Syllabus for Chemical Discipline

Industrial Chemistry – UNITS 1) Nomenclature &Reaction Intermediates of Organic Compounds 2) Surface Chemistry 3) Chemical Thermodynamics 4) Material Science 5) Engineering Materials

Mechanical Engineering – UNITS 1) Strength Of Materials 2) Mechanical Systems And Friction 3) Basics Of Thermodynamics And Refrigeration 4) Steam Boilers, Steam Turbines And I.C Engines 5) Fuels, Nanotechnology And Robotics

Electrical and Electronics Engineering – UNITS 1) Basics in Electric Current 2) A.C Circuits 3) Electrostatics and Electromagnetism 4) D.C Machines, A.C Machines and Transformers 5) Basic Electronics

Mechanical Operations – UNITS 1) Size Reduction and Conveying 2) Separation of Solid–Solid and Solid–Gas System 3) Separation of Solid – Liquid System 4) Special Separation Methods 5) Mixing and Agitation

Momentum Transfer – UNITS 1) Fluid Statics 2) Fundamentals of Fluid Dynamics 3) Flow of Incompressible Fluids in Pipes 4) Transportation of Liquids 5) Transportation of Gases, Piping's and Valves

Inorganic Chemical Technology – UNITS 1) Water Treatment 2) Alkalies and Industrial Gases 3) Fertilizers 4) Glass, Cement and Paint   5) Acid Industries

Heat Transfer – UNITS 1) Conduction 2) Convection and Radiation 3) Principles of Heat Flow in Fluids and Heat Exchangers 4) Evaporation 5) Multiple Effect Evaporators and Insulation

Chemical Process Calculations – UNITS 1) Fundamentals of Process Calculations 2) Material Balance Without Chemical Reaction 3) Material Balance with Chemical Reaction 4) Energy Balance 5) Chemical Kinetics

Process Instrumentation and Control – UNITS 1) Basic Concepts of Measurement and measurement of Temperature 2) Measurement of Pressure 3) Measurement of Flow, Liquid Level and Humidity. 4) Process Control 5) Computerized process control

Organic Chemical Technology – UNITS 1) Oils Fats and Detergents 2) Petroleum Processing 3) Petrochemical Technology 4) Polymer Processing 5) Bio-Technology and Fermentation.

Industrial Safety and Pollution Control – UNITS 1) Industrial Accident and Safety 2) Fire and Explosion 3) Process Plant Hazards 4) Legal Aspects of Safety 5) Pollution Control

Mass Transfer-I – UNITS 1) Principles of Mass Transfer 2) Fundamental of Distillation 3) Design and Techniques of Distillation Column 4) Absorption 5) Solvent Extraction

Mass Transfer-II – UNITS 1) Humidification 2) Drying 3) Crystallisation 4) Leaching 5) Absorption

Specific Process Technologies – UNITS 1) Paper and Sugar Technology 2) Pharmaceutical and Genetic Engineering 3) Surface Coating Industries 4) Pesticides and Dyes 5) Food Processing and Nanotechnology

Process Plant Operations – UNITS 1) Plant Utilities 2) Storage and Handling of Chemicals 3) Plant Maintenance 4) Energy Management 5) Corrosion.

Syllabus for Chemistry Discipline

PHYSICAL CHEMISTRY II

Unit I: Photochemistry and Group Theory
1.1 Photochemistry: Laws of Photochemistry: Grothus – Draper`s law – Stark – Einstein`s llaws & photochemical equivalence, Beer – Lamberts law and Quantum yield. Primary and Secondary reactions – kinetics of hydrogen and bromine reaction – Fluorescence and phosphorescence – Photosensitisation – Chemiluminescence.
1.2 Group theory: Symmetry operations – products of symmetry operations – classes and subgroups – group multiplication table – Properties of a group – point groups – C2v, C3v (any one example for each).

Unit II:
2.1 Metallic and Electrolytic Conductors: Specific, equivalent and molar conductance-measurement of conductance – variation of conductance with dilution for strong and weak electrolytes (qualitative explanation), Transport number and its determination by Hittorff's and moving boundary method, effect of temperature and concentration. Ionic mobility and ionic conductance, Kohlrausch's law and its applications, salt hydrolysis and pH of a salt solution, buffer action and explanation.

Unit III:
3.1 Theory of strong electrolytes – Debye – Huckel theory – Verification of Onsager equation – Wein effect and Debye – Falkenhargen effect, ionic strength, activity and activity coefficients of strong electrolytes.
3.2 Applications of conductivity measurements – degree of hydrolysis, solubility product and conductometric titrations.

Unit IV:
4.1 Galvanic Cells – reversible and irreversible electrodes and cells, standard cell – emf and its measurements – types of electrodes – electrode reactions – electrode potentials – reference electrodes – standard electrode potentials.
4.2 Derivation of Nernst equation for electrode potential and cell emf, sign conventions electrochemical series and its applications, formation of cells – electrode and cell reactions, cell emf – chemical cells and concentration cells with and without transference – examples and derivation of expressions for their emfs – liquid junction potential.

Unit V:
5.1 Applications of emf measurements – Calculation of $\Box$G, $\Box$H, $\Box$S and equilibrium constants – determination of pH using quinhydrone and glass electrodes, potentiometric titrations.
5.2 Applications of concentration cells – determination of valency of ions, transport number, equilibrium constant, solubility product, activity coefficients of electrolytes.
5.3 Polarisation – decomposition potential, over voltage cells, lead acid battery – mechanism of discharging and recharging, fuel cells.

