NCE CHEMISTRY

1. PHILOSOPHY

The intrinsic and utility values of Chemistry in all spheres of human activity necessitated its inclusion in the NCE curriculum. Consequently, the teaching and learning of Chemistry should be such as to produce competent teachers that can transmit these values to the learners.

2. OBJECTIVES

The objectives of chemistry programme at the NCE level are to produce highly qualified middle-level manpower knowledgeable in the processes of Chemistry and capable of inculcating these in the students. Students should have competencies in chemistry teaching including ability to:

i) develop functional knowledge of chemistry concepts and principles;
ii) observe and explore the chemical environment;
iii) apply the skills and knowledge gained through the study of chemistry to solve day-to-day problems;
iv) explain simple natural phenomena;
v) develop scientific attitudes such as curiosity, objectivity, creativity etc.
vi) manipulate simple apparatus and use of chemicals for purposes of demonstration, production and;
vii) improvise simple equipment from available junk in the local environment

3. GENERAL ADMISSION REQUIREMENTS

a) Senior Secondary School Certificate of WAEC or NECO or any other equivalent Certificate from recognized examination bodies with credit passes in five (5) subjects including English Language and Mathematics at not more than two sittings. Two of the credits must be in chemistry and physics.

b) A Grade II Teacher's Certificate (TC II) with credit or merit in five (5) subjects, two of which must be in general science and agricultural science. Credits/Merits in English Language and Mathematics are required for candidates wishing to study Chemistry.

c) d) All candidates wishing to be considered for direct admission must meet the requirements of a selection examination organized by an accredited body such as JAMB

e) It should be noted that some colleges may in addition to all the above, administer their own elimination tests and/or interviews for some courses. This is legitimate.

FACILITIES

a) i) An Air-conditioned Laboratory (Dimension: 18 x 8 and 20 x 8 sq. meters)
The Department of Chemistry with 50 students or less in each year would need a minimum of one standard laboratory with the following items:
a) Fume cupboard
b) Air-conditioned preparatory room attached to the laboratory

c) A weighing balance room
d) Spacious chemical store attached to the preparatory room
e) A bulletin boards
f) Two adjoining classrooms each accommodating at least 50 students. Colleges admitting more than 50 students would need additional laboratories.

ii. Staff Offices

Each Senior Staff should have a comfortably furnished office to himself/herself. There should also be an office for support staff (Typist, Clerks) with relevant equipment, e.g. Typewriters, duplicating machine, photocopier, computer and printer.

iii. Books in the Departmental mini - Library

There must be enough books to cover all the areas of Chemistry in the ratio of at least ten book titles to one (1) student.

b) EQUIPMENT

Apart from the routine standard equipment and materials required for the teaching and learning of chemistry, the following items of equipment are also required and in numbers that will be adequate for the number of students:

a. Mettler balance,
b. Top loading balance,
c. Thermostat,
d. Water bath,
e. Centrifuge. (Hand and Electric),
f. Oven, hot plate and heating mantle,
g. Steam bath,
h. Magnetic stirrer,
i. Suction pump,
j. Circulating water pump,
k. Soxlet extractor,
l. Rotator evaporator,
m. Calorimeter,
n. pH meter,
o. Constant water supply
p. First aid box and water shower for acid bath,
q. Victor Meyer's apparatus for measuring vapour density,
r. Conductivity meter,
s. Water distiller,
t. Spectrophotometer and colorimeter
u. Kedjahl Digestion flask,
v. Kedjahl Distribution Apparatus,
w. Chromatograph tank.
x. Fume cupboard
y. Muffle Furnace

c) **ESSENTIAL NEEDS**
Constant supply of (i) water (ii) electricity and (iii) gas.

d) **SUPPLY OF CHEMICALS**
Chemistry teaching involves the use of chemicals that would need to be replenished. There is therefore, the need to provide adequate potent chemicals/reagents for the experiments specified in the curriculum.

5. **PERSONNEL**

a) **Academic Staff**
Minimum of eight (8) academic staff with at least the following qualifications in chemistry is required:
B.Sc. (Hons) with Second Class lower plus PGDE
B.Sc. (Hons) Second Class Lower plus NCE/PGDE
B.Sc. (Ed) Second Class Lower

b) The Head of the department should have at least Master's degree and he/she must be a senior lecturer

6. **SUPPORT STAFF**
One qualified chemistry Laboratory Technologist (HND), one Laboratory Assistant (OND) and two Laboratory Attendants (SSSC)
One typist/computer operator and clerical officer, one messenger and cleaner.

