Scheme of courses for B.Tech chemical engineering
B.Tech Ist year, Ist Semester

S. No.	Course No.	Subject	Credits	Teaching Schedule Hrs. LTP	Total
1.	PH-101T	Engineering Physics-I	4	310	4
2.	CY-101T	Engineering Chemistry	4	310	4
3.	MA-101T	Engineering Mathematics-I	4	310	4
4.	HU-101T	Communicative English	3	210	3
5.	CS-101T	Computer Fundamentals & Programming	4	310	4
6.	ME-107 T	Engineering Graphics	2	120	3
7.	EE-101T	Basic Electrical Engineering (EE, EI & EC)	4	310	4
8.	EI-101T	Basic Electronics Engineering (ME, CS & CH)	4	310	4
9.	CY-103T	Environments Studies (EE, EI & EC)	2	300	3
10.	HU-103T	Engineering economics (ME, CS & CH)	2	300	3
		Total	20/21		22/22
Laboratory Courses					
11.	PH-101P	Physics Lab (EE, EI & EC)	2	003	3
12.	CY-101P	Chemistry Lab (EE, EI & EC)	2	003	3
13.	CS-101P	Computer Lab (CS, CH & ME)	2	003	3
14.	EE-101P	Basic Electrical Engg. Lab (EE, EI & EC)	2	003	3
15.	EI-101P	Basic Electronics Engg. Lab (CS, CH & ME)	2	003	3
16.	ME-101P	Workshop Practice (CS, CH & ME)	2	003	3
		Total	**6/6**		**9/9**
		G. Total	**26/27**		**31/31**

Scheme of courses for B.Tech chemical engineering
B.Tech Ist year, IInd Semester

S. No.	Course No.	Subject	Credits	Teaching Schedule Hrs. LTP	Total
1.	PH-102T	Engineering Physics-II (All Branches)	4	310	4
2.	MA-102T	Engineering Mathematics-II (All Branches)	4	310	4
3.	EE-102T	Basic Electrical Engineering (CS, CH & ME)	4	310	4
4.	EI-101T	Basic Electronics Engineering (EE, EI & EC)	4	310	4
5.	CY-101T	Engineering Chemistry (CS, CH & ME)	4	310	4
6.	HU-101T	Communicative English (EE, EI & EC)	3	210	3
7.	CS-101T	Computer Fundamentals & Programming (EE, EI & EC)	4	310	4
8.	ME-107T	Engineering Graphics (ME, CS & CH)	2	120	3
9.	CY-103T	Environmental Studies (ME, CS & CH)	2	300	3
10.	HU-103T	Engineering Economics (EE, EI & EC)	2	300	3
		Total	21/20		22/22
Laboratory Courses					
11.	PH-101P	Physics Lab (CS, CH & ME)	2	003	3
12.	CY-101P	Chemistry Lab (CS, CH & ME)	2	003	3
13.	CS-101P	Computer Lab (EE, EI & EC)	2	003	3
14.	EE-101P	Basis Electrical Engineering Lab (ME, CS & CH)	2	003	3
15.	EI-101P	Basic Electronics Engineering Lab (EE, EI & EC)	2	003	3
16.	ME-101P	Workshop Practice (EE, EI & EC)	2	003	3
		Total	**6/6**		**9/9**
		G. Total	**27/26**		**31/31**

Scheme of courses for B.Tech chemical engineering
B.Tech IInd year, IIIrd Semester

S.NO.	SUBJECT CODE	TEACHING DEPTT.	SUBJECTS	CONTACT HOURS / WEEK			DURATION OF EXAM. HOURS	CREDITS
				LECT.	PRACT.	TOTAL		
1.	CY-201	CHEMISTRY	Applied Organic Chemistry	4	-	4	3	4
2.	CE-201	CHEMICAL ENGG.	Fluid and Particle Mechanics	4	-	4	3	4
3.	CE-203	CHEMICAL ENGG.	Material and Energy Balance	4	-	4	3	4
4.	CE-205	CHEMICAL ENGG.	Inorganic Chemical Technology	4	-	4	3	4
5.	CE-207	CHEMICAL ENGG.	Chemical Engineering Fluid Mechanics	4	-	4	3	4
6.	MA-201	MATHEMATICS	Mathematics II	4	-	4	3	4
7.	CE- 201P	CHEMICAL ENGG.	Fluid and Particle Mechanics Lab	-	3	3	3	2
8.	CE-203P	CHEMICAL ENGG.	Chemical Engineering Fluid Mechanics Lab	-	3	3	3	2
9.	CY-201P	CHEMISTRY	Chemistry Lab-II	-	3	3	3	2
TOTAL				**24**	**09**	**33**		**30**

Scheme of courses for B.Tech chemical engineering
B.Tech IInd year, IVth Semester

S.NO.	SUBJECT CODE	TEACHING DEPTT.	SUBJECTS	CONTACT HOURS / WEEK			DURATION OF EXAM. HOURS	CREDITS
				LECT.	PRACT.	TOTAL		
1.	CE-202	CHEMICAL ENGG.	Heat Transfer	4	-	4	3	4
2.	CE-204	CHEMICAL ENGG.	Chemical Engg. Thermodynamics-I	4	-	4	3	4
3.	CE-206	CHEMICAL ENGG.	Chemical Reaction Engg.-I	4	-	4	3	4
4.	CE-208	CHEMICAL ENGG.	OrganicChemical Technology	4	-	4	3	4
5.	ME-212	MECHANICAL ENGG.	Material Science	4	-	4	3	4
6.	MA-202	MATHEMATICS	Mathematics-III	4	-	4	3	4
7.	CE-202P	CHEMICAL ENGG.	Heat Transfer Lab	-	3	3	3	2
8.	CE-204P	CHEMICAL ENGG.	Chemical Process Lab	-	3	3	3	2
TOTAL				24	06	30		28

Scheme of courses for B.Tech chemical engineering
B.Tech IIIrd year, Vth Semester

S.NO.	SUBJECT CODE	SUBJECTS	CONTACT HOURS / WEEK		TOTAL	DURATION OF EXAM. HOURS	CREDITS
			LECT.	PRACT.			
1.	CE-301	Chemical Reaction Engg.-II	4	-	4	3	4
2.	CE-303	Chemical Engg. Thermodynamics-II	4	-	4	3	4
3.	CE-305	Mass Transfer-I	4	-	4	3	4
4.	CE-307	Transport Phenomena	4	-	4	3	4
5.	CE-309	Energy Engg.	4	-	4	3	4
6.	CE-311	Process Instrumentation	4	-	4	3	4
7.	CE-301P	Reaction Engineering Lab	-	3	3	3	2
8.	CE-303P	Instrumentation and Analysis Lab	-	3	3	3	2
9.	CE-305P	Process Control Lab	-	3	3	3	2
TOTAL			**24**	**09**	**33**		**30**

Scheme of courses for B.Tech chemical engineering
B.Tech IIIrd year, VIth Semester

S.NO.	SUBJECT CODE	SUBJECTS	CONTACT HOURS / WEEK			DURATION OF EXAM. HOURS	CREDITS
			LECT.	PRACT.	TOTAL		
1.	CE-302	Process Dynamic & Control	4	-	4	3	4
2.	CE-304	Process Engg. & Economics	4	-	4	3	4
3.	CE-306	Equipment Design	4	-	4	3	4
4.	CE-308	Mass Transfer-II	4	-	4	3	4
5.	CE-310	Industrial Pollution Control	4	-	4	3	4
6.	CE-***	Departmental Elective-I	4	-	4	3	4
7.	CE-302P	Energy Lab.	-	3	3	3	2
8.	CE-304P	Mass Transfer Lab.	-	3	3	3	2
9.	CE-306P	Computer Applications Lab.	-	3	3	3	2
TOTAL			**24**	**09**	**33**		**30**