ORGANIC CHEMISTRY II

Unit I:

1.1 Preparation of phenylene diamines, sulphanilic acid, sulphanilamide, saccharin and chloramines – T.

1.2 Dyes – theory of colour and constitution. Classification – according to structure and methods of application. Preparation and use of 1) Azo dye – methyl orange and Bismark brown 2. Triphenyl methane dye-malachite green 3. Phthalein dye – phenolphthalein and fluroescein 4. Vat dye – indigo 5. Anthraquinone dye – alizarin.

Unit II:

2.1 Amino acids and proteins – classification of amino acids. Essential and non-essential amino acids. Preparation of $\square$-amino acids, properties and reactions. Zwitter ions, isoelectric points – Peptide synthesis – structure of polypeptides – end group analysis.

2.2 Proteins – Classification based on physical and chemical properties and on physiological functions. Primary and secondary structures of proteins. $\square$ – helical structure (elementary treatment only). Denaturation of proteins.

Unit III:

3.1 Carbohydrates – Classification – Constitution of glucose and fructose. Reactions of glucose and fructose – osazone formation. Mutarotation and its mechanism. Cyclic structure. Pyranose and furanose forms. Determination of ring size. Haworth projection formula. D and L configuration of monosaccharides – epimerisation, chain lengthening and chain shortening of aldoses. Inter conversion of aldoses and ketoses.

3.2 Disaccharides: Structure of sucrose & maltose. Polysaccharides: Properties of Starch & Cellulose (Structural elucidation not required). Uses of cellulose derivatives.

Unit IV:

4.1 Natural products – Terpenes – isoprene rule. Classification of Terpenes. Structural elucidations of Citral, menthol and $\square$- terpineol.

4.2 Alkaloids – General methods of isolation and general methods of structure determination – structural elucidation of coniine, piperine and nicotine.

Unit V:

5.1 Diazomethane and diazoacetic ester – preparation, structure and synthetic uses.

5.2 Nucleic acids – types of nucleic acids – RNA and DNA – components – Types of RNA and their biological functions.

5.3 Molecular rearrangements: Pinacol – Pinacolone,, Wagner Meerwein, Wolff, Beckmann, Hofmann, Benzilic acid, Cope and Claisen rearrangements.

INORGANIC CHEMISTRY II

Unit-I: Chemistry of `d' block elements
1.1 Characteristics of `d' block elements. Comparative study of Ti, V, Cr, Mn and Iron group metals- occurrence, oxidation states, magnetic properties, catalytic properties and color.
1.2 Theory of Bonding, Valence bond theory – hybridization, geometry and magnetic properties. Failure of VBT.

Unit-II: Coordination compounds
2.1 Nomenclature, Werner's theory, EAN rule, Coordination number and geometry. Chelation and effect of chelation. Application of EDTA. Ionisation isomerism, hydrate isomerism, Linkage isomerism, Ligand isomerism, Coordinated isomerism, polymerization isomerism. Geometrical and optical isomerism in 4 and 6 coordinated complexes.

Unit-III: Crystal Field Theory
3.1 Crystal field theory-Spectrochemical series, splitting of `d' orbital in Octahedral, tetrahedral and square planar complexes- low spin and high spin compleces- Explanation of magnetic properties, color and geometry using CFT. Trans effect and its explanation.
3.2 Comparison of VBT and CFT.

Unit-IV: Bio inorganic chemistry
4.1 Elementary aspects of Haemoglobin, myoglobin, Chlorophyll and Vitamin 13 – 12.
4.2 Pi acceptor Ligands- Bonding, hybridization and structures of carbonyls of Ni, Cr, Fe, Co, Mn, W and V.

Unit-V: Pollution and its control
5.1 Sources of air pollution CO_2 Pb, CO, Oxides of nitrogen and sulphur, freons, smog-green house effect-global warming – methods of control.
5.2 Pollution of soil- fertilizers, insecticides, solid waste and acid rain. Methods of control.
5.3 Water Pollution – Industrial and domestic waste, effluents, sewage waste, fertilizers, insecticides oil, toxic metals. COD and BOD. Consequences- methods to control water pollution. Rain water harvesting –its need, methods and advantages.
5.4 Noise pollution and radioactive pollution – health hazards.

ANALYTICAL CHEMISTRY –I

Unit I:

1.1.Data analysis – idea of significant figures and its importance with examples- precision and accuracy – method of expressing accuracy – error analysis- minimizing errors – method of expressing precision – average deviation – standard deviation and confidence limit.

1.2.Principles of gravimetric analysis – characteristics of precipitating agents – choice of precipitants and conditions of precipitation. Specific and selective precipitants – DMG, cupferron, salicylaldehydeoxime – use of sequestering agents – Co- precipitation – Post-precipitation – differences – reduction of error – Precipitation from homogeneous solutions.

Unit II:

2.1. Thermo analytical methods – principle involved in thermo gravimetric analysis and differential thermal analysis – discussion of various components with block diagram – characteristics of TGA and DTA – factors affecting TGA and DTA curves – thermometric titrations.

2.1.Separation and purification techniques: Solvent extraction – soxhlet extraction- recrystallisation – fractional crystallization – sublimation. Experimental techniques of distillation – fractional distillation – vacuum distillation – steam distillation.

