

**(b) Curriculum for B.Sc. Degree in Industrial Chemistry**

**100 Level Harmattan Semester**

<b>Course Code</b>	<b>Course Title</b>	<b>Pre-requisite</b>	<b>Units</b>	<b>Status</b>
CHM 101	General Chemistry I	-	3	C
CHM 107	Experimental Chemistry I	-	1	C
PHY 101	General Physics	-	3	C
PHY 107	Experimental Physics	-	1	C
BIO 101	Basic Biology I	-	3	C
BIO 107	Experimental Biology I	-	1	C
MTH 101	General Mathematics I	-	3	C
CIT 111	Introduction to Information and Communication Technology	-	2	R
FRN 211	Basic French	-	2	R
GNS 101	Use of English I	-	2	R
LIB 101	Use of Library	-	1	R
	<b>Total</b>		<b>22</b>	

**100 Level Rain Semester**

<b>Course Code</b>	<b>Course Title</b>	<b>Pre-requisite</b>	<b>Units</b>	<b>Status</b>
CHM 102	General Chemistry II	-	3	C
CHM 108	Experimental Chemistry II	-	1	C
PHY 102	General Physics II	-	3	C
PHY 108	Experimental Physics II	-	1	C
BIO 102	Basic Biology II	-	3	C
BIO 108	Experimental Biology II	-	1	C
MTH 102	General Mathematics II	-	3	C
CIT 112	Introduction to Computer Programming	-	2	R
FRN 222	French for Specific Purposes	-	2	R

GNS 102	Use of English II	-	2	R
	<b>Total</b>		<b>21</b>	

### 200 Level Harmattan Semester

Course Code	Course Title	Pre-requisite	Units	Status
ICH 203	Industrial Management I	CHM 101, CHM 102	2	C
ICH 205	Industrial Chemical Processes I	-	2	C
CHM 203	Analytical Chemistry	-	2	C
CHM 205	Physical Chemistry I	CHM 101	2	C
CIT 201	Introductory Computer Science	-	3	C
PHY 209	Thermal Physics	-	2	C
CHM 207	Inorganic Chemistry I	CHM 101	2	C
CHM 291	Experimental Physical/Inorganic Chemistry	-	1	C
GNS 201	Nigerian Peoples and Culture	-	2	R
	<b>Total</b>		<b>18</b>	

### 200 Level Rain Semester

Course Code	Course Title	Pre-requisite	Units	Status
ICH 204	Industrial Materials	-	2	C
CHM 202	Organic Chemistry I	-	2	C
CHM 206	Spectroscopy	CHM 101, CHM 102	2	C
CHM 208	Physical Chemistry II	CHM 205	2	C
CHM 292	Experimental Physical/Organic Chemistry	-	1	C
PHY 242	Atomic Physics I	-	3	C
BCH 202	General Biochemistry	-	3	C
GNS 202	Osun Peoples and Culture	-	2	R
GNS 302	Introduction to Logic and	-	2	R

	Philosophy			
<b>Electives:</b> One of the following				
ICH 202	Basic Concepts of Drugs Design and Production	-	2	E
<b>OR</b>	Any other 2-unit course	-	2	E
	<b>Total</b>		<b>21</b>	

### 300 Level Harmattan Semester

Course Code	Course Title	Pre-requisite	Units	Status
ICH 301	Industrial Management II	ICH 203	2	C
ICH 305	Industrial Chemical Processes II	ICH 205	2	C
STA 371	Statistics and Elementary Probability	-	4	C
CHM 301	Inorganic Chemistry II	CHM 207	2	C
CHM 303	Organic Chemistry II	CHM 202	2	C
CHM 311	Colour and Textile Chemistry	-	2	C
CHM 313	Petroleum Chemistry	CHM 202, CHM 208	2	C
CHM 359	Glass Blowing Practical	-	1	C
EPS 301	Entrepreneurial Studies II	-	2	E
<b>Electives:</b> One of the following				
ICH 303	Heavy Inorganic Chemicals	-	2	E
ICH 307	Introductory Catalysis	-	2	E
	<b>Total</b>		<b>21</b>	

### 300 Level Rain Semester

Course Code	Course Title	Units	Status
ICH 399	Industrial Attachment	16	C
	<b>Total</b>	<b>16</b>	

