum) before specific confirmatory tests. 2.18 Explain species identification for blood strain. 2.19 Carry out test on blood stains, saliva, smina stains and species identification.	Lecture "	Teaching tools " "	Carry out analysis on blood group, Carry out qualitative identification of blood strains, urine and saliva.		
13	2.20 Define hard drugs. 2.21 Classify hard drugs. 2.22 Describe spot test for drugs of forensic interest. 2.23 Describe methods of purification of such hard drugs. 2.24 Describe standard confirmatory methods of analysis of hard drugs.		"	Type blood stains and other stains.		

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
14 -15	2.25 Compare results obtained in 2.23 above with the normal level (data) set by Nigerian standards organization, food and Drug administration (FDA) and World Health Organisation (WHO) and similar bodies. 2.26 Make proper deductions from all available data. 2.27 Build up result/data banks for future references. 2.28 Explain presentation pattern of work reports. 2.29 Explain why the analyst must report only his findings.	Illustrative lecture " " "	Teaching tools " "	Carry out forensic tests on blood stains (dried and fresh)		

Assessment:

Give details of assignments to be used:
Coursework/ Assignments 10 %; Practical 40%; Examination 50%

Recommended Textbooks & References:

(1) Forensic Medicine by Keith Simpson.
(2) Introduction to Clinical Chemistry by Derek A. Woodrow.

Course: Higher Practical Project and Seminar

Department/ Programme: HND Chemistry			
Subject/Course: Higher Practical Project and Seminar	**Course Code: STC 426**	**Credit Hours:**	**9**
Year: Semester:	**Pre-requisite:**	**Theoretical:** **Practical:**	**1 hours/week** **8 hours /week**

GENERAL OBJECTIVES:

Students should be able to:

1. Select, with the help of lecturers, a laboratory based topic for investigation.

2. Decide, with the help of a lecturer, on an experimental investigation in that area.

3. Carry out a literature review of the topic, paying particular attention to the area selected for investigation.

4. Prepare a seminar on the proposed investigation

5. Give the seminar and defend the proposed investigation when questioned by the participants in the Seminar

6. Perform, under the supervision of lecturing staff, the experimental investigation over the course of the Semester. Drawing conclusions and making suggestions for developing the research as the work proceeds

7. Write a full project report in scientific format consisting of: (i) A free standing Abstract, (ii) Introduction, (iii) Methods (or Experimental), (iv) Results, (iii) Discussion, (iv) References.

8. Prepare a seminar on the investigation, the results found, the conclusions drawn and proposals for further investigations.

9. Give the seminar and defend the investigation when questioned by the participants in the Seminar

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 1 Select, with the help of lecturers, a laboratory based topic for investigation					
1	Students are able to 1. Understand the process of carrying out a research project and seminar. 2. Explain the characteristics of a good project/research investigation 3. List the different components of a research/project work 4. List the factors considered in selecting a project/research problems 5. Select a topic for investigation	Explain the process by using the general objectives 1-9 above. Provide a list of proposed investigations and help students choose one.	Cooperation of all lecturers, list of topics, classroom resources			
	General Objective 2: Decide, with the help of a lecturer, on an experimental investigation in that area					
2	With help from the lecturer students: 1. Understand the topic and areas suitable for experimental investigation. 2. Select the area of the topic and design experiments for the investigation	Discuss the topic and areas for investigation design experiments for the student	Expertise of the Lecturer Desk chairs paper and pen or pencil			

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 3: Carry out a literature review of the topic, paying particular attention to the area selected for investigation					
3	1. Read relevant books and papers 2. Make relevant notes 3. Understand how the proposed investigation complements the existing literature	Check that students understand relationship between existing knowledge and the proposed investigation	Quiet areas for talking			
	General Objective 4: Prepare a Seminar on the proposed investigation					
4	1. Students understand how to prepare for presenting a seminar. 2. Students prepare for the seminar	Revise how to prepare a seminar (refer to the Technical English course) and Guide students through their preparation	Classroom and Library	Students begin relevant experiments e.g. analysis, synthesis, measurement, observations, data collection etc		Laboratory resources, glassware, chemicals, meters, instruments spectrometers etc
	General Objective 5: Give the seminar and defend the proposed investigation when questioned by the participants in the Seminar					
5	1. Student gives a seminar on the proposed topic 2. Student answers questions from the audience 3. Student adjusts proposed project in light of comments made during the seminar	Attend seminar, ask questions designed to challenge and improve project, note helpful comments from the audience	Seminar room Overhead projector and acetates	Students continue relevant experiments e.g. analysis, synthesis, measurement, observations, data collection etc		Laboratory resources, glassware, chemicals, meters, instruments spectrometers etc
	General Objective 6: Perform, under the supervision of lecturing staff, the experimental investigation over the course of the Semester. Drawing conclusions and making suggestions for developing the research as the work proceeds.					
6 - 12	1. Students can work under GLP conditions, keeping notebook and writing up experiments in a second lab notebook (both notebooks hard bound) 2. Students begin to draft their report beginning with the Introduction then methods then results and, at a late stage their conclusions	Advise and Guide students Make sure students are writing up as they go along and begin to write the final report at about week 7.		Students continue experiments and data collection	Guide and supervise students. Review results regularly making sure that students understand them and draw appropriate conclusions.	Laboratory resources, glassware, chemicals, meters, instruments spectrometers etc

Theoretical Content				Practical Content		
Week/s	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Resources**
	General Objective 7: Write a full project report in scientific format consisting of: (i) A free standing Abstract, (ii) Introduction, (iii) Methods (or Experimental), (iv) Results, (iii) Discussion, (iv) References					
13	1. Students complete and submit a full project report in the layout of a Scientific report. 2. Students Write an Abstract that stands alone and does not refer to the body of the report 3. Students know the report consists of an Introduction, Methods (or Experimental), Results, Discussion and References. (The Results and Discussion may be combined as Results and Discussion).	Revise how to prepare a seminar (refer to the Technical English course) and Guide students through their preparation				
	General Objective 8. Prepare a seminar on the investigation, the results found, the conclusions drawn and proposals for further investigations.					
14	1. Students understand how to prepare for presenting a seminar. 2. Students prepare for the seminar	Revise how to prepare a seminar (refer to the Technical English course) and Guide students through their preparation				
	General Objective 9 Give the seminar and defend the investigation when questioned by the participants in the Seminar					
15	1. Student gives a seminar on the proposed topic 2. Student answers questions from the audience	Attend seminar, ask questions	Seminar Room, overhead projector and acetates			

Assessment:

Give details of assignments to be used:
Seminars 20%; Practical 40 %; Final Report 40%;

Recommended Textbooks & References:

Scientific Journals (particularly reviews)