Unit III:

3.1. Chromatography techniques – principles of adsorption, partition and ion exchange chromatography. Column chromatography – adsorbents – preparation of column – elution and applications. TLC – choice of adsorbent and solvent – preparation of chromatogram and applications – Rf value. Paper chromatography – principle, Rf value, separation of aminoacid mixtures. Ion exchange chromatography – resins – action of resins – experimental technique – applications – separation of Zn-Mg, Co-Ni, Cd-Zn, Cl-Br. Gas chromatography and high performance liquid chromatography – principles and applications only.

Unit IV:

4.1. Introduction to absorption spectroscopy – Electromagnetic spectrum, its regions. Line and Band spectra. UV – Visible spectroscopy – instrumentation – spectrophometer – block diagrams with description of components – theory – types of electronic transitions – Chromophore and auxochromes. Shift of absorption bands (Blue, red shift, Hyperchromic and Hypochromic effects.). Absorption maximum (λmax) – calculation of λ max for a few aromatic compounds. (ArCOG; G=H, R, OH, OR)

Unit V:

5.1. Infrared spectroscopy – principle – types of stretching and bending vibrations – vibrational frequencies – instrumentation of single beam spectrometer only – block diagram – source – monochromator – cell sampling techniques – detector and recorders – identification of organic molecules from characteristic absorption bands (carbonyl compounds, carboxylic acids, phenols and nitro compounds only)

5.2 Raman spectroscopy – Raleigh and Raman scattering – Stoke's and anti stokes lines – instrumentation – block diagram – differences between LR and Raman Spectroscopy – mutual exclusion principle (definition only) – applications – structural diagnosis.

PHYSICAL CHEMISTRY- I

Unit-I:

1.1 Solutions: Solutions of gases in liquids – Henry's law, Solution of liquids in liquids. Raoult's law, Binary liquid mixtures – Ideal solutions – deviations from ideal behaviour – vapour pressure – Composition and vapour pressure – temperature curves, azeotropic distillation.

1.2 Clapeyron – Clausius equation: Derivation and uses, thermodynamic derivation of elevation of boiling point and depression of freezing point, calculation of molecular weights.

1.3 Distribution law – Thermodynamic derivation and applications:

Unit-II:

2.1 Phase equilibria: Gibb's phase rule – statement and definition of terms – Application to one-component systems – water and sulphur, reduced phase rule – two component systems simple electric system (lead – silver system), freezing mixtures. Two component systems – compound formation with congruent melting point (Zinc – Magnesium system, Ferric chloride – water system), incongruent melting point (sodium – potassium system), Partially miscible liquids – Phenol – water, CST and effect of impurities on CST.

Unit-III:

3.1. Chemical Kinetics: - Definition of order and molecularity – methods to determine the rate of reactions, derivation of rate constants for I, II. order reactions - Third and zero order reactions and examples. (No derivation of rate constant) Derivation for time for half change with examples, methods to determine the order of reactions – effect of temperature on the rate of reactions.-Arrhenius equation and concept of energy of activation.

Unit-IV:

4.1. Collision theory: Collision theory and derivation of rate constant for bimolecular reactions – theory of absolute reaction rates – thermodynamic derivation for the rate constant for a biomolecular reaction from it – Absolute Reactions Rate Theory (ARRT) Comparison of collision and ARRT. Significance of entropy and free energy of activation – Consecutive, parallel and reversible reactions. (No derivations, only examples)

Unit-V:

5.1 Adsorption: Physisorption and chemisorption – Freundich adsorption isotherm – Langmuir adsorption isotherm – BET equation (noderivation) – applications of adsorption.

5.2 Catalysis: Definition – homogeneous catalysis – function of a catalyst in terms of Gibb's free energy of activation, heterogeneous catalysis.

ORGANIC CHEMISTRY- I

Unit - I:
1.1 Carbonyl polarization, Reactivity of carbonyl group - acidity of hydrogen.
1.2 Mechanisms of Aldol, Perkin, Knoevenagel, Benzoin, Dieckmann, Stobbe condensations, Claisen, Wittig, Cannizzaro, Reformat sky, Halo form and Mannich reaction.
1.3 Mechanisms of Clemmensen, Wolf-Kishner, MPV, Rosenmund
1.4 Mechanisms of oxidation of aldehydes and ketones by $KMnO_4$ and Baeyer - Villiger oxidation.

Unit - II:
2.1 Ionization of carboxylic acids - acidity constants - comparison of acid strengths of mono, di and unsaturated acids - acid strengths of substituted benzoic acids.
2.2 Preparation and properties of mono carboxylic acids - HVZ, esterification. decarboxylation, kolbe's electrolysis, Hunsdieker reaction, Arndt - Eistert homologation.
2.3 Preparation and properties of dicarboxylic acids - uses of NBS as an oxidizing agent.
2.4 Preparation and properties of salicylic and phthalic acids - Kolbe- Schmidt reaction and Dakin reaction.
2.5 Active methylene compounds: Malonic and acetoacetic ester – synthetic uses of malonic and acetoacetic ester.