7. **WORKLOAD FOR ACADEMIC STAFF**: A minimum of 3 credits per semester

8. **MODE OF TEACHING**
A teacher of chemistry should be aware and familiar with various teaching methods available. This will enable him/her to use any method or a combination of methods he/she finds appropriate in his special circumstance and setting. A combination of the following methods is recommended.

a. Discussion
b. Activity-Based Learning
c. Demonstration
d. Lecture
e. Project
f. Tutorial
g. Field trips
h. Games and simulation
i. Concept mapping
j. Computer Assisted Instruction

9. **GRADUATION REQUIREMENT**

Chemistry	-	24	Credits
Second Teaching subjects	-	24	Credits
Education including TP	-	30	Credits
General Study	-	16	Credits
Total		**94**	**Credits**

10. **TEACHING PRACTICE**

Teaching Practice is compulsory for **all** students to graduate. Teaching Practice earns 6 credits under Education 311

11 ***ASSESSMENT AND CERTIFICATION**: For theory-based courses CA=40% and Examination=60% and for practical courses, CA=60% and Examination=40%. CA is to be administered as quiz (written and/or verbal) and take-home assignments.

12. **PROJECT**
The final year Project is compulsory for all final year students. The project may be written in any of the subjects offered by the students and credited to EDU 323. Project earns 2 credits.

13. **CHEMISTRY COURSE CODES, TITLES CREDIT UNITS AND STATUS**

NCE YEAR 1 - FIRST SEMESTER

COURSE CODE	COURSE TITLE	CREDIT UNIT	STATUS
CHE 111	General Chemistry	1(2hrs)	Compulsory
CHE 112	Introductory Organic Chemistry I	1(2hrs)	Compulsory
CHE 113	Chemistry Practicals I	1(3hrs)	Compulsory
CHE 114	Chemistry Methodology I	1(2hrs)	Compulsory
	Total	**4C**	
GSE 000 A	Media Information Litracy		Compulsory
GSE 111	General English I	1C	Compulsory
GSE 112	Introduction to Library Studies	1C	Compulsory
	Total	**2 C**	

NCE YEAR I - SECOND SEMESTER

COURSE CODE	COURSE TITLE	CREDIT UNIT	STATUS
CHE 121	Introductory Physical Chemistry	1(2hrs)	Compulsory
CHE 123	Chemistry Practicals II	1(3hrs)	Compulsory
CHE 124	Introductory Organic Chemistry	1(2hrs)	Compulsory
CHE 126	Application of Mathematics to Chemistry II	1(2hrs)	Compulsory
	Total	**4C**	
GSE 000 B	Media Information Litracy	C	Compulsory
GSE 121	General English II	1C	Compulsory
GSE 123	Introduction to Computer Studies	1C	Compulsory
GSE 124	Family Life & Emerging Health Issues	1C	Compulsory
	Total	**C**	

NCE YEAR 2 - FIRST SEMESTER

COURSE CODE	COURSE TITLE	CREDIT UNIT	STATUS
CHE 211	The Gaseous State	1 (2hrs)	Compulsory
CHE 212	Environmental and Industrial Chemistry	1 (2hrs)	Compulsory
CHE 213	Chemistry Practicals III	1 (3hrs)	Compulsory

*CHE 214	Nuclear Chemistry	1 (2hrs)	Elective
CHE 215	Chemistry of Metals, Non-metals and Alloys	1 (2hrs)	Compulsory
CHE 216	Transition Elements and Ionic Compounds	1 (2hrs)	Compulsory
*CHE 217	Liquid State and Colloids	1 (2hrs)	Elective
	Total	**5 C + 1E= 6**	
GSE 000 C	Media Information Litracy	C	Compulsory
GSE 211	General English III	1C	Compulsory
GSE 213	Introduction to Computer Studies II	1C	Compulsory
GSE 214	Trafficking in Persons Issues	1C	Compulsory
	Total	**3 C**	

*** Choose any ONE of the Electives in Year 2.**

NCE YEAR 2 - SECOND SEMESTER

COURSE CODE	COURSE TITLE	CREDIT UNIT	STATUS
CHE 221	Organic Chemistry I	1 (2hrs)	Compulsory
CHE 223	Chemistry Practicals IV	1 (3hrs)	Compulsory
CHE 224	Basic Analytical Chemistry and Research Techniques	1 (2hrs)	Compulsory
CHE 225	Chemistry Methodology II	1 (2hrs)	Compulsory
	Total	**4C**	
GSE 000 D	Media Information Literacy	2 C	Compulsory
GSE 221	General English IV	1C	Compulsory
GSE 223	Citizenship Education	1C	Compulsory
GSE 224	Entrepreneurship	1C	Compulsory
	Total	**3.5C**	

NCE YEAR III - FIRST SEMESTER

EDU 311 **TEACHING PRACTICE**

NCE III - SECOND SEMESTER

COURSE CODE	COURSE TITLE	CREDIT UNIT	STATUS
CHE 321	Chemical Kinetics	1 (2hrs)	Compulsory
CHE 322	Chemistry of Alcohols, Carbonyl Compounds and Mono Carboxylic Acids	1 (2hrs)	Compulsory
CHE 323	Chemistry Practicals V	1 (3hrs)	Compulsory