Scheme of courses for B.Tech chemical engineering
B.Tech IVth year, VIIth Semester

S.NO.	SUBJECT CODE	SUBJECTS	CONTACT HOURS / WEEK			DURATION OF EXAM. HOURS	CREDITS
			LECT.	PRACT.	TOTAL		
1.	**-***	Open Elective	3	-	3	3	3
2.	CE-***	Pool Elective	4	-	4	3	4
3.	CE-***	Departmental Elective-II	4	-	4	3	4
4.	CE-401	Process Equipment Design	4	-	4	3	4
5.	CE-403	Process Utility & Safety	4	-	4	3	4
6.	CE-405	Report Writing, Seminar and Group Discussion	-	3	3	3	3
7.	TRN-401	Industrial Training(Colloquium)	-	6 weeks	-	3	3
8.	CE-401P	Design Lab.	-	3	3	3	2
9.	CE-403P	Industrial Pollution Control Lab.	-	3	3	3	2
TOTAL			**19**	**09**	**28**		**29**

Scheme of courses for B.Tech chemical engineering
B.Tech IVth year, VIIIth Semester

S.NO.	SUBJECT CODE	SUBJECTS	CONTACT HOURS / WEEK			DURATION OF EXAM. HOURS	CREDITS
			LECT.	PRACT.	TOTAL		
1.	CE-***	Departmental Elective-III	4	-	4	3	4
2.	CE-***	Departmental Elective-IV	4	-	4	3	4
3.	CE-402	Modeling Simulation & Optimization	4	-	4	3	4
4.	CE-404	Corrosion and Materials of construction	4	-	4	3	4
5.	CE-402P *	Project Work and Viva Voce		1 5	15	3	12
TOTAL			**16**	**15**	**31**		**28**

CE-402P* - Project work shall be assigned in the beginning of VII Semester.
Contact hour per week in VII semester is 15 hours.

Electives

Departmental Elective I

1.	Computer Aided Design	CE-350
2.	Computer Application in Chemical Engineering	CE-352

Departmental Elective II

1.	Petroleum Refining and Petrochemical Technology	CE-451
2.	Fertilizer Technology	CE-453

Departmental Elective III

1.	Membrane Separation Processes	CE-450
2.	Fluidization Engineering	CE-452

Departmental Elective IV

1.	Solid Waste Management	CE-460
2.	Safety and Hazard Analysis inProcess Industry	CE-462

Pool Elective

1.	Environmental Management	CE-461
2.	Polymer Science and Technology	CE-463

Open Elective

1.	Polymer Technology (Chemistry)	CY***
2.	Futuristic Materials	PH***
3.	Principle of Management	HU**
4.	Foreign Trade	HU***

The list of electives can be changed as per availability of faculty or interest and need of students.

B. TECH CHEMICAL ENGINEERING

Ist YEAR Ist SEMESTER

PHYSICS-I

SUBJECT CODE: - PH-101T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Interference: Coherent sources, Theory of interference, displacement of fringes, Fresnel's biprism experiment, Interference in thin film, wedge shaped film, Newton's rings.

Diffraction: Basic idea of Fresnel & Fraunhofer diffraction, single, double and n slit diffraction, diffraction grating, Rayleigh's criterion of resolution, resolving power of telescope, microscope and grating.

Polarization: Phenomenon of double refraction, Malus law, Nicol prism, quarter wave and half wave plates, production and analysis of plane, circularly and elliptically polarized light, optical activity, specific rotation, Lorentz half shade and biquartz polarimeters.

Wave Mechanics: Elementary idea of quantization, black body radiation, Frank-Hertz experiment, Photoelectric effect. Wave particle duality, De Broglie concept of matter waves, Heisenberg's uncertainty principle, Schrodinger's wave equation, physical significance of wave function, applications of Schrodinger's wave equation: (i) Particle in one dimensional box. (ii) Potential Step (iii) Potential barrier-quantum mechanical tunneling (Basic idea).

Solid State Physics: Structure of crystalline solid: Lattice translational vectors, unit cell, Bravais lattice, Miller indices and simple crystal structures.

Free electron model: Free electron gas in one and three dimensions, Fermi energy, Density of states, Heat capacity of the electron gas, failure of free electron model.

Band theory: Kroni Penny model, motion of electrons in one dimension according to the band theory, effective mass of an electron, concept of hole, distinction between metals, insulators and intrinsic semi-conductors.

Books:

1. Geometrical & Physical Optics: B.K.Mathur
2. Introduction of Solid State Physics: C. Kittel
3. Solid State Physics: A.J. Dekkar
4. Quantum Mechanics: Singh and Bagdel
5. Optics: Ajai Ghatak
6. Quantum Mechanics: B.K. Agarwal & Hari Prakash
7. Optics: A.H. Flower
8. Geometrical & Physical: Zenkin's & White
9. Quantum Mechanics: Eisberg

B. TECH CHEMICAL ENGINEERING

Ist YEAR Ist SEMESTER

CHEMISTRY-I

SUBJECT CODE: - CY-101T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Schrödinger equation: origin of quantization; applications of particle in a box problem; hydrogen atom; properties of atomic orbitals; many electron atoms; molecular orbital theory; bonding and intermolecular forces.

Thermodynamics: Fundamental definition and concepts of thermodynamics; Work, heat and energy; First law: Cp and Cv; Second law: entropy; Helmholtz and Gibbs Energy; chemical potential; Third law; phase equilibria; chemical equilibrium.

Chemical kinetics: Rate laws; elementary reaction and chain reaction. Periodic table and periodic properties: basis of periodic table, trends in size, electron affinity, ionization potential and electro negativity, Use of Ellingham diagram and thermodynamics in the extraction of elements; Transition metal chemistry: inorganic complexes, isomerism, nomenclature; bonding in transition metal complexes; valence bond and crystal field theory, magnetism, bonding aspects, structural distortion; Bioinorganic chemistry: storage and transport proteins; Catalysis: hydrogenation, hydroformylation and olefin metathesis.

Organic Chemistry: Hűckel treatment of ethylene, butadiene and benzene, concept of aromaticity, configuration, molecular chirality and isomerism, conformation of alkanes and cycloalkanes, reactivity of carbonyl groups (additions, addition-eliminations, reactions due to acidic proton, reactivity of acid halide, ester and amide), functional group inter-conversions involving oxidation and reduction.

Introduction to bio-organic chemistry: carbohydrates, amino acids proteins and nucleic acids.

Polymer chemistry: definition, classification of polymers, orientation of polymers, types of polymerization, Mechanism of addition and condensation polymerization, thermo plastic and thermo setting revius: Important thermosetting and thermoplastic polymers: eg. Bakelite, polyester, cellulose derivatives, PVC, Poly ethylene, Teflon, Polystyrene, Nylon Natural and synthetic rubbers.

Suggested Books

1. P.W. Atkins, Physical Chemistry (7th Edition), Oxford University Press, 2006.
2. D.A. McQuarrie and J.D. Simon, Physical Chemistry -A Molecular Approach, Viva Books Pvt. Ltd., 1998.
3. R.T. Morrison and R.N. Boyd, Organic Chemistry, Prentice Hall of India Pvt. Ltd., 5th Ed, 1990
4. G. Solomons and C. Fryhle, Organic Chemistry, John Wiley & Sons (Asia) Pte Ltd.
5. J.D. Lee, Concise Inorganic Chemistry, (5th Edition), ELBS, 1996.
6. D. F. Shriver and P. W. Atkins, Inorganic Chemistry, Oxford University Press, 2006
7. F.W.Bill mayer, Polymer Science, Tata McGraw Hill.
8. A Levine, Physical Chemistry, McGrawHill, 2009

B. TECH CHEMICAL ENGINEERING

Ist YEAR Ist SEMESTER

MATHEMATICS-I

SUBJECT CODE: - MA-101T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Note: A setting of eight questions will be there covering all the units proportionally out of which any five are to be attempted.