Unit-III:
3.1 Stereoisomerism: Definition – classification into optical and geometrical isomerism.
3.2 Optical isomerism – optical activity – conditions for optical activity – asymmetric center – chirality – methods of racemisation and resolution – asymmetric synthesis – (partial and absolute) – Walden inversion.
3.3 Absolute configuration: Cahn – Ingold – Prelog rules, R-S notations for optical isomers with one and two asymmetric carbon atoms.
3.4 Geometrical isomerism: Cis, trans and E,Z notations – geometrical isomerism in maleic and fumaric acids – physical and chemical methods of distinguishing geometrical isomers.
3.5 Conformational analysis: Conformers – dihedral angle – conformational analysis of ethane and n-butane – energy diagram – conformers of cyclohexane – boat and chair forms.

Unit-IV:
4.1 Aromaticity of heterocyclic compounds.
4.2 Preparation, properties and uses of furan, pyrrole and thiophene.
4.3 Synthesis and reactions of pyridine – comparative study of basicity of pyrrole, pyridine and piperidine with amines.
4.4 Synthesis and reactions of quinoline, isoquinoline and indole with special reference to Skraup. Bischler-Napieralskii and Fischer indole syntheses.

Unit-V:
5.1 Nitro compounds & amines – Conversion of nitro benzene into ortho, para and meta dinitrobenzene & TNT. Aromatic nitro compounds: reduction in neutral, acidic and alkaline media. Relative basic strengths of aliphatic and aromatic amines. Diazotisation and its mechanism. Synthetic applications of diazonium salts.
5.2 Photochemistry of carbonyl compounds: Norrish type I and type II reactions and Barton reaction.
5.3 Tautomerism: Definition – keto – enol & nitro – acinitro tautomerism – Identification, separation and mechanism.

INORGANIC CHEMISTRY –I

Unit-I: Nuclear Chemistry

1.1 Radioactive series including Neptunium series-group displacement law. Fundamental particles of the nucleus- nucleon terminology, nuclides, isotopes, isobars, isotones, mirror nuclei. Nuclear radius, nuclear mass and nuclear forces operating between the nucleons. N/P ratio, curves, stability belts – Radioactivity Grauthers draper law – Radioactive series.

1.2 Nuclear binding energy. Mass defect, simple calculations involving mass defect and B.E per nucleon, Magic numbers – Liquid drop model- shell model.

Unit-II: Artificial Radioactivity

2.1 Definition – Induced radioactivity-uses of radio isotopes. Nuclear fission-nuclear energy-nuclear reactors-breeder reactors-nuclear fusion – thermonuclear reactions-energy source of the sun and stars.

Unit-III: Chemistry of `f' block elements

3.1 Comparative account of – Lanthanides and actinides- occurrence, elements, oxidation states, magnetic properties, color and spectra.

Unit-IV: Metallurgy

4.1 Metallurgy and metallurgical processes, zone refining, Van arkel process, electrolytic refining extraction, alloys and uses of Pt, Th and U. Uranium hexafluoride and its importance. Steel alloys – heat treatment of steel.

Unit-V: Industrial Chemistry

5.1 Fuel Gases, Calorific value-composition and source of water gas, semi water gas, carbonated water gas, producer gas, oil gas, LPG and bio-gas. (Manufacture not required)

5.2 Water: Hardness of water, Types of hard water – Softening of water using washing soda, ion exchange resins and boiling methods.

5.3 Cement: Composition and setting of cement

5.4 Paints and Pigments: Examples and their role.

GENERAL CHEMISTRY-IV

Unit-I

1.1 Nitrogen family

Comparative study of N, P, As, Sb, and Bi – elements, oxides, oxyacids, halides and anhydrides, valency states – preparation, properties, structure and uses of hydrazine, hydroxylamine and hydrazoic acids, preparation and uses of $NaBiO_3$.

1.2 Oxygen family

Comparative study of O, S, Se, and Te – elements, hydrides, oxides and oxyacids of sulphur including peroxy acids.

Unit-II

2.1 Halogens

Comparative study of F, Cl, Br, I and At – elements reactivities, hydrogen halides, oxides and oxyacids. Interhalogen compounds and pseudo halogens. Exceptional properties of Fluorine.

2.2 Nobel Gases

Electronic configuration and position in the periodic table. Applications, clathrates and compounds of xenon, hybridization and geometries of XeF_2, XeF_4, $XeOF_4$.

Unit-III

3.1 Elimination Reactions

Hoffmann and Saytzeff's rules – cis and trans eliminations – mechanisms of E1 and E2 reactions. Elimination vs. substitution.

3.2 Alcohols

Synthesis by Grignard method and oxymercuration – chemical reactivity. Polyhydric alcohols, cleavage reactions with periodic acid, lead tetra acetate, osmium tetra oxide. Unsaturated alcohols – preparation and reactions of allyl alcohol.

Unit-IV Phenols

4.1 Acidic character of phenols – explanation on the basis of resonance stabilization. Ring substitution in phenol – orientation of phenolic group towards electrophiles. Mechanisms of electrophilic substitution reactions - alkylation, acylation, nitration, sulphonation, halogenation, coupling with diazonium salts. Kolbe's reaction, Reimer-Tiemann reaction, Gattermann reaction. Dihydric phenols (catechol, quinol, and resorcinol), trihydric phenols (pyrogallol and phloroglucinol), alpha and beta napthols – preparation and properties.

Unit-V

5.1 Third law of Thermodynamics

Nernst heat theorem-statement of Third law of thermodynamics. Evaluation of absolute entropy from heat capacity measurements. Exception to Third law.

5.2 Partial Molar Properties

Chemical potential – Gibbs Duhem equation – effect of temperature and pressure on chemical potential – chemical potential in system of ideal gases – Duhem-Margules equation.