CHE 324	Chemical Equilibrium & Thermodynamics	1 (2hrs)	Compulsory
CHE 325	Natural Products & Amines	1 (2hrs)	Elective
CHE 326	Benzene Chemistry	1 (2hrs)	Compulsory
	Total	**5C+1E = 6**	
322			Compulsory
GSE 323	Science and Technology in Society	1C	Compulsory
GSE 324	Political Economy	1C	Compulsory
	Total	**3C**	

The project may be done in the other teaching subject, but it will be credited to EDU 323

SUMMARY

Study Status	First year credit units	Second year credit units	Third year credit units	TOTA
Compulsory	8	9	5	22
Elective	-	1	1	2
Total	8	10	6	24

Minimum Credits Required for Graduation

Compulsory = 22 Credits
Elective = 2 Credits
Total = 24 Credits

NCE YEAR I - FIRST SEMESTER

COURSE CODE COURSE TITLE CREDIT UNITS /STATUS

CHE 111 GENERAL CHEMISTRY 1Credit Compulsory

Objectives

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

a. Define the concepts taught in relation to atoms and molecules
b. describe how protons and neutrons were discovered
c. explain the principles underlying the periodic table and its properties of elements
d. and explain the types of chemical bonding.

Topics

- Concepts of the atom and the molecule
- Discharge of electricity through gases
- Determination of e/m of cathode rays
- Determination of the charge of an electron
- Discovery of protons and neutrons
- Experiments of Rutherford and Chadwick Isotopes and Mass Spectroscopy
- Atomic orbital, Bohr atom, Dual nature of matter
- Quantum numbers
- Uncertainty principle Hydrogen atom
- Many electron systems, Electrons spin
- Pauli Exclusion Principle, Electronic structure of the elements
- The Periodic Table, Valence shell electrons, Consequences of the Periodic Table, The
- Modern Periodic Law
- Ionization Potential, Electron Affinity. Atomic and Ionic radii, Electro negativity.
- Isotopes and mass spectrometry
- Types of chemical bonds: electrovalent, covalent, dative, hydrogen, metallic and Octet
- Lewis Formulae.
- Multiple electron-pair bonds. Odd – Electron compounds

CHE 112 INTRODUCTORY ORGANIC CHEMISTRY I 1 Credit Compulsory

Objectives

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

a. State the characteristics of organic compounds and their relationship to other branches of chemistry
b. Differentiate between pi and sigma bonds in relation to hybridization, bond length, bond energy and bond angle
c. State the classes of organic reaction using homolytic and heterolytic fission

d. Explain the concept of organic acids and bases
e. Explain functional groups, homologous series, hydrocarbons.
f. Explain Electrophiles and Nucleophiles

Topics

- Characteristics of Organic Chemistry and its relationship to other branches of chemistry through covalent bonding resulting in chain formation.
- Review of ground state electronic structures especially C, H, O, N, S, etc. Hybridization
- Review of atomic orbitals.
- Sigma and Pi-bonds
- Molecular orbitals and their relationships to structures.
- Bond characteristics: length, angle and strength.
- Electronegativity, polarization and their effects on physical properties of organic compounds.
- Intermolecular forces and their relationships to physical properties.
- Classification of reactions as involving homolytic and heterolytic fissions. Carbonium ion and free radicals as reactant intermediates.
- Organic Acids and Bases.
- Functional groups and homologous series.
- Chemistry of hydrocarbons.
- Electrophiles and Nucleophiles.

CHE 113 **CHEMISTRY PRACTICALS I 1 credit, (3 hours/week)** Compulsory

Objectives

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

a. State various safety precautions in the chemistry laboratory,
b. Detect the presence of anions and cations using wet, dry and group analysis,
c. Carry out simple experiments involving acid-base titration.

Topics

- Safety in the Chemistry laboratory precautions
- Maintenance of equipment
- Setting up apparatus for demonstrating:
- Preparation of gases as in SSCE syllabus
- Preparation of salts
- Simple distillation
- Steam distillation
- Sublimation
- Fractional crystallization
- Paper chromatography
- Heating under reflux
- Using drying agents
- Detection of Anions: SO_4^{2-}, SO_3^{2-}, NO_3^-, NO_2^-, CO_3^{2-}, HCO_3^- Cl^-, Br^-, and I^-
- Detection of cations: Groups 1-6
- Weighing
- Preparation of standard solutions

- pH scale and choice of indicator
- Acid – Base titrations: e.g. NaOH/HCl; H_2SO_4/NaOH

CHE 114 CHEMISTRY METHODOLOGY I 1 Credit Compulsory

Objectives:

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

a. Have thorough understanding of Chemistry Methodology
b. Explain the nature and structure of science
c. Explain the role of science, scientist, science teacher and society
d. State the requirements and needs to become a professional teacher
e. State and Explain the Comparison between science, religion and culture
f. Define and Explain Science, Clubs and Fair
g. How to organize chemistry exhibition