#### 400 Level Harmattan Semester

Course Code	Course Title	Pre-requisite	Units	Status
ICH 461	Research Project I	-	3	C
CHM 401	Instrumental Analytical Methods	CHM 203	2	C
CHM 403	Structure and Coordination Chemistry	CHM 207	2	C
CHM 405	Macromolecular Chemistry	-	3	C
CHM 407	Inorganic Chemistry III	CHM 301	2	C
CHM 409	Organic Chemistry III	CHM 303	2	C
CHM 411	Electrochemistry	CHM 205, CHM 208	2	C
<b>Electives:</b> One of the following				
ICH 401	Fertilizer and Agrochemicals	-	2	E
ICH 403	Unit Operation	-	2	E
	<b>Total</b>		<b>18</b>	

#### 400 Level Rain Semester

Course Code	Course Title	Pre-requisite	Units	Status
ICH 462	Research Project II	-	3	C
CHM 402	Nuclear and Radiation Chemistry	-	2	C
CHM 404	Organic Synthesis	CHM 303, CHM 409	2	C
CHM 406	Food Chemistry	CHM 202	2	C
CHM 408	Reaction Kinetics	-	3	C
CHM 410	Environmental Chemistry	-	2	C
<b>Electives:</b> One of the following				
ICH 404	Industrial Fermentation Technology	-	2	E
ICH 406	Industrial Surface Chemistry	-	2	E
	<b>Total</b>		<b>16</b>	

## Course Description (B.Sc. Industrial Chemistry)

### **CHM 101    General Chemistry I    L2T1P0    3 UNITS**

**Physical Quantities and Chemistry:** The physical quantities understood as consisting of numerical magnitude and unit. International system of units: Base units, mass length, time, current, amount of substance. Other units expressed as products or quotients of base units.

**Relative masses of atoms and molecules:** relative atomic, isotopic, molecular and formula masses. Calculation of empirical and molecular formulae. Chemical Stoichiometry.

**Atomic and nuclear Basis:** Evidence for atomic constituents. Electrons, protons and neutrons – their relative charges and masses. The nucleus, atomic number, mass isotopes and mass spectra. The electronic structure of the atom. Radioactivity; X-ray radiation and detection. Nuclear transformation and binding energy. Nuclear reaction and stability. Applications of radionuclides, electromagnetic radiation, wavelength and frequency. Radiation as energy, the Plank relation, regions of electromagnetic spectrum absorption and emission of radiation. Wave particle dualism and the de Broglie equation treated symbolically. Heisenberg uncertainty principle. Energy levels in atomic hydrogen and their quantum numbers. Ionization energy. The size, shape and orientation of atomic orbitals. Radical and polar diagrams and the effect of nuclear change. Electron and nuclear spin- the Stern-Gerlach experiment. Many electron atoms, electron configuration and Pauli principle. Hund's rule.

**Chemical Bonding:** Dependence of properties of solids, liquids and gases on type of chemical bonding. Electrovalent bond between ions. Covalent bonds. The shape of simple molecules including CO<sub>2</sub> (linear), CH<sub>4</sub> (tetrahedral), NH<sub>3</sub> (pyramidal), H<sub>2</sub>O (non-linear), SO<sub>3</sub> (trigonal), SF<sub>6</sub> (octahedral). Metallic bonds. Intermolecular bonds. Hydrogen bonding and its influence on properties.

### **CHM 102    General Chemistry II    L2T1P0    3 UNITS** **Gases, Liquids and Solids**

Derivation of ideal gas equation leading to Boyle's Law and Avogadro's Hypothesis. The Avogadro constant. A simplified treatment (e.g. particle in a box). The assumption for ideal behavior and their limitation for real gases at high pressure and low temperature. Boltzmann distribution and molecule speed. Boltzmann constant. Liquids: the kinetic concept of the liquid state and simple kinetic-molecular description of melting, vaporization and vapor pressure, saturated and unsaturated vapours. Phase equilibria: Phase rule, equilibria involving one, two and three components. Solids: Lattice structure and spacing. NaCl as ionic lattice. Cu as a cubic close-packed metal lattice. Graphite and Diamond- their properties as

macromolecular structures. Lattice energy and forces between the particles in atomic molecular and ionic lattice.

