

INSTITUTE OF CHEMICAL TECHNOLOGY
(Deemed to be University under section 3 of the UGC Act 1956)

Detailed Syllabus for First Year B. Chem. Engg & B. Tech

Sr. No.		Hrs
1.	CHT 1121 – Inorganic Chemistry (50 marks) 3hr./week	
	Periodic Table, s,p,d and f elements and their general properties, correlations among various properties.	3
	Main group Chemistry: Hydrogen, Chemistry of Group IA, II B and Group IIIB to VIIB elements and noble gases.	12
	Chemical Bonding: Valence Bond theory and Molecular orbital theory	3
	Coordination Chemistry: Nomenclature, Werner theory, VSEPR, crystal field theory, electronic and magnetic properties of the complexes.	12
	Organometallics: Metal Ligand concept, , types of ligands, Effective atomic number rule reactions using organometallic compounds like addition, insertion, migration. Concepts of sigma bond and pi bond formation. Application of organometallic complexes in hydrogenation, hydroformylation, carbonylation etc.	15
	Reference Books <ul style="list-style-type: none"> • Concise Inorganic Chemistry, J.D. Lee, Wiley India Edition • Basic Inorganic Chemistry, F.A. Cotton and G. Wilkinson, John Wiley and Sons 	
2.	CHT 1131 – Organic Chemistry I (100 marks) 4hr./week	
	Nomenclature of organic compounds	5
	Mechanisms of organic reactions: Types of Organic Reaction, Reactive intermediates; their generation, structure, stability and general reactions.	10
	Stereochemistry: Elements of symmetry, stereochemistry of compounds containing one and two carbon atoms. Racemates and their resolution, conformation of cyclic and acyclic systems, E and Z isomers of olefins, Idea of asymmetric synthesis.	10
	Chemistry of alkanes, cycloalkanes, alkenes and alkynes: Alkanes from petroleum, methods of synthesis. Properties, General reactions, oligomerization and polymerization of olefins, acidity of terminal alkynes, alkenes as fuels.	10
	Aromaticity and Aromatic hydrocarbons: Huckel's theory of Aromaticity and monocyclic carbocyclic aromatic species, BTX, Aromatic hydrocarbons. Friedel-Craft alkylation. General reaction of aromatic hydrocarbons.	10
	Aliphatic and aromatic halides: Methods of preparation, properties, General reactions, SN ¹ , SN ² reactions, Aromatic nucleophilic reactions.	15

	Reference Books: <ul style="list-style-type: none"> Organic Chemistry, J. McMurry, Brooks/Cole Organic Chemistry, T.W.G. Solomons, C.B. Fryhle, John Wiley and Sons Inc., Organic Chemistry, L.G. Wade Jr, Pearson Education StereoChemistry of Carbon compounds, E.L. Eliel, McGraw-Hill Organic Chemistry, Paula Y. Bruice, Pearson Education 	
3	MAT 1101 Applied Mathematics I (100 marks) 4hr./week	
	Rank of matrices, Solutions of system of linear equations (Gauss-elimination, LU-decomposition etc.) Eigenvalues and Eigenvectors, Caley-Hamilton theorem:	6
	Numerical methods for solution of linear and non-linear single and multiple algebraic equations. Solution of transcendental Equations, Newton's method, Fixed point iterative method etc.	6
	Interpolation and extrapolation: interpolating polynomials for equal and non-equal spaced data (Forward, backward, central and spline) their applications to numerical integration (trapezoidal rule, Simpson's Rule, Romberg Integration etc.) and numerical differentiations.	10
	Probability of Statistics: Review of elementary probability theory, Random variables, Functions of random variables, probability distribution functions, expectation, moments and moment generating functions, Joint probability distributions, binomial, Poisson, and Normal distribution.	12
	Sampling distributions, Point and interval estimations, Statistical hypothesis tests, t-tests for one and two samples, F-test, χ^2 -test, tests of hypothesis for proportion, Simple Applications;	10
	Statistical Methods for Data Fitting: Linear, multi-linear, non-linear regression, ANOVA	6
	Differential Calculus : Review and Concepts, Higher order differentiation and Leibnitz Rule for the derivative, Rolle's and Mean Value theorems, Taylor's and Maclaurin's theorems, Maxima/Minima, convexity of functions, Asymptotes, Radius of curvature;	10
	Reference Books: <ul style="list-style-type: none"> Advanced Engineering Mathematics, Erwin Kreyszig, John-Wiely. Advanced Engineering Mathematics S. R. K. Iyengar, R. K. Jain, Narosa. Introductory Methods Of Numerical Analysis, S. S. Sastry, PHI. A First Course in Probability, Sheldon Ross, Pearson Prentice Hall. Probability and Statistics in Engineering , W.W. Hines, D. C. Montgomery, D.M. Goldsman, John-Wiely 	
4	MAT 1102 Applied Mathematics II (100 marks) 4hr./week	
	Functions of two or more variables, Limit and continuity, Partial differentiation, Total derivatives, Taylor's theorem for multivariable	10