Topics

- Philosophical elements of science education
- Nature and structure of science
- Role of science, the scientist, the science teacher and society
- The concept of integration in science and chemistry
- Professional growth of the science/chemistry teacher
- Science, religion and culture
- Science clubs and fairs
- Exhibitions in chemistry
- Conferences, clubs, seminars, symposia and workshops

NCE YEAR 1 - SECOND SEMESTER

CHE 121 INTRODUCTORY PHYSICAL CHEMISTRY 1 Credit Compulsory

Objectives

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

a. Explain the key concepts of valence bond
b. define hybrid orbital, covalent bonds and Hybridization
c. explain Heisenberg rules, electron pair repulsion and valence shell
d. explain Resonance and delocalization of electrons
e. Explain bond length, Dipole moment and bond character
f. Describe the characteristics of Noble gases
g. explain the nature of ionic crystals
h. Solve simple calculation of lattice energies using Born – Haber cycle
i. Explain the properties of covalent compounds, Homonuclear diatomic, Quantum Mechanics

Topics

- Valence bond theory.
- Molecular orbital approach (qualitative treatment only)
- Directional character of covalent bonds, hybrid orbitals.
- Hybridization involving orbitals of complex compounds.
- Hesenberg's rules, valence shell, electron pair repulsion.

- Resonance.
- Delocalized electrons.
- Bond length.
- Dipole moments.
- Partial covalent bond character, electronegativity and hydrogen bonding.
- Noble gases compounds.
- Ionic crystals.
- Madelung constant.
- Electron Affinity
- Calculation of lattice energy using Born-Haber cycle.
- The covalent bond as related to physical chemistry.
- Description of simple homonuclear diatomic molecules and ions including CO and NO.
- Basic concepts of quantum mechanics.

CHE 123 CHEMISTRY PRACTICALS II QUALITATIVE ORGANIC ANALYSIS

Credit 1 (3 hours/week) Compulsory

Objectives

At the end of the course the students should be able to carry out simple experiment to:

a. Test for unsaturation,
b. Conduct elemental analysis of organic molecules
c. Test of functional groups of organic compounds
d. distinguish the classes of amines
e. distinguish alkanals from alkanones
f. distinguish alkanals from alkanones
g. distinguish the classes of alkanols

Topics

- Test for unsaturation
- Detection of the following elements in organic molecules: N, S, Cl, Br, I, C, H, O.
- Detection of the following functional groups, carboxyl, hydroxyl, alkanoate (ester), amine, alkanals (aldehyde) and alkanones (ketone).
- Distinguishing the classes of amines
- Distinguishing alkanals from alkanones
- Distinguishing classes of alkanols (alcohols)

CHE 124 INTRODUCTORY ORGANIC CHEMISTRY II 1 Credit Compulsory

Objectives

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

a. Name organic compounds using IUPAC rules
b. Differentiate between alkane, alkenes and alkynes from simple chemical reactions
c. Explain bond dissociation energy
d. Explain the concepts of isomerism
e. Be able to relate the importance of petroleum to everyday life.

Stereochemistry

Topics

- Introduction to the rules of IUPAC nomenclature as compared with trivial or common names of compounds.
- Chemistry of the Alkanes: relative inertness, oxidation, halogenation, pyrolysis and catalytic cracking of Alkanes.
- Mechanism and orientation of halogenation.
- Chemistry of Alkenes and alkynes. Bond dissociation energy, heat of reaction, energy of activation, rate of reaction and transition state.
- Isomerism: structural, geometrical and optical.
- Applied alkene chemistry: Petroleum chemistry, fuel and petrochemical, energy considerations.
- Brief elementary introduction to stereochemistry including elements of symmetry and chirality.
- Optical activity and operation of a polarimeter.
- Fischer projection and assignment of configuration e.g. D (+) 2,3– dihydroxypropanal (glyceraldehydes).

CHE 126. APPLICATION OF MATHEMATICS TO CHEMISTRY 1 Credit Compulsory

Objectives

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

a. Apply basic mathematical skills/operation to solve problems in chemistry
b. Application of S.I Units in Chemistry
c. make use of proportion to mole concept, stoicheometry and volumetric analysis
d. Apply ratio, percentage, rates and reciprocal to solve problems in chemistry
e. Demonstrate competence in the use of various mathematical principles to facilitate the learning of chemistry

Topics

- Observation and measurement, precision of experimental measurements. SI Units of measurements, e.g. distance, volume, concentration, time, mass, density, etc. Proportion: Application to mole concept, stoichiometry and volumetric analysis. Ratio, percentage, rates and reciprocals. Quadratic equation and indices. Standard forms and Logarithms, Application to pH calculations.
- Graphical solution to simple equations and linear simple simultaneous equations.
- Application to equilibrium and kinetic calculations. Plotting of graphs and estimating slopes, intercepts, etc. Application to physical chemistry problems.
- Simple treatment of differentiation and integration of functions (rational and algebraic functions).
- Differential equations involving separable variables.
- Application to kinetic theory of gases, rate law and thermodynamics.