UNIT-I: Differential Calculus: Limit, continuity and differentiability of functions of single variable. Successive, Differentiations, Leibnitz Theorem, Expansion of functions by Maclaurin's and Taylor's theorems. Functions of several variables: Partial derivatives, Euler's theorem, change of variables, total differential coefficients, maxima and minima, Lagrange's method of multiplier.

UNIT-II: Integral Calculus: Fundamental and mean value theorems of integral calculus. Reduction formulae, Walli's formula, Beta and Gamma functions, Double and Triple integrals, change of orders of integrations. Area enclosed by plane curves, surfaces and volumes of revolutions.

UNIT-III: Vectors and Matrices: Differentiations and integrations of vectors. Gradient, Divergence and Curl. Vector identities, Green's, Gauss's and stoke's theorems with applications. Types and algebra of matrices, rank, solution of simultaneous linear equations, Eigen values and Eigen vectors, diagonalisation of matrices, Cayley-Hamilton Theorem.

References

1. E.Kreyszig: Advance Engineering mathematics, John Wiley & Sons, 2005.
2. B.V.Ramana: Higher Engineering Mathematics, Tata McGraw Hill Co. Ltd., 2008
3. R.K.Jain & S.R.K. Iyenger: Advance Engineering Mathematics, Narosa Publishing House, 2002.
4. J.C. Sharma: Vector Algebra, Students & Friends Co. Ltd. Agra.
5. J.K.Goel & K.P.Gupta: Matrix algebra, Students & Friends Co. Ltd. Agra.
6. H.K.Dan: Advanced Engineering Mathematics.

B. TECH CHEMICAL ENGINEERING

Ist YEAR Ist SEMESTER

ENGLISH LANGUAGE AND LITERATURE LAB

SUBJECT CODE: - HU-101T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

This course has a double purpose. It introduces literature and its forms and also helps students learn the English language. The linguistic aspect will be dealt with by concentrating on the dictionary skills and introducing principles of pronunciation, vocabulary development, and syntax.

The main topics include: Pronunciation: basic sounds of English (vowels and consonants) and word-stress

Vocabulary: word-formation (prefixes and suffixes),synonyms and antonyms

Syntax: parts of speech, active and passive voice, direct and indirect speech, tenses, basic sentence patterns, etc.

The literary aspect will be dealt with through suitable texts such as poems, short stories and plays (chosen be the instructors).

The main topics for discussion will be:

What is literature?

The nature of literary language (mainly “figurative “language)

The literary forms or genres

Literature and socio-cultural context

B. TECH CHEMICAL ENGINEERING

Ist YEAR Ist SEMESTER

COMPUTER FUNDAMENTAL & PROGRAMMING

SUBJECT CODE: - CS-101T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 02 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Pre-Requisites of Scientific Writing: Salient features: BOCUST formula. Grammatical pre-requisites: Usage, Sentence fragments, questions tag. Modifiers, connectives Split infinitives, Dangling participle Gerunds, ellipsis coherence & unity: Method.

UNIT-I: Introduction to Computers: Basic definition, Generation, Classification of computers, Introduction to Computer architecture. Number Systems: Introduction, Classification- Decimal, Binary, Octal, Hexa Decimal, and their convertibility, Data representation, ASCII, BCD, Gray Code. Input/Output: Input System, Input device- Keyboard, Mouse, Joystick, Lighten, MCR MICR, Touch Screen, Graphic Tablet, Voice Input System, Output System, Output Devices-VDU, Printers, Plotters.

UNIT-II: Planning the Computer Program: Purpose of program planning, Algorithms, Flowcharts, Decision Tablets, Pseudo code. Memory: Introduction, Characteristic, Main Memory, secondary memory, Back- Up Memory, Cache Memory, Primary Memory, Semiconductor Memory, Memory Management Unit.

UNIT-III: Basic Operating System Concept: MS-DOS, WINDOWS, Introduction to basic commands of DOS, Evolution of Operating Systems, Batch Processing, Spooling, Multiprogramming, Multiprocessing, Time Sharing, On Line Processing, Real-Time Processing, Introduction to Internet, Basic Terms related with internet. Computer Software: Introduction to Software, Relationship between Hardware and Software, Types of Software, Acquiring software, Firmware.

UNIT-IV: Programming in C: History, Introduction to C Programming, Language, Structure of C Programs, Compilation and Execution of C Programs, Debugging Techniques, Data Type and sizes, Declaration of Variables, Modifiers, Identifiers and Keywords, Symbolic constants, Storage Classes (Global, Automatic, External, Register, And Static), Enumerations, Command line Parameters, Macros, The C Preprocessors.

UNIT-V: Operators: Unary Operators, Arithmetic and Logical Operators, Bit wise Operators, Assignment Operators, Expressions, Conditional Expressions, Precedence and order of evaluation. Control Statements: if-else, switch, break, continue, the comma operator, Goto statement. Loops: for, while, do-while. Functions: Built-in and user-defined, Function declaration, Definition and Function call, parameter passing, call by value, Call by reference, Recursive Functions, Multifile programs. Arrays: Linear Arrays, Multidimensional Arrays, Passing array to functions, Arrays of strings.

UNIT-VI: Structure and Union: Definition and differences, Self- referential Structure. Pointers: Introduction, Accessing the address of a variable, Declaring & Initializing pointers, Accessing a variable though in pointer, Pointers and Arrays, Pointers and character strings, Pointers and functions.

REFERENCES:

1. Computers Fundamental by Rajaraman
2. Computers Fundamental by B. Ram.
3. Computers Fundamental by P.K. Sinha.
4. 'Programming in C' by E. Balagrusamy, TMIL.
5. 'Let Us C' by Yashwant Kanetkar, Narosa.
6. Exploring 'C' by Yashwant Kanetkar

B. TECH CHEMICAL ENGINEERING

Ist YEAR Ist SEMESTER

MANUFACTURING TECHNIQUES

SUBJECT CODE: - ME-101 **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 02 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

UNIT-I: Carpentry: - Wood, timber-exogenous & endogenous, Cross section of an exogenous tree, seasoning of wood, Seasoning methods, defects (Both natural and that occurs during conversion), Brief description of carpentry tools, various carpentry process. Carpentry joints.

UNIT-II: Pattern & Pattern making: - Pattern, types of pattern (Single piece, split, Match plate, Sweep, Loose piece, Gated patterns), Pattern making allowances, Design considerations in pattern making, pattern making materials, Core prints.

UNIT-III: Foundry: - Moulding materials, types of foundry sands; characteristics of foundry sands; Binders & additives; moulding procedures: Floor moulding, Bench moulding, Pit moulding, Machine moulding, Green sand moulding, Dry sand moulding, CO2, Core making processes.

UNIT-IV: Foundry' tools & equipment: - Tools used in foundry (hand tools); moulding machine- (Jolt machine, squeezing machine, Sand Slinger, Push off machine), Furnaces (Pit furnace, cupola furnace).

UNIT-V: Welding: - Welding: Pressure and non-pressure, arc welding (AC and DC arc welding, Introduction to Carbon arc welding, metal arc welding, TIG & MIG welding); Electric resistance welding (Spot, seam, projection, But, thermit welding), welding tools and equipment, Gas welding (oxyacetylene).

UNIT-VI: Bench work & fitting: - Tools (holding tools, striking tools, cutting tools), various operations performed in fitting shop (detailed).

UNIT-VII: Machine tools: Definition, types. Lathe specifications; Lathe operations in brief (facing, plain turning, step turning, taper turning, threading, drilling and boring). Milling machine (introduction & brief description of operations only).

UNIT-VIII: Jigs & Fixture: Introduction, Location points, Basic Design of Jigs & Fixture, Types of Jigs & Fixture.