**Electrolysis:** The factors affecting the mass of substance liberated during electrolysis. Relationship between Faraday and the Avogadro constant and the charge of the electron.

**Equilibria:** Chemical equilibria: Reversible reactions and dynamic equilibrium. Factors affecting chemical equilibria. Le Chatelier's principle. Equilibrium constants; their definition and calculation in terms of concentrations. Effects of temperature on equilibrium constants. Ionic equilibria: Bronsted-Lowry theory of acids and bases. Strong and weak acids in terms of conductivity. Strong and weak electrolytes. Degree of dissociation. The ionic product of water  $K_w$ . pH and calculation, pH indicators; choice of indicators, Buffer solutions.

**Chemical kinetics:** Simple rate equations; order of reactions; rate constants.

Rate =  $k(A)$ . Reactions, simple calculations on half life. Qualitative effects of temperature on rate constants. Catalysis.

**Thermo-chemistry and Chemical Energetics:** Standard enthalpy changes of reaction, formation, combustion and neutralization: Hess Law. Lattice energy for simple ionic crystals. A treatment of the Born-Haber cycle is not required.

### **CHM 203 ANALYTICAL CHEMISTRY L2TOP3 2 UNITS**

Pre-requisite: CHM 101, CHM 102.

Introduction to theory of sampling and errors, Statistical treatment of data, Chemical methods of analysis including volumetric, gravimetric and other physico-chemical methods, optical method of analysis, separation methods, Fundamental laws and theories. Chromatography: practical experience, thin layer, paper and column chromatography, the use of  $R_f$  values.

### **CHM 205 PHYSICAL CHEMISTRY I L2TOP3 2UNITS**

Pre-requisite: CHM 101

**Energetic:** Bond dissociation energies, Energy cycles including the Born-Haber cycle, applied to both covalent and ionic bonds. Limited accuracy of dissociation energies. Heats of formation and their determinations. Laws of thermodynamics. The concept of reversibility. The possibility of endothermic process, and the concept of entropy – with calculations based on the simple models. Standard entropy values. Free energy as a criterion for chemical reaction and equilibrium. Kinetic and thermodynamic control. Derivation of isotherm.

**Chemical kinetics:** Factors affecting the rates of chemical reactions. Rate laws. Order of reaction and molecularity of elementary process. Relationship of order to mechanism. Rate equation for zero order, first and second order reactions. Half

lives. Experimental investigation of reaction rates. Sampling and physical methods of following reactions. Determination of order. Effect of temperature on reaction rate. The Arrhenius equation. Presentation of collision and transition state theories. Catalysis, simultaneous reactions, opposing, consecutive, side and chain reactions.

**CHM 207 INORGANIC CHEMISTRY I L2TOP3 2UNITS**

Pre-requisite: CHM 101

Solid state structures of simple AB and AB<sub>2</sub> type compounds of the s, p and d block elements. Periodicity of the elements illustrated by a study of their simple compounds, the hydride acids and halides. The solution properties of the compounds including solvation, solute/solvent interaction and redox reactions.

**CHM 202 ORGANIC CHEMISTRY I L2TOP3 2UNITS**

Pre-requisite CHM 101

**Molecular Structure and Isomerism:** Empirical and molecular formulae. Molecular constitution and constitutional isomerism. Molecular configuration and configurational isomerism. Molecular conformation and conformational isomerism. Influence of molecular structure on physical properties.

**Mechanism and Reactivity:** Modes of bond formation and fission. Types of reagent. Types of reactions. Electronic and steric effects. Kinetic and thermodynamic control of reaction. Elementary concepts of acidity and basicity.

**Chemistry of hydrocarbons:** Nomenclature, structure, physical properties, reactions and industrial importance of typical alkanes and cycloalkanes, alkenes and cycloalkenes, alkynes and cycloalkynes. Practical work will illustrate physical properties and reactions of representative hydrocarbons.

**CHM 206 SPECTROSCOPY L2TOP3 2 UNITS**

Pre-requisite: CHM 101, CHM 102.

Existence of characteristic energy levels; Bohr-Einstein frequency relationship; selection rules; characteristic spectra; factors determining relative intensities; Boltzmann distribution effects of temperatures; characteristics line width; absorption and emission spectra and their determination; absolute intensity; Beer-Lambert law.