5.3 Chemical Equilibrium

Derivation of the law of chemical equilibrium – reaction isotherm – relationship between equilibrium constant and free energy – variation of equilibrium constant with temperature – Vant Hoff isochore.

GENERAL CHEMISTRY-III

Unit-I

1.1 Principles of Inorganic Analysis - Principles of common ion effect and solubility product and their applications in qualitative analysis. Spot test reagents - aluminon, cupferon, thiourea, magneson, and alizarin - Semi micro techniques.

1.2 'p' block elements - Boron family - electron deficiency and electron acceptor behavior - bonding in diborane. Preparation, properties, uses and structure of borazole, $NaBH_4$, and $LiAlH_4$.

Unit-II

2.1 Carbon family - Comparison of properties of carbon and silicon valencies, oxides, halides, hydrides and oxyacids classification, properties and uses of carbides. Classification of silicates.

Unit-III

3.1 Aromatic hydrocarbons and aromaticity - resonance in benzene - delocalized cloud in benzene - Huckel's rule $(4n+2)$ system and its simple applications. Electrophilic substitution reactions in aromatic compounds. General mechanisms- nitration, halogenations, sulphonation, Friedal-Craft's alkylation and acylation -directive influence - orientation, nuclear and side chain halogenations.

Unit-IV

4.1 Polynuclear hydrocarbons - naphthalene, and anthracene and phenanthracene-isolation, properties, synthesis and uses.

4.2 Aliphatic Nucleophilic substitution, mechanism of SN1, SN2 and SNi reactions - effects of structure, substrate, solvent, nucleophile and leaving groups.

Unit-V

5.1 Second law of thermodynamics - need for second law, statement of second law. Spontaneous process, carnot cycle – efficiency - carnot's theorem (statement only).

5.2 Concept of entropy – definition - entropy of an ideal gas - entropy changes in cyclic, reversible and irreversible processes and physical transformations. Calculation of entropy changes with changes in temperature, pressure and volume – entropy of mixing.

5.3 Gibbs free energy - Helmotz free energy-their variations with temperature, pressure and volume. Criteria for spontaneity - Gibbs-Helmoltz equations -derivation and applications.

GENERAL CHEMISTRY- II

Unit: I:
1.1 Ionic bond**:** Formation and general properties. Radius ration rule and its limitations Hydration energy and lattice energy and their applications. Born-Haber cycle and Fajan's rule.
1.2 Covalent bond: Valence bond theory. Formation and general properties. Orbital overlap – Hybridization, sigma and pi bonds. VSEPR theory and geometrics of H_2O, NH_3, CH_4, PCl_5, PCl_3 BF_3, SF_6, IF_7 and SO_2 molecules. Partial ionic character of covalent bond and percentage of ionic character.

Unit: II
2.1 Molecular Orbital theory: Bonding and antibonding orbitals and bond order. MO diagrams of H_2, Be_2, O_2, O_2^+, O_2^-, CO and NO. Comparison of VB and MO theories. Hydrogen bonding – types, examples and effect on properties.
2.2 Hydrides **–** classification and chemistry**.**
2.3 Alkali metals: Occurrence, comparative study of elements, oxides, halides, hydroxides, sulphates and carbonates. Exceptional property of Lithium
2.4 Alkali earth metals: Occurrence, comparative study of elements, oxides, halides, hydroxides, sulphates and carbonates. Exceptional property of Beryllium.

Unit: III:
3.1 Alkynes – Preparation and properties, acidity of alkynes, formation of acetylides Addition of water with $HgSO_4$ catalyst, addition of hydrogen halides and halogens, oxidation, ozonolysis and hydrocarboration
3. 2 Dienes- Classification – conjugated, isolated and cumulative dienes. Stability and chemical reactivity- 1,2 and 1,4 additions. Diels-alder reaction. Synthesis of dienes – 1,3 – butadiene, isoprene and chloroprene.
3.3 Polymerization – Types of polymerization – free radical cationic and anionic Polymerization including mechanism of preparation of polymers – addition polymers Condensation polymers with examples.

Unit: IV:
4.1 Definition and explanation of terms – intensive and extensive properties – types of systems – thermodynamic process – cyclic, reversible, irreversible, isothermal and adiabatic.
4.2 Thermodynamic functions – complete differential – Zeroth law of thermodynamic – concept of heat and work.

Unit: V
5**.1** First Law of thermodynamics – statement and equation. Cp and Cr relationship – calculation of W, E and H for the expansion of ideal gases under reversible, isothermal and adiabatic conditions**.**
5.2 Joule's law – joule – Thompson effect – inversion temperature and its significance.
5.3 Thermo chemistry: Bond energy – Bond disassociation energy – Calculation from thermo chemical data – variation of heat of reaction with temperature – Kirchoff's equation.

GENERAL CHEMISTRY- I

UNIT :I
1.1 Atomic structure: Aufbau principle, Hund's rule and electronic configuration of elements-stability of half filled and completely filled orbitals – shapes of s, p, d and f orbitals. S,p,d and f block elements – classification and characteristic properties.
1.2 Periodicity of properties: Definition and periodicity of the following properties – atomic radii, ionic radii, ionization potential, electron affinity and electro negativity (no determination) – lanthanide contraction – inert pair effect and diagonal relationship with example.