Text Book:

1. A text Book on workshop technology by B. S. Raghuvanshi

REFERENCE BOOK:

1. Workshop technology by Hazara & Chaudhry, Production technology by R.'K.Jain

B. TECH CHEMICAL ENGINEERING
Ist YEAR Ist SEMESTER
ENGINEERING GRAPHICS

SUBJECT CODE: - ME-103 **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 03 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

UNIT-I: Importance of Engineering Drawing, Engineering Drawing Instruments and uses, Layout of Drawing sheet, Lettering and Dimensioning, Types of Lines. Scales: What is scale, Representative factor, Types of Scale: Plain, Diagonal and Vernier scales, Metric Measurements and conventions, Plain Scale, diagonal scale& Vernier scale (forward & backward both).

UNIT-II: Conic Section, Definition, and different methods of construction of ellipse, hyperbola and parabola by Eccentricity method Construction of parabola and ellipse by Concentric circles method, Oblong method, Parallelogram method.

UNIT-III: Projections, Principle, types and conventions, Theory of Projections and orthographic projections: - Introduction, Types of projections, Orthographic projections, Planes of Projection, Four quadrants, Types of orthographic projections, (a) Projections of point and straight lines, (b) Projections of lines inclined to both the planes, Projection of planes, (a) Projection of solids (b) Projection of solids inclined to both H.P. & V.P. (of prisms pyramids etc).

UNIT-IV: Isometric Projections: Theory of isometric projection- Isometric lengths, Isometric scales:- Methods to draw Isometric view or projection, various positions of Isometric axes. Isometric projection with isometric lines, non-isometric lines and with curved & circular surfaces.

RECOMMENDED TEXT BOOK

1. Engineering Drawing (Geometrical Drawing) by R.K. Dhawan
2. Engineering Drawing & Graphics, by K.Venugopal Rao
3. Engineering Drawing by P.S. Gil
4. Engineering Drawing by N. D. Bhatt.

B. TECH CHEMICAL ENGINEERING
Ist YEAR Ist SEMESTER
BASIC ELECTRONICS

SUBJECT CODE: - EI-101T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

UNIT-I: Introduction of Semiconductor Physics: Band Theory of solids, Insulator, Semiconductor & Metals, Mobility and Conductivity, Electrons and holes in an intrinsic semiconductor, Carrier concentration in an intrinsic semiconductor, n-type material, p-type material, Donor and Acceptor impurities, Charge densities in a semiconductor, Hall-effect, Diffusion, the continuity equation, Fermi level in a semiconductor having impurities.

UNIT-II: Junction Diode Characteristics: p-n junctions, Forward bias, Reverse bias junction, V-I characteristics, Effect of temperature on a p-n junction diode, Maximum temperature operation, Reverse breakdown voltage, Capacitive effects in a p-n junction diode, Space charge capacitance, Diffusion capacitance, Diode Resistance, Static and Dynamic Resistance, Comparison of practical with ideal diode, load line analysis of a diode circuit.

UNIT-III: Rectifying Circuits and DC Power supplies: p-n junctions as a rectifier, form factor, average voltage and current, haft wave & full wave rectifier, voltage regulation, Ripple factor, Bridge rectifier, Comparison of rectifier circuits, Filter circuits for power supplies, inductor filter, capacitor filter, Effect of capacitor series resistance, Peak inverse voltage of a half wave rectifier, LC filter, Comparison of filter circuits.

UNIT-IV: Diode Applications: Clippers, Series and parallel, Clampers, Zener diodes, Zener diode specification, Voltage regulator circuits, Design of a voltage regulator circuits, Effect of supply voltage variations, Zener diode breakdown mechanism, Voltage multiplier circuits, voltage doubles, voltage Tripler, Quadrupolar.

UNIT-V: Bipolar Junction Transistor: The junction transistor, Transistor current components, transistor as an amplifier, Common base configuration. Early effect, the input and output characteristics, Common emitter configuration I/O characteristics, Active, Saturation, Cut-off regions for both configurations, common collector configuration, common base current gain, common emitter current gain.

REFERENCES

1. Integrated Electronics: Analog and Digital Circuits and System by Millman, halkias and Parikh, TMH, Second Edition.
2. Electronic Devices and Circuits, An introduction by Allen Mottershead,TMH.
3. Electronic Devices and Circuits theory by Robert L. Boylestad, Lonis nashelsky,

B. TECH CHEMICAL ENGINEERING
Ist YEAR IInd SEMESTER
MATHEMATICS-II

SUBJECT CODE: - MA-102T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Note: A setting of eight questions will be there covering all the units proportionally out of which any five are to be attempted.

UNIT-I: Numerical Techniques: Numerical solution of algebraic and transcendental equations by Bisection method, Secant method, Regula-Falsi and Newton-Raphson methods. Numerical integration by Gauss quadrature formula, Trapezoidal rule, Simpson's rule and Weddle's rule. Numerical solution of ordinary differential equations by Euler's method, Milne's method and Runge-Kutta method.

UNIT-II: Probability and statistics: Definitions of probability and simple
theorems, conditional probability, Baye's Theorem, random variables, discrete and continuous distributions, Binomial, Poisson and normal distributions, correlation and linear regression.

UNIT-III: Complex Analysis: Analytic functions, C-R equations in Cartesian and polar forms, Harmonic functions, Milne-Thomson method, complex integration, Cauchy's theorem, Cauchy's integral formula. Lioville's and Morera's Theorems, Taylor's and Laurent's theorems. Residues: Cauchy's residue theorem, evaluation of real integrals of the type $\int 02\pi$ f (cos θ, sin θ) do and $\int -\infty\infty$ fn, dx.

REFERENCES

1. E.Balagurusamy: Numerical Methods, Tata McGraw Hill, 2008.
2. Devi Prasad: An introduction to Numerical analysis, Narosa Publishing House, 2006.
3. J.B.Conway: Functions of one complex variable, springer verlag, International Students Edition Narosa Publishing House, 1980.
4. A.M.Goon, M.K.Gupta & B.Das Gupta: Basic Statistics, The world Pren Pvt. Ltd., Calculta, 1991.
5. L.V.Alhfors: Complex analysis, Tata McGraw Hill, 1979.

B. TECH CHEMICAL ENGINEERING
Ist YEAR IInd SEMESTER
BASIC ELECTRICAL ENGINEERING

SUBJECT CODE: - EE-101T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

UNIT-I: Basic Concept: Definitions & units, Introduction to Basic Laws, Circuit Elements, KVL, KCL, Ideal & Real Sources, Dependent & Independent Sources, Conversion of Voltage Source into Current Source & vice Versa, Controlled and Uncontrolled Sources, Loop and Nodal Method of analysis, Star to Delta Transformation & vice-versa.

UNIT-II: Magnetic Circuit: MMF, Flux, Reluctance, Magnetic Effect of Electrical Current, Hysteresis & Eddy Current Losses.

UNIT-III: Network Theorems: Superposition, Thevenin, Norton, Maximum Power Transfer & Reciprocity Theorems.

UNIT-IV: Steady-State Response: Steady-State Response of Circuit to Sinusoidal functions, Phasor Representation of Sinusoids, Concept of Complex Impedance, Series & Parallel AC Circuits, Series & Parallel resonance

UNIT-V: Balanced Three-Phase Circuit: Generation of Three Phase Voltage, Star/Delta Connected Supply, Balanced Load Circuits, Line and Phase Voltage & current Relations. Concept of Three Phase Power.

UNIT-VI: Transient: Response of RC, RL & RLC Circuit to DC Excitation only (simple problem).

UNIT-VII: Instruments: Introduction to MI, MC Instruments, Extension of range, Dynamometer Type Wattmeter, Simple problems based on these instruments.