NCE YEAR II - FIRST SEMESTER

CHE 211 THE GASEOUS STATE 1 Credit Compulsory

Objectives

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

a. state the gas laws
b. Derive the ideal gas equation
c. state the fundamental kinetic theory of gases
d. Explanation of distribution of molecular velocity of gases
e. Explain deviation of real gases from ideal behavior
f. Explain Mean free path and Heat capacities of gases

Topics

- The physical states of matter.
- Measurement of gas pressure, the barometer and manometer.
- The gas laws: Boyle's law, Charles' law equation of state, and Dalton's law of partial pressure.
- Ideal gas equation: $PV = nRT$. Derivation from Boyle's and Charles' laws. Kinetic theory of gases.
- Derivation of the fundamental kinetic theory equation from the kinetic theory i.e. $PV = mnc^2$.
- The distribution of molecular velocities Derivation of gas laws from ideal gas equation.
- Determination of molecular mass of real gases.
- The nature of intermolecular forces and deviations from ideal behavior.
- The mean free path of gas molecules.
- The heat capacities of gases and the equi-partition of energy.

CHE 212 ENVIRONMENTAL AND INDUSTRIAL CHEMISTRY 1 Credit
Compulsory

(Industrial visit is a major requirement of this course)

Objectives

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

a. list the different types of pollutants and their effects on the environment
b. Describe the techniques involved in some industrial processes
c. Explain causes of Acid Rain and effects on the environment

Topics

- A study of the composition of soil and water.
- Environmental pollution: air, water and soil.
- Solvent extraction, ion exchange and their applications in industries.
- Production of: trioxonitrate (V) acid, sodium hydroxide, washing soda, baking soda, soaps, detergents, glass, alcohol, matches, iron and steel.
- Production and utilization of allied products by students as assignment or project. Reports on visits to Industries (20 % of the CA).
- Acid rain formation and its effects on the environment.
- Oil pollution and its hazards.
- Environmental studies
- Body Abuse, prevention and control.

CHE 213 CHEMISTRY PRACTICAL III REDOX TITRATIONS

1 Credit (3hours/week) Compulsory

Objectives

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

a. Carry out simple redox titrations
b. Determine the partition coefficient of iodine between polar and non-polar solvents
c. Measure the pH of solutions

Topics

- Balancing of redox equations
- Redox titrations using $KMnO_4$ with Iron (II) ammonium tetraoxosulphate (VI) and sodium dioxonitrate (III), Iodine with $Na_2S_2O_35H_2O$, Silver trioxonitrate (V) with sodium chloride and mixture of $KClO_3$ and K_2SO_4, and $K_2Cr_2O_7$ with iron (II) ammonium tetraoxosulphate (VI).
- Determination of the partition coefficient of iodine between carbon tetrachloride and water.
- Determination of molecular weight by freezing point depression.
- Measurement of pH using indicators.
- Buffer solutions and pH meter.

CHE 214 NUCLEAR CHEMISTRY 1 Credit (2hours) Elective

Objectives

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

a. Understand the concept of nuclear stability and radioactivity
b. identify radioactive isotopes, calculate half-life and list their applications and negative effects
c. state Einstein's mass-energy equation and apply it in solving problems

Topics

- Nuclear stability.
- Natural/ artificial radioactivity: Alpha, beta and gamma rays.
- Einstein's mass-energy equation.
- Kinetic calculations of half-life.
- Identification of Radio Isotopes.
- Application and uses of radioactivity: tracers, dating and nuclear reactors.
- Effects of nuclear reactions on the environment.

CHE 215 CHEMISTRY OF METALS, NON-METALS AND ALLOYS

1 Credit (2hours) Compulsory

Objectives

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

a. list the physical and chemical properties of metals, non-metals and alloys
b. state the differences and similarities among the Groups 15,16 & 17 elements
c. describe the peculiarities of the first row transition elements

d. list properties and uses of non-metal hydrides, oxides, hydroxides and oxo-acids

Topics

- Physical and chemical properties of metals.
- Arrangement of atoms in metals.
- Bonding in metals.
- Valence bond theory of metallic bond.
- Molecular orbital approach to the theory of solids.
- Free electron theory of metals.
- Structure of pure metals.
- Insulators and semiconductors.
- Group 1(the Alkali metals). Group 2 (the Alkaline – earth metals).
- The elements of Groups 13 (Boron group) and 14 (Carbon group).
- Physical and chemical properties of non-metals.
- Groups 15, 16 and 17. Extraction of Sulphur.
- Peculiarities of the first-row transition elements.
- Detailed treatment of group trends.
- Group similarities and differences.
- Simple inorganic compounds of nonmetals: hydrides, oxides, hydroxides and oxo-acids including their properties and uses.
- Alloys: Classification of alloys.
- Structure of simple alloys, interstitial couples and bonding.