**Survey:** Spectra transactions and their main uses.

**Vibrational Spectroscopy:** Harmonic oscillators and the effects of harmonicity; normal modes of vibration criteria for infra-red activity; Raman activity; group frequencies.

**Ultra-violet and visible spectroscopy:** Resonance condition, chemical shifts; intensities; coupling constants.

**Mass spectrometry:** Generation of positive ions; characteristic fragmentation patterns; isotope effects.

**Practical Work:**

Examples are as follows: determination of meaningful a spectra (sample preparation and instrumental parameters); determination of simple n.m.r. and mass spectra; investigation of carbonyl stretching frequencies; study of the effects of conjugation in the ultra-violet region; Lambert law as applied to mixture; determination of pKa of methyl red; the investigation of an unknown compound using the integrated approach.

**CHM 208    PHYSICAL CHEMISTRY II                    L2TOP3    2 UNITS**

Prerequisite: CHM 205

**Ions in Solutions:** Bronsted and generalized acid-based concepts; application to aqueous solvents. Equilibria; strengths of acids bases, pH hydrolysis of salts, buffer actions, acid base indicators, titrations, concepts of activity, Debye-Huckel theory. Conductance measurements. Interactions in electrolyte solutions.

**Surface Chemistry;** Interfacial relationships. Criteria for spreading monomolecular films on water. Adsorption form solution, at gas – solid interface; adsorption isotherms. Classification of colloidal systems. Preparation and properties of lyophilic and lyophobic sols. Ideal solids, glasses and polymers. Colloidal systems, surface energies, wetting, adhesion and contact angles. Insoluble surface films. Micelle formation, lyophobic and lyophilic properties.

**CHM 301    INORGANIC CHEMISTRY II    L2TOP3    2 UNITS**

Prerequisite: CHM 207

Chemistry of s-and p-block elements: Relations between electronic structure, size and reactions of compounds. Chemistry of d- and f- block elements: Detection, nomenclature and isomerism of complex compounds. Crystal field theory, d-d spectra detection, nomenclature and isomerism of complex compounds. Crystal field theory, d-spectra, molecular orbital and valence bond theories. Comparative study of the chemistry of the transition elements and their compounds. Lanthanides and Actinides

**CHM 303    ORGANIC CHEMISTRY II                    L2TOP3    2 UNITS**

Prerequisites: CHM 202

Review of General organic chemistry, aromatic chemistry: preparation and reactions of benzene derivatives. Electrophilic and nucleophilic substitution in the benzene



ring. Carbonyl chemistry and synthetic applications. Stereochemistry: stereochemistry of organic compounds and optical isomerism of compounds with one or more asymmetric centres. Concepts of chirality and absolute configuration. The synthesis of alicyclic compounds and their stereochemistry. Introduction to mechanistic organic chemistry.

### **CHM 311 COLOUR & TEXTILE CHEMISTRY L2TOP1 2 UNITS**

Classification of dyes and textile fibers. Natural regenerated and synthetic fibers. Physical and structural properties of fibres. Preparatory processes: singeing, desizing, scouring, bleaching, mercerization and optical brightening. Colour and constitution. Theory of dyeing, dyeing preparation, structure, and application of dyes. After treatments and quality control: colour fastness.

### **CHM 313 PETROLEUM CHEMISTRY L2TOP3 2 UNITS**

Prerequisites: CHM 202, CHM 210

Nature, classification and composition of crude petroleum. Characteristic and scope of petroleum industry. Physical and chemical outlay of refinery operations. Oil refining. Crude oils and separation processes. Steam reforming and major reforming reactions. Catalytic cracking and desulphurization. Petrochemicals and production.

### **CHM 359 GLASS BLOWING PRACTICAL LOTOP3 1 UNIT**

Properties of glass in general use. Manufacturers symbol and what they represent. Types of glass used for laboratory wares. Identification methods, working temperatures. Coefficient of expansion, annealing, thermal resistance, correlation of these factors. Identification of basic tools, gas supplies, safety measures, cutting, rotation techniques, drawing simple butt joining bulb blowing and bending, rounding off end of tube, taper drawing and reaming, ring seal and side grinding and polishing.