Books:

1. Basic Circuit Therory by L.P.Huelsman, PHI.
2. Hughes Electrical Technology by M.Smith, Addison- Wessley Pub
3. Electrical Technology by B.L.Theraja.
4. Electrical Engineering Fundamentals by V.Deltoro, PHI

B. TECH CHEMICAL ENGINEERING
Ist YEAR IInd SEMESTER
PHYSICS-II

SUBJECT CODE: - PH-102T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Dielectric Properties of Materials: Polarization of dielectrics, dielectric constant, electric susceptibility, non-uniform polarization, electric displacement vector, Lorentz local field, Polarizability, Clausius-Mosotti relation, frequency dependence of dielectric constant.

Magnetic Properties of Materials: Magnetization, three magnetic vectors (B.M & H), susceptibility and permeability, Dia, Para, and ferromagnetism, Magnetic domains, hysteresis, Ferro electricity & Piezoelectricity.

Maxwell's Equations: Displacement Current, Maxwell's equation in vacuum & medium (Integral and Differential forms), Poynting theorem, Poynting vector.

Electromagnetic Waves: Wave equation, plane waves, Propagation of electromagnetic waves through non-conducting medium, reflection and transmission.

Superconductivity: Temperature dependence of resistivity in superconducting materials, Effect of magnetic field (Meissner effect), Type I and Type II superconductors, BCS theory (Qualitative), high temperature superconductors. Characteristics of superconductors in superconducting state, applications of superconductors.

Nuclear Physics: Basic properties and constituents of nucleus, mass defect, packing fraction and binding energy, semi empirical mass formula, elementary idea of nuclear forces and their characteristic properties, Nuclear fission, important components and working of nuclear fission reactor, Basic Concept of nuclear fusion reactors.

Books:

1. Electricity and Magnetism: Berkley Physics Course-II.

B. TECH CHEMICAL ENGINEERING
Ist YEAR IInd SEMESTER
ENVIRONMENTAL STUDIES: SCIENTIFIC AND ENGINEERING ASPECTS

SUBJECT CODE: - ME-102T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Multidisciplinary nature of environmental studies, Ecosystems, Biodiversity and its conservation, Indicators of environmental pollution, Environment and human health.

Consumption of natural resources and environmental degradation of forests, water, coal, minerals, energy, and land. Sustainable development, Environmental policy and legislation, Environmental impact assessment.

Pollution of lakes, rivers, ground water, coasts, and oceans, Science and technology for drinking water and wastewater treatment and issues in management of systems.

Solid and hazardous waste management: causes, effects and control measures.

Air and noise pollution, science and engineering of pollution control, Global Issues including climate change, global warming, acid rain, ozone layer depletion, nuclear hazards, Disaster management, industrial accidents, floods, earthquakes, cyclones and landslides, Greenhouse effect etc.

SUGGESTED BOOKS

1. W.P. Cunningham and M.A. Cunningham, Principles of Environmental Science,
2. Tata McGraw-Hill Publishing Company, New Delhi, 2002.
3. J.A. Nathanson, Basic Environmental Technology, Prentice Hall of India, New Delhi, 2002.
4. S.J. Arceivala, and S.R. Asolekar, Wastewater Treatment for Pollution Control and Reuse (3rd Edition), Tata McGraw Publishing Co. Ltd., New Delhi, 2006.
5. S.R. Asolekar, and R. Gopichandran, Preventive Environmental Management: An Indian Perspective, Foundation Books Pvt. Ltd., New Delhi, 2005. Some selected book-chapters, monographs and journal paper.

B. TECH CHEMICAL ENGINEERING
Ist YEAR IInd SEMESTER
FUNDAMENTALS OF ECONOMICS

SUBJECT CODE: - HU-102T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Microeconomics: What is Economics, basic economic problems and nature of economics; demand and supply; consumer choice; individual and market demand; production and cost of production; profit maximization and perfect competition; market structure-monopoly, monopsony, monopolistic competition, and oligopoly; externalities and public goods; factor markets-land, labor and capital market.

Macroeconomics: National income accounting-income, expenditure and components of GDP; consumption and saving; investment spending and demand for money; financial systems-central bank, money, credit, financial markets and asset prices; income and spending; money, interest and income; fiscal and monetary policies; economic growth and accumulation; aggregate supply-wages, prices and unemployment; inflation.

SUGGESTED BOOKS

1. R.S. Pindyck and D.L. Rubinfeld. Microeconomics (7th Edition), Pearson Prentice Hall, New Jersey, 2009.
2. R. Dornbusch, S. Fischer, and R. Startz. Macroeconomics (9th Edition), McGraw-Hill Inc. New York, 2004.

B. TECH CHEMICAL ENGINEERING
Ist YEAR IInd SEMESTER
BASIC MECHANICAL ENGINEERING

SUBJECT CODE: - ME-104T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

A. Thermodynamics:

Unit: 1 Fundamental Concepts and definitions: Definition of thermodynamics, system, surrounding and universe, phase, concept of continuum, macroscopic & microscopic point of view. Density, specific volume, pressure, temperature. Thermodynamic equilibrium, property, state, path, process, cyclic process, Energy and its form, work and heat, Enthalpy.

Unit: 2 Zeroth Law: Concepts of temperature, zeroth law.

First Law: First law of thermodynamics. Concept of processes, flow processes and control volume, flow work, steady flow energy equation, Mechanical work in a steady flow of process.

Second Law: Essence of second law, Thermal reservoir, Heat engines. COP of heat pump and refrigerator, Statements of second law. Carnot cycle, Clausius inequality, Concept of Entropy.

Unit: 3 Properties of steam and thermodynamics cycles: Properties of steam, use of property diagram, Steam- Tables, processes involving steam in closed and open systems. Rankine cycle. Introduction to I.C. Engines-two & four stoke S.I. and C.I. engines. Otto cycle, Diesel cycle.

B. Mechanics

Unit: 4 Force system and Analysis: Basic Concept: Laws of motion. Transfer of force to parallel position. Resultant of planer force system. Free Body Diagrams, Equilibrium and its equation, Centre of gravity, Moment of Inertia. Friction: Introduction, Laws of coulomb friction, Equilibrium of bodies involving dry friction-Belt Friction.

Unit: 5 Stress and Strain Analysis: Simple stress and strain: Introduction, Normal shear stresses, stress-strain diagrams for ductile and brittle materials, elastic constants, one dimensional loading of members of varying cross sections, strain Energy.

Unit: 6 Newton's Second Law: D' Alembert's Principle- problems (for horizontal & inclined surface). Analysis of lift, motion problem. Motion of several connection bodies, Motion of two bodies connected by as tiring, when one body is lying on horizontal surface and other is hanging free, when one body is lying on inclined plane and other is hanging free case (i) Smooth inclined surface case (ii) Rough inclined surface of co-efficient of friction 'μ' (only problems). Work Power & Energy: work- Units of work- Problems (horizontal & inclined surface). Power Derivation of the expression for power required to drive a body, problems energy, Types of energy problems. Laws of conservation of energy. Newton's law of conservation of momentum. Plastic impact & Elastic impact. Driving a pile into ground-problems. Motion of connected bodies, work done by spring.

Books:

1. Thermodynamics by P.K. Nag.
2. Thermodynamic by P.L. Ballaney.
3. Engineering Mechanics & Strength of Materials by R.K.Bansal Lakshmi Publications, New Delhi.
4. Holman, J.P.: Thermodynamics, MC Graw Hill book Co. NY.
5. Yadav R.: Thermodynamics and Heat Engines. Vol I & II (SI Edition) Central Publishing House Allahabad.
6. Engineering Mechanics by S.S. Bhavikatti & K.G. Rajashekarappa New Age Publications, New Delhi
7. F.L. Singer: Strength of Materials.
8. Timoshenko: Strength of Materials.

B. TECH CHEMICAL ENGINEERING

II[nd] YEAR III SEMESTER

FLUID AND PARTICLE MECHANICS

SUBJECT CODE :- CE-201T **DURATION OF EXAM :- 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Unit-I: Particle: - Characterization of solid particles, properties of particulate masses, size reduction, principles of comminuting, size reduction equipment, crusher, grinders, ultrafine grinders, cutting machine, empirical relationship, Rittinger's and Kick's laws, Bond crushing law and work index.