	functions and its application to error calculations, Maxima/Minima, Jacobian.	
	Integral Calculus : Improper integrals, Beta and Gamma functions, Differentiation under the integral sign, Curve tracing, Application to length, Area, volumes, Surface of revolution, Moment of inertia, Centre of gravity	14
	Differential Equations: Solution of Higher order ODE with constant and variable coefficients and its applications to boundary and initial value problems, Series solution of differential equations, Bessel functions, Legendre Polynomials, Error function, Solution by orthogonal set of functions.	12
	Fourier Series and Fourier integrals, Fourier and Laplace Transforms and their applications to differential equation (both ODEs and PDEs)	14
	Numerical methods for solution of ODEs (initial values and boundary values) using single step methods (RK, Euler's explicit and implicit methods). Multi-Step methods (predictor – corrector methods etc), Solution of Stiff ODEs, Adaptive step size, Shooting method , Solutions of Differential Algebraic Equations	10
	<p>Reference Books:</p> <ul style="list-style-type: none"> ● Advanced Engineering Mathematics, Erwin Kreyszig, John-Wiely ● Advanced Engineering Mathematics S. R. K. Iyengar, R. K. Jain, Narosa. ● Elements of <i>Applied Mathematics</i>. Volume 1, P.N.Wartikar and J.N.Wartikar, Pune Vidyarthi Graha. ● Introductory Methods Of Numerical Analysis, S. S. Sastry, PHI. ● Numerical Solution of differential Equations, M. K. Jain, Wiley Eastern. 	
5	CHT 1231 – Organic Chemistry – II (100 marks) 4hr./week	
	Chemistry of Hydroxy derivatives of aliphatic and aromatic compounds: Methods of preparation, Properties, General reaction, Acidity of phenol	10
	Aldehydes and ketones: Methods of preparation. Fridel-Craft acylations and related reactions, properties and reactivity, general reactions	16
	Carboxylic acids and their Derivatives: Carboxylic acids, esters, amides, acid chlorides and anhydrides Methods of preparation, Properties, Acidity of carboxylic acids, General reaction of their compounds. Interconversion.	10
	Amines: Methods of preparation of primary, secondary and tertiary amines, properties, Basicities and general reactions.	7
	Ethers, epoxides and sulphur acids: Methods of preparation, General reaction, Acidity of sulphur acids. EO condensates.	5
	Heterocyclic chemistry: Comparison with carbocyclic compounds, methods of Preparation, Regenerated compounds Pyrrole, Furan, Thiophene, Pyridine, Quinoline and Isoquinoline. Retrosynthetic approach, characteristic properties and Reactions	12

	Reference Books: <ul style="list-style-type: none"> Organic Chemistry, J. McMurry, Brooks/Cole Organic Chemistry, T.W.G. Solomons, C.B. Fryhle, John Wiley and Sons Inc. Organic Chemistry, L.G. Wade Jr, Pearson Education Organic Chemistry, Paula Y. Bruice, Pearson Education 	
6	CHT 1211 – Analytical Chemistry (50 marks) 3hr./week	
	Concept of quality: Definition of quality, quality control and assurance, TQM. Correlation between quality and analysis, steps and types of analysis, Stoichiometry and expression of concentration.	2
	Theory of errors: Sources and classification of errors. Statistical treatment of analytical data and presentation of results	2
	Sampling of solids, liquids and gases.	2
	Evaluation and validation of analytical methods	2
	Good laboratory practices.	1
	Fundamentals of chromatography, Chromatography methods: GLC, HPLC, TLC, HPTLC, ion chromatography, hyphenated techniques like GC-MS, LC-MS	6
	Fundamentals of absorption / emission spectroscopy: Absorption of light, UV – VIS spectrophotometry, Beer-Lambert Law, characteristic bond frequencies. Energy levels in atoms and molecules. Principles of Atomic Absorption Spectroscopy (AAS), its application, feature of the instrument. Principles of IR spectroscopy, application, and features of the instrument	10
	Diamagnetism and paramagnetism, nuclear spin, NMR spectroscopy, chemical shift, nuclear spin - spin coupling, EPR spectroscopy, Spectroscopy based on Scattering.	6
	Fundamentals of Imaging Techniques: SEM TEM	4
	Electrochemical instruments, techniques and applications, controlled current and controlled potential principles, amplifiers, potentiostats, galvanostats, cyclic voltametry, chronoamperometry, chronopotentiometry, applications such as corrosion, electroplating, anodising, organic and inorganic electrosynthesis, fuel cells.	8
	Thermal Methods : TGA, DTA, DSC	4
	References: <ul style="list-style-type: none"> Instrumental methods of Chemical Analysis, E.W. Ewing, McGraw Hill. Instrumental Methods of Analysis, H.H. Willard, L.L. Merrit, J.A. Dean and F.A. Shette, Jr, CBS Publishers and Distributors, New Delhi. New Instrumental Methods in Electrochemistry, P.D. Delaha Instrumental methods of analysis, D.A. Scoog and D.M. Wes Inorganic quantitative analysis, A.I. Vogel, Longmans ELBS. 	