### **CHM 401 INSTRUMENTAL ANALYTICAL METHODS L2TOP3 2 UNITS**

Prerequisites: CHM 203

Radiochemical methods; fluorescence and phosphorescence; Electro analytical methods; voltametry; spectroscopy; Theory and practices of gas chromatography; Thermal methods of analysis; High performance liquid chromatography; Automated analytical methods; Enzymatic methods.

### **CHM 403 STRUCTURE AND COORDINATION CHEMISTRY L2TOP3 2 UNITS**

Prerequisites: CHM 207

Nomenclature, coordination number. Isomerism and stability of complex compounds. Theories of structures i.e. valence bond theory, crystal field theory, molecular orbital and ligand field theories and their relations to bonding in coordination compounds. Kinetics and mechanism of complex formation. Electronic spectra of transition metal complexes as well as their magnetic properties. Preparations, reactions and structure of complexes with  $\pi$ -acceptor ligands such as CN, CO, and NO. Applications of infrared and nmr spectroscopy to problems of coordination chemistry. Introduction to non-aqueous solvent systems; classification of solvents. Solute-solvent interactions.

### **CHM 405    MACROMOLECULAR CHEMISTRY    L2TOP3    2 UNITS**

Classification of macromolecules; polymers and copolymers as natural, modified natural or synthetic substances. Polymer formation processes; methods, kinetics and mechanisms. The characterization of macromolecules; molar mass and distribution, molecular size and shapes, stereochemistry. Crystallinity and methods of determination. Structural classification in natural macromolecules. Bulk structure, crystalline, amorphous, glassy and rubbery states. Inter-relation of structure and properties.

Polymerization processes; mechanism and kinetics of free radical, ionic and stereospecific polymerization. Additions of polymerization in bulk, solution, suspension and emulsion. Ring opening polycondensation processes, Gelation Theory, Copolymerization: addition copolymerization, reactivity ratios, and the copolymer-equation. Prediction of reactivity ratios. Degradation of polymers: by thermal, oxidative, photochemical and chemical environments. Kinetics and mechanism of degradation. Inhibitors and retarders. Biopolymers: organization in protein and nucleic acid structures, super-cooling. Inorganic macromolecules; condensed oxyanion structures, silicates; silicon. Solution properties of macromolecules: thermodynamics of polymers solutions. Morphology, crystallinity and orientation.

### **CHM 407    INORGANIC CHEMISTRY III    L2TOP3    2 UNITS**

Prerequisites: CHM 301

Compounds having metal-carbon bonds: sigma – and pi bonded compounds. Their structure, properties and uses. Energy considerations applied to extraction of elements and thermal stability of compounds in aqueous and non-aqueous solvents. Inorganic reactions in solution: types of reaction, effects of solvent, oxidation-reduction and substitution reactions. Kinetics of fast reactions, methods of study of  $SN^1$ ,  $SN^2$  and ion-pair mechanisms.

### **CHM 409    ORGANIC CHEMISTRY III    L2TOP3    2 UNITS**

Prerequisites: CHM 303

Heterocyclic Chemistry: The Chemistry of five – six – member ring. Heterocyclic compounds containing Nitrogen, oxygen and sulphur. Fused heterocycle.

Substitution reaction in monocyclic/heterocyclic compound and the benzoyl derivatives. Brief treatment of heterocyclic compounds containing more than one hetero-atom. Reactive intermediates: formation and reaction of arynes, carbenes, nitrenes and free radicals. Photochemical generation of reactive species and its use in organic synthesis. Polyfunctional molecules: the interaction of functional groups within molecules, synthesis and reaction of amino acid. Formation of peptides bond; racemization. Chemistry of hydroxy-acids, hydroxy-ketones, and hydroxy-aldehydes. Lactone and lactan formation. Properties of bicaronyl compounds.

**CHM 411 ELECTROCHEMISTRY L1TOP3 2 UNITS**

Prerequisites: CHM 205, CHM 210

Chemical Equilibria: Ionic Equilibria, conductance, theory and measurement, interpretation of data for strong and weak electrolytes, conductance and transport processes. Thermodynamics and galvanic cells. Standard electrode potentials. Practical electrode. Molecular forces in solids and liquids: Dipole moments. Interaction potentials and forces. Reversible galvanic cells, measurement of e.m.f. electrode potentials and the electrochemical series. Standard state and the Nernst equation. Application of e.m.f. measurements (excluding thermodynamic relationships). Potentiometric titration including measurement of pH. Redox reactions. The electrical double layer and its application.