CHE 216 TRANSITION ELEMENTS AND PROPERTIES OF IONIC COMPOUNDS

1 Credit (2hours) Compulsory

Objectives

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

a. Define ionization potential and electron affinity
b. Explain formation of an ionic crystal and determination of the geometry
c. Explain X-ray diffraction methods
d. Describe NaCl structure and determine the Avogadro number from lattice dimensions
e. Explain electrolysis, Galvanic cells and the Faraday's laws
f. Explain the position, general properties of the 1^{st} , 2^{nd} and 3^{rd} rows transition elements and their compounds
g. Describe the crystal field, adjusted crystal field and ligand field theories of bonding in transition metal complexes
h. Describe Isomerism and stability of metal coordination complexes
i. Explain the lanthanide contraction

Topics

- Formation of ions.
- Ionization Potential and electron affinity.
- Formation of an ionic solid.
- Arrangement of ions in crystals.

- Diffraction of electro-magnetic radiation.
- Experimental methods of X-ray diffraction.
- Bragg's equation.
- The structure of Sodium Chloride from X-ray diffraction.
- Avogadro's number from lattice dimensions.
- Effects of ionic size on crystal geometry.
- Electrolytic solutions.
- Dissociation of strong and weak acids and bases.
- Electromotive force and Galvanic cells.
- Faraday's laws and electrode reactions.
- Position of transition elements in the Periodic Table.
- General characteristics (1^{st},
- 2^{nd} and 3^{rd} row) transition elements.
- Electronic structure of the atoms and ions (1^{st}
- row only) Extraction of Iron (Fe).
- Bonding in transition elements-Crystal Field Theory (CFT), Adjusted Crystal Field Theory (ACFT), Ligand Field Theory (LFT). Emphasis should be on CFT, while ACFT and LFT should be mentioned only.
- Formation of complexes: Isomerism and stability of complexes
- Lanthanide contraction, chemical behavior and periodic comparison

CHEM 217 LIQUID STATE AND COLLOIDS 1 Credit (2hours) Elective

Objectives

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

a. Compare the states of matter
b. Compare colligative properties ideal and non-ideal solutions
c. Identify hydrophilic and hydrophobic properties of colloids
d. Explain surface phenomena involved in adsorption, chromatography and catalysis

Topics

- General comparison of solids, liquids and gases.
- The liquefaction of gases and the critical state.
- Vapour pressure. Boiling point.
- Freezing point. Sublimation.
- Viscosity of liquids.
- Surface tension.
- Vapour pressure of solutions.
- Ideal solutions and Raoult's law.
- Non-ideal solutions and Henry's law.
- Boiling points of solutions containing volatile compounds.
- Immiscible components.
- Dilute solutions containing non-volatile solutes.
- Colligative properties: Vapour pressure lowering, boiling point elevation, freezing point lowering and osmotic pressure.
- The Nernst Distribution law.

- The colloidal state: preparation and properties of hydrophilic and hydrophobic colloids.
- Stability of colloids.
- Separation of colloids.
- Surface phenomenon and adsorption.
- Chromatography: gas, solid and liquid.
- Catalysis.

NCE YEAR II - SECOND SEMESTER

CHE 221 ORGANIC CHEMISTRY I 1 Credit (2hours) Compulsory
(Mechanism in each of the various reactions in the course is necessary)

Objectives

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

a. Describe the geometry of hydrocarbons
b. Identify electrophiles and nucleophiles in a chemical reaction
c. State Markownikoff's rules and its application to unsymmetrical olefins
d. Describe the reactions of unsaturated hydrocarbons including dienes in polymerization and alkyne chemistry

Topics

- Chemistry and molecular geometry of alkanes, Alkenes, Alkynes.
- Electrophilic and nucleophilic addition reactions.
- Oxidative cleavage and its application in structural determination (e.g. Ozonolysis).
- Relative stabilities of carbonium ions.
- The Markownikoff's rule: radical addition.
- Reduction.
- Polymerization: addition of alkenes and vinyl compounds, natural and synthetic rubber.
- Conjugated dienes: electrophilic 1, 2 – and 1, 4 – additions to conjugated dienes. Resonance orbital interaction.
- Alkyne chemistry: acidity of C ≡ C and reactions of –C≡C– compounds.

CHE 223 CHEMISTRY PRACTICALS IV 1 Credit, (3 hours/week) Compulsory
Objectives

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

a. Describe the various separating techniques
b. State the criteria for determining purity of a substance
c. Verify Raoult's law for ideal solutions

Topics

- Separation techniques: Liquid-liquid (solvent) extraction,
- Column Chromatography.
- Criteria for purity
- Determination of melting point
- Determination of solubility and solubility products.
- Determination of equilibrium constant.

- Verification of Raoult's Law.