UNIT :II
2.1 Principles of Volumetric analysis: Definition of molarity, normality, molality, formality and mole fraction. Definition and examples for primary and secondary titrations. Calculations of equivalent weighs, theories of acid base, redox, metalion, absorption indicators and choice of indicators.
2.2 Types of solvents: Protic and aprotic solvents, aqueous and non aqueous solvents, liquid ammonia and liquid SO_2 as solvents.

Unit: III
3.1 Basic concepts of bonding in organic chemistry – hybridization and geometry of molecules – methane, ethylene, acetylene and benzene. Electron displacement effects inductive, inductometric, electrometric, mesomeric, resonance, hyper conjugation and Steric effects: Cleavage of bonds – hemolytic fission of carbon-carbon bond-reaction reaction intermediaries – carbonations. Carboanions and free radicals-their stability.
3.2. Nomenclature of organic compounds, IUPAC recommendations for naming simple aliphatic, alicyclic and aromatic compounds

UNIT :IV
4.1 Alkaline – mechanism of free radical substitution in alkanes.
4.2 Alkenes- General methods of preparation, properties of alkenes-electrophilic and free radical addition reactions with hydrogen, halogen, halogens, hydrogen halides (Markownikoff's rule) hydrogen bromide (peroxide effect), sulphuric acid. Water, hydroboration, ozonolysis, hydrolaxation with $KMnO_4$

UNIT : V
5.1 Quantum theory: Black body radiation : Planck's theory – photoelectric effect- Compton effect- De-Broglie Relationship-Heisenberg's uncertainty principle- Schrödinger wave equation (no derivation)-significance of wave functions- Probability distribution of electrons-radial Probability distribution curves.
5.2 Gaseous state: – Kinetic Theory of Gasses – Gas laws – Transport properties, viscosity – thermal conductivity – diffusion – Maxwell's distribution of molecular velocities (no derivation) – mean, RMS, most probable velocities – Equipartition of energy-Heat capacity, molecular basis-Virial equation of state- Boyle's Temperature. Coefficient of compressibility and thermal expansion
5.3 Solid state: Elements of symmetry- crystal system – Miller indices – unit cell space lattice - Bravais lattice, Bragg's equation & its derivation, packing fraction, X-ray diffraction method, powder method, rotating crystal method.
5.4 Mesomorphic state: Liquid crystal-classification and molecular rearrangements.

Syllabus for Mechanical Discipline

Strength of Materials – UNITS 1) Statics of particle and friction 2) Mechanical properties, simple stresses and strains 3) Geometrical properties of sections and thin shells 4) Shear force and bending moment diagrams, theory of simple bending 5) Torsion and springs

Manufacturing Processes – UNITS 1) Foundry Technology 2) Welding Technology 3) Forming Technology 4) Theory of Metal Cutting & Lathe 5) Drilling & Metrology

Machine Drawing – UNITS 1) Sectional Views 2) Limits, Fits and Tolerances 3) Surface Texture 4) Keys, Screw threads and Threaded fasteners 5) Assemble drawing

Heat Power Engineering – UNITS 1) Basics of thermodynamics and thermodynamic processes of perfect gases 2) Thermodynamic air cycles and fuels & combustion 3) Air compressors and Gas turbines 4) Formation & properties of steam and steam calorimeters 5) Steam boilers and performance of boilers

Special Machines – UNITS 1) Manufacturing of Plastic Components and Composite Manufacturing 2) Reciprocating Machines and Broaching Machine 3) Milling Machines and Gear Generating Processes 4) Abrasive Process and Non- Conventional Machining Processes 5) CNC Machine and Its Components

Fluid Mechanics and Fluid Power – UNITS 1) Properties Of Fluids And Pressure Measurements 2) Flow Of Fluids And Flow Through Pipes 3) Impact Of Jets, Hydraulic Turbines, Centrifugal And Reciprocating Pumps 4) Pneumatic Systems 5) Hydraulic Systems

Electrical Drives & Control – UNITS 1) DC Circuits and DC Machines 2) AC Circuits and AC Machines 3) Stepper and Servo Motors & Drives 4) Power Supplies and Logic Gates 5) Control Elements and PLC

Design of Machine Elements – UNITS 1) Design of Joints And Fasteners 2) Design of shafts, couplings and keys 3) Design of friction drives (flat belt and v-belt) 4) Design of bearings 5) Design of levers and spur gears

Thermal and Automobile Engineering – UNITS 1) Thermal Power Plant, Steam Turbines & Condensers, Refrigeration and Air Conditioning 2) IC Engines and its components 3) Automobile Cooling Systems, Lubrication System & Fuel Feed Systems 4) Automobile Transmission and Power Trains & Chassis 5) Automobile Brake System, Electrical Equipment and Pollution Control

Process Planning and Cost Estimation – UNITS 1) Process Planning 2) Process Selection 3) Work Study 4) Cost Estimation 5) Machining Time Calculations.