Unit-II: Screening: - Screening equipment, stationary screen and grizzlies, grating screen, vibrating screen, comparison of ideal and actual screens, material balance over screen, screen effectiveness, capacity and effectiveness of screen, storage of solids, transport of solids by screw/belt conveyors.

Unit-III: Fluidization: - Fluidization, conditions for fluidization, minimum fluidization velocity, types of fluidization, particulate fluidization, aggregative fluidization, two phase theory, expansion of fluidized beds, bubbling fluidization, application of fluidization, continuous flidization, slurry and pneumatic conveying.

Unit-IV: Separation based on the motion of particles through fluids: - Gravity settling process, gravity classifiers, sorting classifiers, sink and float method, differential settling method, classifiers and thickeners, batch sedimentation, equipment for sedimentation, thickener, separation of immiscible liquids of different densities, centrifugal settling process, separation of solids from gases (cyclones), liquid-solids separation (Hydro cyclone, disk centrifuge).

Unit-V: Filtration: - Cake filters, discontinuous pressure filters, filter press, shell and leaf filters, automatic belt filter, discontinuous vacuum filter, continuous vacuum filter, rotary drum filter, centrifugal filters, suspended batch centrifuges, automatic batch centrifuges, continuous filtering centrifuges.

Unit-VI: Dimensional analysis and similitude: - Model studies, methods of dimensional analysis, uses of dimensional analysis, Buckinghm's π theorem, similitudes- types of similitudes.

Unit-VII: Viscous effects: Fluid resistance, Reynold's number, laminar incompressible, steady and uniform flow between parallel plates and in circular tubes, kinetic energy and momentum correction factors, boundary layer concept, boundary layer thickness, Prandtl's mixing length theory, drag on immersed bodies. Navier Stoke Equation.

Unit VIII: Pumps: Classification of pump, Reciprocating pump, Centrifugal Pump, Advantages, Limitation and Applications of Pump, Miscellaneous pumps. Pipes & Fittings, Valves.

Text and Reference Books:

1. Unit Operations of Chemical Engineering – W.L. McCabe & J.C. Smith, fifth edition, McGraw Hill Int. Ed. 1993.
2. Introduction to Chemical Engineering – W.L. Badger & J. Banchero, Tata McGraw Hill, New Delhi ed. 1997.
3. J.M. Coulson, and J.F. Richardson, (revised by J.R. Buckhurst and J.H. Harker) Chemical Engineering, Vol2, Pergamon Press, New York (1980)

Question paper pattern:

For examination, the number of questions to be set are Eight, with at least one from each unit. Students are required to answer any five full questions.

B. TECH CHEMICAL ENGINEERING
II[nd] YEAR III SEMESTER
MATERIAL AND ENERGY BALANCE

SUBJECT CODE: - CE-203T DURATION OF EXAM: - 03 Hrs.
CREDIT : 04 MAX END SEM MARKS:
TOTAL CONTACT HOURS: 40

Unit-I: Mathematical & engineering calculations, units & dimensions, conversion of units, dimensionless groups and constants, stoichiometric and composition relationship, conservation of mass, mass and volume relationship in chemical reactions, degree of completion

Unit-II: Behavior of ideal gases, ideal gas law, conversion of gas volume to mole and mass fractions, gas density and specific gravity, ideal gas mixtures, Dalton's law, vapor pressure, Raoult's law, relative humidity, absolute humid volume, humid heat, dew point, effect of temperature on vaporization (Clausius – Clapeyron equation), Cox chart and Duhring plot.

Unit-III: Material balance with and without chemical reaction, recycle, bypass calculations, purge stream, recycle ratio, combined feed ratio, purge ratio.

Unit-IV: Steady state energy balance: - Heat capacity, calculations of enthalpy changes, heat of vaporization, heat of formation, heat of combustion, heat of reaction, solution to energy balance problems, effect of temperature on heat of reaction, use of psychrometry and enthalpy concentration diagrams.

Unit-V: Problems related to simultaneous steady state energy and material balance, unsteady state energy and material balance, simultaneous material and energy balance and its application in process industries.

Text and Reference Books:

1. Introduction to Stoichiometry – K.A. Gavhane
2. Chemical Process Principals – Hougen, Watson, Ragatz
3. Stoichiometry – B.I. Bhatt, S.M. Vora
4. Elementary Principles of Chemical Processes, 3rd Ed. R.M. Felder & R.W. Rousscan, John Wiley & Sons, Inc. Singapore (2000)

Question paper pattern:
For examination, the number of questions to be set are Eight, with at least one from each unit. Students are required to answer any five full questions.

B. TECH CHEMICAL ENGINEERING

IInd YEAR III SEMESTER

INORGANIC CHEMICAL TECHNOLOGY

SUBJECT CODE: - CE-205T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

A general review of the chemical industries involving process technology, availability of raw materials, production trend and preparation of flow sheets.

Unit-I: Water: - industrial use of water, sources & problems of water, Temporary & permanent hardness, methods for reducing permanent hardness -lime soda process, zeolite softening process, ion-exchange process, municipal & industrial water treatment, vapor recompression process for recovery of fresh water from salt water, reverse osmosis, electrodialysis, direct refrigeration – flash process for producing fresh water from sea water.

Unit-II: Industrial gases: - Acetylene- Schusses process, Wulff process, acetylene from calcium carbide, oxygen-Linde Frankl cycle, nitrogen- kellog's process.

Unit-III: Sulphur & sulfuric acid, nitric acid- ammonia oxidation process or Monte-Catini intermediate pressure process.

Unit-IV: Ammonia- synthetic ammonia process, ammonium nitrate, ammonium sulphate, urea – partial and total cycle process.

Unit-V: Electrochemical industries, chloralkali industries, chlorine & caustic soda, electrolytic process for chlorine – caustic soda process, HCl manufacture from common salt, types of furnaces used for manufacture of HCl, soda ash – solvay process, modified solvay process.

Unit-VI: Phosphorous industries, phosphoric acid – wet process, electric furnace process, phosphatic fertilizers-single super phosphate, triple super phosphate, diammonium phosphate, nitro phosphate, ammonium phosphate, sodium phosphate- sodium tripoly phosphate.

Unit-VII: Cement- Portland cement, blast furnace slag cement, white cement, lime- quick lime process, hydrated lime process.

Unit-VIII: Ceramics crockery, glazed tiles, sanitary wares, porcelain, insulators, pottery, refractory- acid bricks, neutral bricks, basic bricks, enamel.

Text and Reference Books:

1. Shreve Chemical Process Industries – Austin, McGraw Hill Pub., 5th ed. 1984
2. Dryden- Outlines of Chemical Technology- revised and edited by M. Gopal Rao and M. Sitting, East West Press Pvt. Ltd., New Delhi (1977)
3. G.N. Pandey - A text book of Chemical Technology, vol 1 & 2, Vikas Publishing house Pvt. Ltd.

Question paper pattern:

For examination, the number of questions to be set are Eight, with at least one from each unit. Students are required to answer any five full questions.

B. TECH CHEMICAL ENGINEERING

II[nd] YEAR III SEMESTER

CHEMICAL ENGINEERING FLUID MECHANICS

SUBJECT CODE: - CE-207T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Unit-I: Properties of fluids: - Ideal and real fluids, Newtonian and Non-Newtonian fluids, compressible and incompressible fluids, physical properties – mass density, specific weight, specific volume, specific gravity, viscosity, thermodynamic properties, compressibility, surface tension and capillarity.