CHE 224 BASIC ANALYTICAL CHEMISTRY AND RESEARCH TECHNIQUES
1 Credit (2hours) Compulsory

Objectives

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

a. list the preliminaries and title in a research work
b. explain the types of research design
c. differentiate between precision and accuracy
d. state the type of statistical tools for analysis in a research work
e. Identify the units of measurements of some quantities such as time, concentration, mass etc.
f. Carryout complexometric and precipitation titrations

Topics

(i) Project work in Chemistry
   a. Title
   b. Abstract
   c. Introduction
   d. Experimental
   e. Results
   f. Discussion
   g. Summary & Conclusion
   h. References

(ii) Significant figures:
   a. Addition and subtraction
   b. Multiplication and division

(iii) Measurement:
   a. Accuracy
   b. Precision
   c. Errors (concept, types, sources, control, estimation)

(iv) Measures of central tendency: mean, mode, median, range, co-efficient of variance, standard deviation.

(v) Test of significance: Chi^2-Test and T-test.

(vi) Units of concentration: $mol.dm^{-3}$ (molarity), gdm^{-3} (mass concentration), molality, parts per million, percentage concentration.

(vii) Titrations
   a. Complexometric titrations
   b. Precipitation titrations

(viii) Determination of melting and boiling points

(ix) Tests for oxidizing and reducing agents

CHE 225 CHEMISTRY METHODOLOGY II 1 Credit (2hours) Compulsory

Objectives

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

a. Explain the various methods of teaching chemistry
b. Use different methods of teaching chemistry
c. Differentiate between lesson note and lesson plan
d. Identify the personnel involved in organizing chemistry laboratory
e. State the criteria for selecting chemistry textbooks for use

Topics

- Trends in the teaching of chemistry.
- Lesson note preparation.
- Methods of teaching Chemistry. Demonstration, Guided discovery, Discussion, Activity, Tutorial, Project, team teaching
- Organization of the chemistry laboratory
- Duties of laboratory personnel (technologist, assistant, attendant)
- Record keeping in the chemistry laboratory
- Use of multimedia in chemistry teaching (use of films, slides and overhead projector during a chemistry lesson).
- Computer Assisted Instruction (CAI)
- Games and simulations, concept mapping
- Evaluation of chemistry textbooks
- Practicum in Chemistry teaching (Microteaching)

NCE YEAR III - FIRST SEMESTER

EDU 311
TEACHING PRACTICE

NCE YEAR III - SECOND SEMESTER

CHE 321 CHEMICAL KINETICS 1Credit (2hours) Compulsory

Objectives

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

a. Define reaction rate, the rate law, molecularity and order of a reaction
b. Explain the various theories of reaction rate
c. Use steady state approximation to derive theoretical rate law from reaction mechanism

Topics

- The reaction rate: Reaction order.

- Molecularity.
- The rate laws.
- Experimental techniques for determining first order reactions.
- Derivation of first-order kinetic equation.
- Example of first order reactions, second order reactions, third order reactions.
- The half-life of a reaction.
- Methods for determining the reaction order.
- Factors affecting rates of reactions. Solvent effects.
- The Arrhenius theory of reaction rates. The collision theory of reaction rates.
- The transition state theory of reaction rates, the activated complex relationship between Arrhenius and Transition state theories.
- Unimolecular gaseous decomposition reactions.
- Steady state approximation. Reaction mechanisms.

CHE 322 CHEMISTRY OF ALCOHOLS, CARBONYL COMPOUNDS AND MONOCARBOXYLIC ACIDS 1 Credit (2hours) Compulsory

Objectives

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

a. describe the methods of preparation, properties and uses of alcohol
b. Describe the reaction of carbonyl compounds
c. State the characteristic reactions of carbonyl compounds
d. Mention some reaction of carboxylic acids
e. Differentiate between mesomeric and inductive effect
f. State the reaction and preparation of some aromatic acid derivatives

Topics

- Structure, nomenclature and properties of alcohols, carbonyl and monocarboxylic compounds
- Methods of preparation of alcohols, carbonyl and monocarboxylic compounds
- Uses of alcohols, carbonyl and monocarboxylic compounds
- Chemistry and reactivity of the carbonyl group. Structural survey of alkanals and alkenones.
- General characteristics and nomenclature of alkanals and alkenones.
- Similarities and contracts with other types of double bonded compounds.
- Nucleophilic addition to the carbonyl group.
- Some examples of aliphatic and aromatic. Alkenones and Alkanals.
- Special topics related to carbonyl groups.
- Acetals, ketals and use as protecting groups.
- Introduction to reactions of annulate ions.
- Keto-enol tautomerism.
- Simple aldol condensation and its synthetic utility.
- Halogenation of ketones.
- The haloform reactions.

- The Cannizzaro reaction.
- Chemistry of the carboxylic acids and derivatives.
- Polarity, structure and nomenclature of monocarboxylic acids,
- Hydrogen bonding in carboxylic acids and its medication by inductive effects and mesmeric effects.
- Some reactions of carboxylic acids.
- Some reactions of carboxylic acid derivatives e.g. anhydrides, acyl halides, esters and amides.
- Synthesis and reactions of aromatic sulphonyl acids.