Total Quality Management – UNITS 1) Basic Concepts of Total Quality Management 2) Continuous process improvement –7 QC Tools 3) Statistical Fundamentals 4) Control charts 5) Management Planning tools & Bench marking

Press Tools – UNITS 1) Press working fundamentals, operations, and machinery 2) Press & press tool accessories and cutting dies 3) Bending and forming dies 4) Drawing dies and dies for secondary operations 5) Fine blanking tool and specialized press tool applications

Renewable Energy Sources and Energy Conservation – UNITS 1) Fundamentals of Energy, Wind Energy 2) Solar Energy, Application, Storage 3) Solar Photovoltaic System and Design, Ocen, Tidal, Wave Energy 4) Bio-Energy 5) Energy Conservation Techniques and Energy Audit

Industrial Engineering and Management – UNITS 1) Plant Engineering and Plant Safety 2) Work Study, Method Study and Work Measurement 3) Production Planning and Quality Control 4) Principles, Personnel Management and Organizatioal Behavior 5) Financial and Material Management

Computer Aided Design and Manufacturing – UNITS 1) Computer Aided Design 2) Computer Aided Manufacturing 3) CNC Programming, Rapid Prototyping 4) Computer Integrated Manufacturing, Flexible Manufacturing Systems, Automatic Guided Vehicle, Robot 5) Concurrent Engineering, Quality Function Deployment, Product Development Cycle, Augmented Reality.

Mechanical Instrumentation – UNITS 1) Types of Measurement, Measurement of Error 2) Displacement Measurement- Pressure Measurement 3) Temperature Measurement- Flow Measurements 4) Miscellaneous Measurement 5) Control Systems

Robotics – UNITS 1) Fundamentals of Robot Technology 2) Robot Controller, Drive Systems and End Effecters 3) Sensors and Machine Vision 4) Robot Kinematics and Robot Programming 5) Robot Applications in Manufacturing

Refrigeration and Air-conditioning – Units 1) Refrigeration System and Refrigeration Equipments 2) Vapour Compression & Absorption Refrigeration System and Cryogenic Refrigeration Systems 3) Refrigeration Flow Controls, Refrigerants and Lubricants and Applications Of Refrigeration 4) Psychometrics And Comfort Air Conditioning Systems 5) Cooling Load Calculations and Duct Design, Energy Conservation Techniques

Syllabus for Electrical Discipline

Electrical Circuit Theory – UNITS 1) Electrostatics / D C Circuits 2) Circuit Theorems 3) Single Phase Circuits 4) Resonant Circuits 5) Three phase Circuits

Electrical Machines - I – UNITS 1) D C Generators 2) D C Motors 3) Single Phase Transformers 4) Three Phase Transformers 5) Storage Batteries

Electronic Devices & Circuits – UNITS 1) Semiconductor and Diodes 2) Bipolar Junction Transistor 3) Transistor oscillators and FET and UJT 4) SCR, DIAC, TRIAC and MOSFET 5) Opto Electronic Devices and Wave Shaping Circuits

Electrical Machines - II – UNITS 1) Alternator principles and construction 2) Alternator performance and testing 3) Three phase induction motor 4) Single phase induction motor / Synchronous motor 5) Special AC machines / Special DC machines

Measurements And Instruments – UNITS 1) Classification and Characteristics of Instruments 2) Measurement of current Voltage and Resistance 3) Measurement of Power and Energy 4) Measurement of Power factor Frequency and Phase difference 5) Measurement of L,C and waveforms

Digital Electronics – UNITS 1) Number System, Boolean Algebra, Logic Gates and Digital Logic Families 2) Combinational Logic 3) Sequential Logic 4) Memory Devices 5) Microprocessor – 8085

Transducers And Signal Conditioners – UNITS 1) Classification and Sensing elements 2) Passive Transducers 3) Active Transducers 4) Operational amplifiers 5) Signal conditioners in Industrial Instrumentation

Generation, Transmission And Switchgear – UNITS 1) Generation Of Electrical Power 2) A.C. And H.V.D.C Transmission 3) Line Insulators And Underground Cables 4) Circuit Breakers And Over Voltage Protection 5) Protective Relays And Grounding

Microcontroller – UNITS 1) Architecture & Instruction set of 8051 2) Programming Examples 3) I/O and Timer 4) Interrupt and Serial Communication 5) Interfacing Techniques

Electrical Estimation And Energy Auditing – UNITS 1) Systems Of Internal Wiring And Earthing 2) Domestic and Industrial Estimate 3) Energy Management & Audit 4) Electric Motors & Lighting System 5) Diesel Generating System & Energy Efficient Technologies In Electrical Systems

Control Of Electrical Machines – UNITS 1) Control circuit components 2) AC motor control circuits 3) Industrial control circuit 4) Programmable Logic Controller 5) PLC Programming

Programmable Logic Controller – UNITS 1) Introduction PLC 2) Input and Output Moules 3) PLC Programming 4) Networking 5) Data Acquisition Systems

Electrical Machnice Design – UNITS 1) Electrical Machine Design – Basic Consideration 2) Magnetic Circuit Calculations 3) Design of Transformer 4) Design of dc machines 5) Design of ac machines

Distribution and Utilization – UNITS 1) Distribution 2) Industrial Devices 3) Electric Traction 4) Illumination 5) Electric Heating and Welding

Operation And Maintenance Of Electrical Equipment – UNITS 1) Earthing Arrangements, Safe Working Of Electrical Equipment, Building Electrical Installations 2) Operation & Maintenance Of Transformer 3) Operation & Maintenance Of Generators, Sub-Stations And Circuit Breakers 4) Operation & Maintenance Ac Motors And Starters 5) Operation & Maintenance Of Lighting, Transmission And Distribution
.
Power Electronics – UNITS 1) Overview Of Power Electronics 2) Line Commutated Power Control Circuits 3) Forced Commutated Power Control Circuits 4) Applications Of Power Electronics 5) Motor Drive Applications