Unit-II: Fluid Pressure and its measurement: - pressure at a point, pressure variation in a fluid at rest, absolute, gauge, atmospheric and vacuum pressures, measurement of pressure manometers and mechanical gauges, piezometers, U-tube manometer, single column manometer, differential manometer, inverted and inclined manometer, micro-manometers

Unit-III: Kinematics of flow: - Methods of studying fluid flow, types of fluid flow, rate of flow, continuity equation for one dimensional flow, continuity equation for 3D flow for Cartesian co-ordinate system, stream function, velocity potential function, equi-potential line, stream line, stream tube, path line, relationship between stream function and velocity potential, flow net & its uses.

Unit-IV: Dynamics of fluid flow: - (analysis of one-dimensional flow only will be followed) Euler's equation of motion along a stream line, Bernoulli's equation (derivation from Euler's equation and also from energy principle), assumptions in deriving Bernoulli's equation, modified form of Bernoulli's equation, limitations of Bernoulli's equation. momentum equation. Flow measuring devices - venturi meter, orifice meter, Pitot tube, flow nozzle and Rotameter

Unit-V: Flow through pipes: Darcy-Weisbach equation – velocity distribution in smooth and rough pipes, Moody diagram, minor energy losses, hydraulic and energy gradients, flow through pipes in series and parallel and siphon.

Unit-VI: Flow Measurements: Flow through orifices classification, Flow through mouth pieces classification, Flow over notches classification, Equation of discharge over rectangular and trapezoidal notches, Equation for discharge over V notch.

Text Books:

1. Hydraulics & Fluid Mechanics – P.N. Modi & S.N. Seth (Standard Book House, New Delhi).
2. Fluid Mechanics - Jagdish Lal
3. Theory & Application of Fluid Mechanics- K. Subramanya (TMH Outer Series)
4. Fluid Mechanics- Schaum Series.

References:

1. Fluid Mechanics – by V.L. Streeter (Mc-Graw Hill-SI edition).
2. Fluid Mechanics – by Douglas (ELBS edition).
3. J.M. Coulson, and J.F. Richardson, (revised by J.R. Buckhurst and J.H. Harker) Chemical Engineering, Vol. 1 Pergamon Press, New York (1980).
4. J.G. Knudsen and D.L. Katz, Fluid Mechanics and Heat Transfer, McGraw Hill Book Co., New York, (1958).

PRACTICALS

B. TECH CHEMICAL ENGINEERING
III SEMESTER
FLUID AND PARTICLE MECHANICS LAB

SUBJECT CODE :- CE-201P **DURATION OF EXAM :- 03 Hrs**
CREDIT : 02 **MAX END SEM MARKS: 70**
TOTAL CONTACT HOURS: 20

Selected laboratory experiments based on the course CE-201T: Fluid & Particle Mechanics.

B. TECH CHEMICAL ENGINEERING
HEAT TRANSFER LAB

SUBJECT CODE :- CE-202P **DURATION OF EXAM :- 03 Hrs**
CREDIT : 02 **MAX END SEM MARKS: 70**
TOTAL CONTACT HOURS: 20

Selected laboratory experiments based on the course CE-202T: Heat Transfer.

B. TECH CHEMICAL ENGINEERING
III SEMESTER
CHEMICAL ENGINEERING FLUID MECHANICS LAB

SUBJECT CODE :- CE-203P **DURATION OF EXAM :- 03 Hrs**
CREDIT : 02 **MAX END SEM MARKS: 70**
TOTAL CONTACT HOURS: 20

Selected laboratory experiments based on the course CE-207T: Chemical Engineering Fluid Mechanics.

B. TECH CHEMICAL ENGINEERING
III SEMESTER
CHEMICAL PROCESS LAB

SUBJECT CODE :- CE-204P **DURATION OF EXAM :- 03 Hrs**
CREDIT : 02 **MAX END SEM MARKS: 70**
TOTAL CONTACT HOURS: 20

Selected laboratory experiments based on the course CE-208T: Organic Chemical Technology.

B. TECH CHEMICAL ENGINEERING

IInd YEAR IV SEMESTER

HEAT TRANSFER

SUBJECT CODE: - CE-202T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Unit-I: Basic concepts: - Introduction, basic modes of heat transfer, conduction, convection, radiation. Heat transfer by conduction: - Introduction, general heat conduction equation in rectangular, cylindrical and spherical coordinates; steady state conductions - heat conduction through a plane wall, heat conduction through a composite wall, heat flow between a surface and surrounding, cooling and heating of fluids, heat conduction through a cylindrical wall, heat conduction through a multi-layer cylindrical wall, heat conduction through a sphere, critical thickness of insulation.

Unit-II: Transient (Unsteady state) heat conduction: - Transient conduction in solids with infinite thermal conductivity, (lumped parameter analysis), transient heat conduction in solid with finite conduction and convective resistances ($0< Bi<100$), analytical solution for slabs, use of transient (Heisler) temperature charts for slabs, cylinders and spheres, transient heat conduction in infinite thick solids (Bi), periodic variation.

Unit-III: Heat transfer from extended surfaces: - Steady flow of heat along a rod, governing differential equation and its solution, heat dissipation from a fin insulated at the tip, heat dissipation from a fin losing heat at the tip, fin performance, design considerations for fins.

Unit-IV: Convection: - Fundamentals of convection, basic concepts and definitions, natural and forced convection, hydrodynamic and thermal boundary layers, laminar and turbulent heat transfer inside and outside tubes, dimensional analysis, determination of individual and overall heat transfer coefficients and their temperature dependence, heat transfer in molten metals.

Unit-V: Heat exchangers: - Classification of heat exchangers, nature of heat exchange process, relative direction of motion of fluids, mechanical design of heat exchange surfaces, physical state of heat exchanging fluids, performance analysis, overall heat transfer coefficient, logarithmic mean temperature difference, effectiveness and number of transfer units, parallel flow heat exchanger, counter flow heat exchanger

Unit-VI: Radiation :- Process and properties, salient features and characteristics of radiation, absorptivity, reflectivity, and transmissivity; wave length distribution of black body radiation, Planck's law , total emissive power, Stefan-Boltzmann law, Wien's displacement law, Kirchhoff's law, gray body & selective emitters, intensity of radiation and Lambert's cosine law, radiation exchange between surfaces - heat exchange between black bodies; configuration factor, shape factor algebra & salient features of the shape factor, numerical based on shape factor,

Unit-VII: Boiling and condensation: - Condensation, laminar film condensation on a vertical plate, convective coefficient for film condensation on tubes, boiling, boiling regimes, Evaporators; Liquid characteristics, types of evaporators- long tube vertical evaporator (upward flow, down ward flow, forced circulation), agitated film evaporators; evaporator capacity, evaporator economy.

Text and Reference Books:

1. Process Heat Transfer- Donald Q. Kern, McGraw Hill, ed. 1997.
2. Heat Transfer – J.P. Holman, 8th ed., McGraw Hill, international ed.
3. J.M. Coulson, and J.F. Richardson, (revised by J.R. Buckhurst and J.H. Harker) Chemical Engineering, Vol- 1, Pergamon Press, New York (1980)
4. Vijay Gupta, Elements of Heat and Mass Transfer, New Age Int. Pub. New Delhi (1995).
5. Heat & Mass Transfer- Dr. D.S. Kumar

Question paper pattern:
For examination, the number of questions to be set are Eight, with at least one from each unit.
Students are required to answer any five full questions.

B. TECH CHEMICAL ENGINEERING
IInd YEAR IV SEMESTER
CHEMICAL ENGINEERING THERMODYNAMICS-I

SUBJECT CODE: - CE-204T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Unit-I: Basic concept of thermodynamics: - Closed and open systems, forms of energy, properties of system pressure, manometer, barometer, zeroth law of thermodynamics, temperature scales.

Unit-II: Properties of pure substances: - Pure substance, phases of pure substance, compressed liquid and saturated liquid, saturated vapor and super-heated vapor, T-V diagram, P-V diagram, P-T diagram, enthalpy, saturated liquid- vapor mixture, virial equation, compressibility factor, Van der walls equation of state.