CHE 323 CHEMISTRY PRACTICALS V 1 Credit, (3 hours/week) Compulsory

Objectives

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

a. Synthesize and characterize inorganic complex
b. Determine enthalpies of neutralization and combustion
c. Synthesize some benzene derivatives
d. Test for food content

Topics

- Synthesis and characterization of inorganic complexes.
- Determination of enthalpies of neutralization and combustion.
- Synthesis of some benzene derivatives.
- Tests for proteins, carbohydrates, sucrose, glucose and lipid

CHE 324 CHEMICAL EQUILIBRIUM AND THERMODYNAMICS 1 Credit (2hours) Compulsory

Objectives

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

a. Define thermodynamics terms and principles
b. State and explain the laws of thermodynamics
c. Derive the relationship between heat of reaction at constant pressure and volume
d. Explain the dependence of heat capacity and enthalpy of reaction on temperature
e. Explain the interdependence of Gibb's free energy with equilibrium constant, entropy change and temperature
f. define chemical equilibrium and state factors affecting chemical equilibrium
g. determine the pH of solutions
h. state the effects of common ions on the solubility of salts
i. calculate the equilibrium constants of ionic salts
j. explain phase rule

Topics

- The nature of thermodynamics.
- Definition of some thermodynamic terms, including temperature.

- The first law of thermodynamics. Enthalpy.
- Heat capacity of gases.
- Reversible adiabatic processes.
- Thermochemistry.
- Standard states.
- Enthalpy of reactions.
- Hess's law. Relationship between heat of reaction at constant pressure and at constant volume.
- Heat of solution.
- Enthalpy of formation of ions in solution. Bond energies.
- Dependence of heat capacity and enthalpy of reaction on temperature.
- The second law of thermodynamics.
- Bohr Energy Circle.k Molecular interpretation of entropy.
- Examples of entropy calculations. Criteria for equilibrium.
- The work function and Gibb's Free Energy.
- Free energy and the equilibrium constant.
- Equilibrium between phases.
- The Clapeyron equation.
- The third law of thermodynamics.
- Law of chemical equilibrium.
- Equilibrium constants expressed in different units.
- Variables affecting chemical equilibrium.
- Effects of pressure, temperature, concentration and catalyst.
- Aqueous solutions of weak acids and bases.
- The ionization of water and the pH scale.
- Buffer solutions.
- Polyfunctional acids and bases.
- Hydrolysis: Salts of a weak acid and a weak base.
- Metallic ions, salts of dibasic acid.
- Titration of acids and bases: strong acids and strong bases, weak acids and weak bases.
- Indicators.
- Complex ion equilibrium.
- Equilibrium between ions in the solid and liquid phases.
- Solubility and solubility products: effect of a common ion on the solubility of slightly soluble salts.
- Equilibrium in systems containing solid and gaseous phases.
- Phase rule. One component system and two component systems.

CHE 325 NATURAL PRODUCTS AND AMINES 1 Credit (2hours) Elective

Objectives

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

a. State the composition, structure and functions of lipids in living organisms
b. Mention the types of fatty acids
c. Appreciate the economical application of lipids
d. State and explain the classes of carbonhydrates

c. State the characteristics of amino-acids and amines

Topics

- Lipids.
- Triglycerides: structure, composition and functions in living organisms.
- Types of fatty acids encountered in lipids.
- Commercial applications as soaps, edible oils and fats, etc.
- Carbohydrates: aldoses and ketoses.
- General features, configuration in relation to glyceraldehyde.
- Aldohexoses – structure and chemical reaction.
- Disaccharides, sucrose, maltose, lactose, etc.
- Polysaccharides starch, cellulose, etc. Brewing.
- Proteins: Properties, structure, nomenclature, synthesis and uses.
- Amino acids: Their dipolar nature and relationship to proteins.
- Amines and derivations: General characteristics and nomenclature of amines; structure, physical and chemical properties.
- Amines as nucleophiles: General reaction of aliphatic and aromatic amines. Quatemacy ammonium compounds.
- Hoffman Benzene diazonium salts and their reactions.

CHE 326 BENZENE CHEMISTRY 1 CREDIT 2hours Compulsory

Objectives:

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

a. explain the concept of aromaticity and stability in relation to benzene structure

b. Explain the reactivity of benzene with the functional groups

c. Write the mechanisms of various aromatic substitution reactions

Topics

- Aromatic compounds.
- Aromaticity and stability. Huckel's rule (4n+2)
- Exemplified by benzene, naphthalene etc.
- Short historical account of benzene
- structure. Inadequacy of cyclohexatriene as the structure of benzene.
- Physio- chemical evidence for the benzene molecule.
- Reactivity of benzene and functional groups attached to benzene ring compared with aliphatic analogues, e.g. addition reaction, halogenation, nitration, sulphonation. Friedel- Craft's alkylation and acylation.
- Electrophilic aromatic substitution. Mechanism of the substitution reactions.
- Orientational and kinetic effects of substituents.
- Nomenclature, chemical reactions, side chain and ring substitution.