**CHM 402 NUCLEAR AND RADIATION CHEMISTRY L3TOP0 2 UNITS**

Revision of proton-neutron, neutron excess, shell model and nuclear spin. Alpha, megatron, positron, electron capture, gamma and internal conversion decay modes of properties of particles produced – annihilation, range, shielding etc. health effects, permissible dose level, risk estimates, kinetics of decay, half life and decay curve. Detection systems, solid and liquid scintillation counting. Quenching and channels ratio correction. Natural radioactivity. Induced radioactivity – mass and energy balance including recoil. Binding energy. Fission and fusion. Reactor types classified by fuel, moderator coolant. Introduction to activation analysis. The use of isotopes in reaction mechanism and analysis.

**CHM 404 ORGANIC SYNTHESIS L2TOP3 2 UNITS**

Prerequisites: CHM 303, CHM 409

Reduction methods. Catalytic hydrogenation. Reduction with boron and aluminium hydrides and their analogues and derivatives. Metal reductions. Selective reduction in polyfunctional compounds. Oxidation methods. Epoxidation, hydration and hydroxylation of alkenes, oxidative cleavage of glycol. Peroxyacids and coupling and relevance to biosynthesis survey of synthetic applications of organometallic. Organoboranes. Hydrocarbon oxidation to ketones. Carboxylation reactions and protonolysis phosphorus halides and their applications. Enamines: synthesis and applications. Formation of polycyclic compounds. Aldol type reactivity and reaction

of minimum salts with nucleophile. Synthesis of complex molecules. Pericyclic reactions. Methodology for the construction synthetic routes.

**CHM 406 FOOD CHEMISTRY L2TOP3 2 UNITS**

Prerequisites: CHM 202

The nature of food, vitamin, additives and adulterants; chemistry and microbiology of production processes and control; food preservation and spoilage; processing and preservation of local food stuffs; formulation and practice of food standards

**CHM 408 REACTION KINETICS L2TOP3 3 UNITS**

Second and third order rate equations – review. Rate constant and equilibrium constants – derivation state theory, reaction coordinates, unimolecular reactions theory, bimolecular reaction mechanism; chain reaction mechanisms. Photochemical and electrochemical reactions; complex reaction systems. Concurrent, consecutive and chain reactions. Catalysis and heterogeneous reactions.

**CHM 410 ENVIRONMENTAL CHEMISTRY L2TOP3 2 UNITS**

The water cycle. Heavy metal and pesticides as pollutants. Mutagenic and other effects of pollutants. Recovery of water by sewage treatment etc. Modern and unusual methods of pollution analysis. Biodegradable macromolecules including detergents. Polymers, biodegradable and photodegradable, and polymer additives photochemical aspects.

**ICH 201 BASIC PRINCIPLES OF CHEMICAL PROCESSES L2TOP3 2 UNITS**

Process variables, data presentation and analysis, material and energy balances, application in chemical and allied processes. Steam engine generation and uses. Survey of chemical raw materials in Nigeria. Flowchart for industrial processes. Large scale and bench scale processes. Unit operations equipment.

**ICH 205 INDUSTRIAL CHEMICAL PROCESSES I L2TOP3 2 UNITS**

Commercial process, problems of scale and cost, process flow sheet and Stoichiometry, handling of fluids; conservation laws and dimensional analysis applied to a moving fluid. Process heat transfer, mechanisms of heat transfer, and coefficients in batch and continuous processes. Use of mean temperature difference. Change of phase correlation of heat transfer data. Distillation differential, both fractional and continuous distillation, number of stages; effects of operating variables.

**ICH 203 INDUSTRIAL MANAGEMENT I L2TOP0 2 UNITS**

**Management process and methods:** The nature of management and the role with the chemical industry: management theory. Managerial association and specialization. Line and staff structure: functions and relationship. The manager

role. Organization structure and management structure. Authority and organization. Corporate policy and organizational constraints on management process. The decision process, managerial technique supportive information system.

**Managerial Economics:** Risk and uncertainty in decision making. The theory of production, cost and demand analyses and sales forecasting. Pricing. Investment decision, product diversifications. Theory of business behaviour.