7	PYT 1101 – Applied Physics-I: (100 marks) 4hr./week	
	Thermal Physics Temperature and the zeroeth law of thermodynamics, heat conduction, first law of thermodynamics, kinetic theory of gases, Maxwell-Boltzmann distribution, some aspects of non-ideal behavior, entropy and second law of thermodynamics	12
	Optics Introduction, Diffraction – basic concepts, diffraction at a straight edge, diffraction at single and multiple slits, Resolving power – Rayleigh’s criterion, resolving power of various optical components.	6
	Solid State Physics Crystal Structure Crystal structure of solids, unit cell, space lattices and Bravais lattices, Miller indices, directions and crystallographic planes. Cubic crystals – SCC, BCC, FCC, Hexagonal crystals – HCP, atomic radius, packing fraction, ion-ligancy and critical ratio, Bragg’s law, determination of crystal structure using Bragg spectrometer	6
	Semiconductors Formation of energy bands in solids, concept of Fermi level, classification of solids – conductor, semiconductor and insulator. Intrinsic semiconductor, Effect of doping – extrinsic semiconductors.	4
	Ultrasonics Generation of ultrasound – mechanical, electromechanical transducers, propagation of ultrasound, attenuation, velocity of ultrasound and parameters affecting it, measurement of velocity, cavitation, applications of ultrasound.	8
	Optical Fibers Introduction, optical fiber as a dielectric waveguide – total internal reflection, numerical aperture and various fiber parameters, losses associated with optical fibres, step index and graded index fibers, applications of optical fibers.	6
	Lasers and Microwaves Introduction to interaction of radiation with matter, principles and working of a Laser– population inversion, pumping, various modes, threshold population inversion, types of Lasers – solid state, semiconductor, gas, applications of Lasers. Microwaves – production and applications.	6
	Reference Books:	

	<ul style="list-style-type: none"> • Physics: Vols. I and II – D. Halliday and R. Resnick, 2nd ed, 1962, Wiley Eastern. • Lectures on Physics: Vols. I, II and III – R. P. Feynman, R. B. Leighton and M. Sands, 1963, Narosa. • Concepts of Modern Physics – A. Beiser, 1969, McGraw-Hill. • Introduction to Modern Optics – G. R. Fowles, 2nd ed, 1975, Dover Publications. • A Course of Experiments with LASERS – R. S. Sirohi, 2nd ed, 1991, Wiley Eastern. • Optical Fibre Communication – G. Keiser, 3rd ed, 2000, McGraw-Hill. • Optoelectronics – J. Wilson and J. F. B. Hawkes, 2nd ed, 1992, Prentice-Hall India. • Ultrasonics: Methods and Applications – J. Blitz, 1971, Butterworth. • Applied Sonochemistry – T. J. Mason and J. P. Lorimer, 2002, Wiley VCH. • Solid State Physics – A. J. Dekker, 1957, MacMillan India. 	
8	PYT 1103 – Applied Physics – II (50 marks) 3hr./week	
	<p>Quantum Mechanics Introduction to quantum physics, blackbody radiation, explanation using the photon concept, photoelectric effect, Compton effect, de Broglie hypothesis, wave-particle duality, verification of matter waves, uncertainty principle, Schrodinger wave equation, Born’s interpretation of the wave function, particle in a box, quantum harmonic oscillator, hydrogen atom (no detailed derivation)</p>	12
	<p>Rheology Introduction to rheology Basic concepts in fluid flow, importance of non-linearity, concepts of elasticity in solids and liquids, Hooke’s law, Newton’s law, scaling of time by means of Deborah number for characterisation of flow behaviour in melts and liquids, constitutive equations relating stress and deformation variables.</p>	6
	<p>Melt Viscosity Concept of viscosity, variation of viscosity with different experimental conditions as shear rate, time of shearing, temperature and pressure, shear dependent viscosity , definition of Newtonian behaviour and Non-Newtonian behaviour, concepts of shear thinning and shear thickening.</p>	6
	<p>Viscoelasticity Introduction to viscoelasticity, Maxwell and Kelvin models, relaxation models, relaxation spectrum, creep and creep recovery, complex modulus and complex viscosity</p>	6
	Reference Books:	