Syllabus for Instrumentation Discipline

Electronic devices and circuits – UNITS 1) Semiconductor and Diodes 2) Bipolar Junction Transistor 3) Transistor oscillators and FET and UJT 4) SCR,DIAC,TRIAC and MOSFET 5) Opto Electronic Devices and Wave shaping Circuits

Electrical Circuits and Machines – UNITS 1) DC circuits and DC Networks Theorems 2) AC circuits 3) Resonance and Three phase AC circuits 4) Three DC Machines and AC Machines 5) Transformers

Basics of Instrumentation – UNITS 1) Basics of Instrumentation 2) Performance characteristics of Instruments 3) Sensors and Transducers 4) Mechanical and Optical Transducers 5) Electrical Transducers

Analog and Digital Electronics – UNITS 1) Linear Ics: Op. amp. Timer and their applications 2) Boolean Algebra 3) Combinational Logic 4) Sequential Logic 5) D/A, A/D and Memory

Measurements and Instruments – UNITS 1) Measuring instruments 2) Bridges and oscilloscope 3) Test instruments 4) Digital instruments 5) Operational amplifier applications

Measurement of Process Variables – UNITS 1) Measurement of Temperature 2) Measurement of Pressure 3) Measurement of Flow (Mechanical) 4) Measurement of Flow (Electrical) 4) Measurement of Level, Humidity and Moisture

Industrial Instrumentation – UNITS 1) Comparators 2) Measurement of velocity and Acceleration 3) Measurement of Force, Torque and Shaft power 4) Measurement of PH and Gas analysis 5) Chromatography and spectral method of analysis

Process Control Instrumentation – UNITS 1) Simple process control systems and terminology 2) Control principles 3) Tuning of controllers 4) Final control elements 5) Complex control systems

Microcontroller – UNITS 1) Architecture & Instruction set of 8051 2) Programming Examples 3) I/O and Timer 4) Interrupt and Serial Communication 5) Interfacing Techniques

Control Engineering – UNITS 1) Basics of control systems, laplace transform and transfer function 2) Block diagram, signal flow graph representation and components 3) Time response 4) Frequency response 5) Stability

Instrumentation System Design – UNITS 1) Design of Transducers and Signal Conditioning Circuits 2) Design of Transmitters and Controllers 3) Control Valve Selection 4) Engineering Design Criteria 5) Safety in Instrumentation and Control Systems

Programmable Logic Controllers – UNITS 1) Architecture and operation of PLC 2) Programming of PLC 3) PLC Timers and counters 4) Advanced instructions 5) I/O Module Communication and networking

Industrial Power Electronics – UNITS 1) Power devices and Trigger circuits 2) CONVERTERS (Qualitative treatment only) 3) Choppers 4) Inverters & Applications 5) Numerically Controlled Systems

Test Engineering – UNITS 1) Introduction to Test Engineering 2) Automated Testing Methods And Technology 3) V-I(Signature) Testing Methods And Technology 4) Boundary Scan Testing Methods And Technology 5) Ate Test Program Sets Generation & Semiconductor Testing

Industrial Automation and Drives – UNITS 1) Industrial drives 2) Pneumatic and hydraulic systems 3) Programmable logic controller(PLC) 4) Distributed control system(DCS) 5) Robotics.
.
Robotics – UNITS 1) Basic Configuration of Robotics and Its Working 2) Robot Controller And Servo Systems 3) Robot Motion Analysis And Vision System 4) Robot Programming 5) Robot Application In Manufacturing

Embedded Systems – UNITS 1) ARM processor Architecture 2) ARM instruction set and interrupts 3) Catch mechanism and Memory Protection and Management unit 4) LPC 2148 ARM processor 5) Embedded OS and RTOS

Syllabus for Fire & Safety

UNIT 1

1) PHILOSOPHY OF FIRE - Chemistry of fire, Fire Tetrahedron Spreading methods of fire.

2) CLASSIFICATION OF FIRE - Types of flammable fuels & their symbols.

3) EXTINGUISHING METHODS OF FIRE EXTINGUISHERS - Methods of fire Extinguishing, type of fire Extinguishers & their uses.

4) FIRE FIGHITING EQUIPMENTS - Details about Water Tender, Water Pumps, Ladders, Nozzels, Ropes, Hoses, Risers, Fire Suits, Fire Couplings etc.

5) FIRE ALARM SYSTEMS - Manual Call-Point, Fire Alarm, Automatic Fire Alarm, Gas Flooding System, Sensors & Detectors.

6) ACCIDENT PREVENTION - Philosophy of accident, Causes of accidents & Safety Measures.

7) EMERGENCY PLAN - Do's & Don'ts while major fire & gas leaks. On - site & Off - site Emergency Plan.

8) HOUSE KEEPING - Plant Layout, Handling & Storage of materials.

9) LPG SAFETY - Safe methods of handling LPG cylinder, Do's & Don'ts in case of LPG Leaks.

10) PPE - Personal Protective Equipment's & their uses.

UNIT II
1) FUNDAMENTAL OF FIRE ENGINEERING
2) FIRE PREVENTION & PROTECTION
3) INDUSTRIAL SAFETY MANAGEMENT
4) INDUSTRIAL SAFETY MANAGEMENT
5) FIRE DETECTION & COMMUNICTION SYSTEM
6) EQUIPMENT AND APPLIANCES