### **ICH 204      INDUSTRIAL MATERIALS                      L2TOP0      2 UNITS**

Classification and properties of industrial materials. Type of bonding and its influence on both structure and properties of materials. Manufacture and properties of solid solution (alloys). Structure of crystalline materials, coordination number, crystallography.

Stress- strain relationship in materials, elastic and inelastic regions, mechanical, thermal and electrical properties of materials. Crystal growth and imperfections (defects). Material transformation-deformation, strengthening, electroplating and corrosion.

### **ICH 202 BASIC CONCEPTS OF DRUG DESIGN AND PRODUCTION L2TOP3 2 UNITS**

**Biochemical pharmacology:** Introduction. Absorption and distribution. The blood-brain barrier, placental transfer of drugs. Biotransformation of drugs their conjugation and excretion. Factors affecting metabolism. The micosomal enzymes system. Drug receptor interactions. Bioassay drugs, pharmacokinetics, the importance of plasma levels of a drug. Drug discovery, design and development. Classification of the various types of drugs, chemistry and properties of some drugs. Production of selected drugs from natural sources and synthesis.

### **ICH 301      INDUSTRIAL MANAGEMENT II                      L2TOP0      2 UNITS**

Pre-requisite: ICH 203

An introduction to anatomy of management, Industrial relation, Public relations, Industrial Psychology, organizational design, Management of personnel , an introduction to the production functions, planning for productivity, General problem solving processes and creative thinking; analytical methods of investigation.

**Financial relationship:** statement, revenue, depreciation, taxes, capitals, cash receipts and disbursements. Operation planning and control – cost concepts, estimating and controlling costs, materials, labour production cost (fixed and variable), cost-volume-profit relationships. Budgets-sales and production. Capital investment decision.

### **ICH 303      HEAVY INORGANIC CHEMICALS                      L2TOP3      2 UNITS**

**Chemistry of metals:** occurrence, extraction, general properties and uses of some metals. Nitrogen-based manufacturing industries. Sulphur dioxide production and

the sulphuric industry. The phosphorous and related industries. Glass, cement and asbestos industries.

**ICH 305 INDUSTRIAL CHEMICAL PROCESSES II L2TOP3 2 UNITS**

Pre-requisite: ICH 205

Mass transfer processes; single phase and interphase, mass transfer drying as a heat- mass transfer process. Extraction and absorption; solvent extraction in mixer settlers and columns; number of ideal stages in gas absorption by HTU method; gas film and liquid film rate determining steps. Solid-liquid separation by filtration and sedimentation. Stoichiometry for systems involving recycles.

**ICH 307 INTRODUCTORY CATALYSIS L2TOP3 2 UNITS**

General principles of catalytic processes. Homogeneous, heterogeneous, and enzyme catalyses. Kinetics and mechanism of catalysis. Chemistry, structure, and applications of industrial catalysis.

**ICH 401 FERTILIZER AND AGROCHEMICAL L2TOP3 2 UNITS**

Chemistry and technology of production of phosphatic and nitrogenous fertilizers. Complex fertilizers. Survey of modern approaches to pest and fungal control. Naturally occurring pesticides – rotenoids, pyrethroids. Survey of synthetic chlorinated hydrocarbon insecticides. Insect pheromones – techniques of identification, isolation and structural determination and configuration – some synthetic analogues. Commercial production of insecticides, herbicides and growth regulation substances. Some Nitrogen containing herbicides – a review. Synthesis of selected nitrogen containing herbicides.

**ICH 403 UNIT OPERATIONS L2TOP3 2 UNITS**

Momentum transfer in material transfer. Flow processes and related measurements. Bernoulli's equation and use. Pumping, compression and expansion. Energy economy. Physicochemical industrial processes, filtration, distillation, extraction, crystallization, evaporation and drying. Reactor types, design and optimization. Waste treatment and utilization.

**ICH 404 INDUSTRIAL FERMENTATION TECHNOLOGY L2TOP3 2 UNITS**

Detail discussion of various fermentation processes. Brewery technology. Production of antibiotics, alcohols and some organic acids.

**ICH 406 INDUSTRIAL SURFACE CHEMISTRY L2TOP3 2 UNITS**

Thermodynamics of surface phenomena. Adsorption processes, equations and application. Wetting and floatation. Corrosion and colloidal chemistry.