	<ul style="list-style-type: none"> • Perspectives of Modern Physics – A. Beiser, 1969, McGraw-Hill. • Introduction to Rheology – H. A. Barnes, J. F. Hutton and K. Walters, 4th ed, 1996, Elsevier Science. • Physical Chemistry of Polymers – A. Tager, 2nd ed, 1978, Mir Publishers. • Viscoelastic Properties of Polymers – J. D. Ferry, 3rd ed, 1980, Wiley. 	
9	CET 1501 Material and Energy Balance Computations (100 marks) 4hr./week	
	Introduction to Chemical Engineering: Historical evolution of Chemical Engineering and Chemical Process Industries, Chemistry to Chemical Engineering	4
	Revision of Units and Dimensions., Mathematical techniques, Introduction to use of calculators.	4
	Mole concept, composition relationship and stoichiometry	2
	Applications of Laws of Conservation of Mass and Energy to single and Multistage processes.	6
	Behaviour of gases and vapors	4
	Material balances for reacting systems.	8
	Introduction to psychrometry humidity and air-conditioning calculations.	6
	Calculation of X-Y diagrams based on Raoult's law.	4
	Fuels and combustion	6
	Unsteady state material balances.	4
	Material and energy balances for complete plants.	8
	Material and energy balances using computers.	4
	Reference Books: <ul style="list-style-type: none"> • Chemical Process Principles, Hougen O.A., Watson K. M. • Basic Principles and Calculations in Chemical Engineering, Himmelblau • Stoichiometry, Bhatt B.I. and Vora S.M. 	
10	MAP 1201 Engineering Applications of Computers (Lab)	
	Computer Programming Languages: FORTRAN, C, C++, etc.	32
	Softwares : Wordprocessing, Spreadsheets, Database, etc.	8
	Softwares for Libraries etc.	8
	Introduction to Computer Hardware, Architecture, Networking	12
11	CHP 1122 – Inorganic Chemistry Laboratory (50 marks) 3hr./week	
	Volumetric Analysis: Preparation and Standardisation of Volumetric solutions. Acid base reactions, titrations of a mixture of (a) hydrochloric and acetic acid (b) Sulfuric and phosphoric acid (c) carbonate and bicarbonate. Oxidation - reduction titrations involving permanganate, dichromate, ceric sulfate, iodine (tri-iodide) potassium bromate.	

	Precipitation titration: Mohrs and Volhards titrations. Compleximetric titrations involving EDTA: Determination of hardness of water. Determination of Manganese in pyrolusite. Gravimetric analysis: Gravimetric determination of Fe, Ni, SO_4^{2-} and Cl^- . Analysis of a Fe-Ni alloy. Suitable number of experiments from the above list will be performed.	
12	CHP 1132 – Organic Chemistry Laboratory I (50 marks) 3hr./week	
	Identification of an organic compound through elemental analysis, group detection, physical constants (m.p and b.p) and derivatisation.	
	Estimation of selected organic compounds like: aniline/phenol, formaldehyde/acetone, glucose, glycerol. Neutral equivalents of acids and bases, SAP value of an oil.	
13	CHP 1232 – Organic Chemistry Laboratory II (50 marks) 3hr./week	
	Synthesis of several organic compounds such as acetanilide, m-dinitrobenzene, methyl salicylate, benzamide, o-chlorobenzoic acid, tribromophenol, p-nitrobenzoic acid, azo dye, etc. to demonstrate the various unit processes like oxidation, reduction, alkylation chlorination, nitration, etc. Separation and purification of binary mixtures of the type : water soluble-water insoluble, both water soluble, liquid-liquid by distillation, dissociation –extraction ,crystallization, etc.	
14	CHP 1222 – Analytical Chemistry Laboratory (50 marks) 3hr./week	
	Students will perform eight to ten experiments based on topics that are covered in the theory	
15	HUP 1101 Communication Skills. (50 marks) 3hr./week	
	Development of communication skills in oral as well as writing. The writing skills should emphasize technical report writing, scientific paper writing, letter drafting, etc. The oral communication skills should emphasize presentation skills. Use of audio-visual facilities like power point, LCD for making effective oral presentation. Group Discussions	
16	GEP 1101 – Engineering Graphics – I (100 marks) 4hr./week	
	Solid geometry projections of solids like prism, pyramids, cylinders and cones. Sections of solids. Developments of solids. Interpenetration of simple solids including cone and cylinder. Isometric scales and projections.	
	Machine drawing-Orthographic projections, First Angle and Third Angle method of projections. Conventions in dimensioning and in sections. Forms and proportions of screw threads, bolts, nuts, locking devices for nuts, studs, set-screws, hangers and brackets. Free hand sketches of the above parts	

17	PYP 1102 – Physics Laboratory (50 marks) 3hr./week	
	Students will perform eight to ten experiments from selected topics in modern physics, heat and fluid mechanics	