Unit-III: First law of thermodynamics of closed system, constant volume and constant pressure processes, heat capacity, specific heats, constant temperature process, reversible adiabatic process and its relation, control volumes- conservation of mass principle, mass and volume flow rates, total energy of flowing fluid, steady flow process, steady flow device (nozzles and diffusers).

Unit-IV: Second law of thermodynamics: - Heat engine, thermal efficiency, second law of thermodynamics by Kelvin and Plank or Clausius statements, entropy: - entropy change of reversible and irreversible processes, entropy change of an ideal gas, third law of thermodynamics.

Unit-V: Thermodynamic relations: - Properties of homogenous phase, Maxwell's relation, entropy, internal energy, enthalpy, Helmholtz free energy, Gibbs energy relations, specific heat at constant volume and pressure.

Unit-VI: Refrigeration and liquefaction: - Ideal refrigeration cycle, air vapor compression and absorption refrigeration cycle, COP, choice of refrigerants, liquefaction process and estimation of minimum work requirement.

Text and Reference Books:

1. Chemical Engineering Thermodynamics- Cengel
2. Chemical Engineering Thermodynamics – Van Smith

Question paper pattern:
For examination, the number of questions to be set are Eight, with at least one from each unit. Students are required to answer any five full questions.

B. TECH CHEMICAL ENGINEERING
IInd YEAR IV SEMESTER
CHEMICAL REACTION ENGINEERING - I

SUBJECT CODE: - CE-206T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Unit-I: Reaction rate, rate equation, single and multiple reaction, elementary and non- elementary reaction, molecularity and order of reaction, rate constant, representation of an elementary reaction and non-elementary reaction, kinetic model of non-elementary reaction, search of kinetics of reaction, temperature-dependent term of rate equation, Arrhenius and collision theories.

Unit-II: Constant volume batch reactor, analysis of pressure data obtained in a constant volume reactor, integral and differential methods of analysis of data for irreversible Ist, IInd, zero, nth order reaction, parallel and series, reversible reactions, variable volume batch reactor for Ist, 2nd, and zero order reactions.

Unit-III: Ideal reactor, ideal batch reactor, space time and space velocity, steady state mixed flow reactors, steady state plug flow reactors, holding time for flow reactors, mixed flow reactors for 1st and 2nd order reactions.

Unit-IV: Multiple reactors system, PFR in series and parallel, equal size mixed flow reactors in series, mixed flow reactors of different size in series, reactor of different types in series, quantitative treatment on product distribution of parallel reactors, best arrangement of a set of ideal reactors, recycle reactor.

Unit-V: Irreversible 1st order reaction in series, 1st order followed by zero order reaction, zero order followed by first order reaction, quantitative treatment of plug flow/ batch reactors & mixed flow reactors.

Unit-VI: Temperature and pressure effects, heat of reaction from thermodynamics, heat of reaction and temperature, equilibrium constant from thermodynamics, equilibrium conversion, general graphical design procedure, optimum temperature progression, heat effects in adiabatic and non-adiabatic operations, exothermic reaction in mixed flow.

Unit VII: Non-ideal flow, RTD, state of aggregation and earliness of mixing in determining reactors behavior, experimental methods, pulse and step experiment, convolute theorem, conversion in non- ideal reactor, compartment model, dispersion model.

Text and Reference Books:

1. Chemical Reaction Engineering – Octave Leven spiel, 6th ed
2. Chemical Reaction Engineering – H.Scott. Fogler, 3rd ed
3. Chemical Engg. Kinetics – J.M. Smith

Question paper pattern:
For examination, the number of questions to be set are Eight, with at least one from each unit. Students are required to answer any five full questions.

B. TECH CHEMICAL ENGINEERING
IInd YEAR IV SEMESTER
ORGANIC CHEMICAL TECHNOLOGY

SUBJECT CODE: - CE-208T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

A general review of the chemical industries involving process technology, availability of raw materials, production trend and preparation of flow sheets.

Unit-I: Sugar technology: - introduction, manufacture of sugar (from sugar cane), manufacture of white sugar (sulphitation process, carbonation process), evaporation section, beet sugar.

Unit-II: Pulp and paper industries: - introduction, manufacture of pulp for paper, raw materials, mechanical pulp, sulfate or kraft pulp, soda pulp, rag pulp, manufacture of paper, recovery of chemicals.

Unit-III: Fermentation industries: - Introduction, micro-organism and other growth requirements, outline of the fermentation process, fermentation products, molasses distillery, industrial spirit, rectified spirit, absolute alcohol, manufacture of beer, manufacture of wine, manufacture of vinegar, acetic acid, lactic acid, citric acid.

Unit-IV: Petroleum processing: - introduction, chemical composition, crude oil distillation and cracking (thermal and catalytic), catalytic reforming process, alkylation, isomerization process.

Unit-V: Edible oil and essential oils: - Hydrogenation of vegetable oil, soap, detergents and glycerin (continuous process for fatty acids, soap and glycerin), Paint and surface coatings.

Unit-VI: Polymerization fundamentals: - Introduction, polymer, elastomers and synthetic fibre, mechanism of polymerization, addition polymerization, condensation polymerization, chain growth polymerization, methods of polymerization, bulk or mass polymerization, suspension polymerization, emulsion polymerization, classification of polymers, manufacturing of PVC, PE (HDPE, LDPE), natural & synthetic rubber, butadiene-styrene rubber (SBR), viscous rayon and Nylon 6, polyester.

Unit-VII: Polymer processing: - introduction, plastics, fibers, compounding, calendaring, die casting, rotational casting, film casting, compression moulding, injection moulding, blow moulding, extrusion moulding, thermoforming, fibre spinning, melt spinning, dry spinning, wet spinning.

Text and Reference Books:

1. Shreve Chemical Process Industries – Austin, McGraw Hill Pub., 5th ed, 1984
2. Dryden –Outlines of Chemical Technology, revised and edited by M. Gopal Rao and M. Sittig- East West Press, Pvt. Ltd. N.D. (1997)
3. G.N. Pandey - Chemical Technology, Vol, 1 & 2, Vikas Pub. House Pvt. Ltd., N.D.

Question paper pattern:
For examination, the number of questions to be set are Eight, with at least one from each unit. Students are required to answer any five full questions.

B. TECH CHEMICAL ENGINEERING
IInd YEAR IV SEMESTER
MATERIAL SCIENCE

SUBJECT CODE: - CE-212T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Unit:I Introduction to materials science, types of materials, some mechanical properties. Atomic structure and bonding, types of atomic and molecular bonds, primary and secondary bonds, ionic bonding mechanism and examples, inter atomic forces for ion pair, covalent bonding, mechanism and examples, covalent bonding in carbon, energy and separation distance relationships, metallic bonding, secondary bonding mechanism and example.

Unit:II Crystal structures and crystal geometry, space lattice and unit cells, crystal systems and Bravais lattices, classification of space lattices by crystal system, principal metallic crystal structures, BCC, FCC and SC crystal

Unit:III Crystalline imperfections, types of imperfections, zero-dimension, one dimension and two-dimension defects, point defects, line defections, edge & screw dislocations, their formation and Burger vectors, grain boundaries, rate process in solids, Numerical determination of number of vacancies.

Unit:IV Atomic diffusion in solids, diffusion in solids in general, Diffusion mechanisms, vacancy mechanism, substitutional mechanism, types of diffusion, steady state diffusion and non-steady state diffusion, Fick's Laws of diffusion, factors affecting diffusivity, Numerical problem on Non-steady diffusion (Industrial applications).

Unit:V Phase diagrams, definition, explanation of phases, phase diagram of pure substances (water and Iron), Gibbs phase rule, Binary isomorphous alloy systems, Lever rule, numerical examples on lever rule for binary alloys, binary eutectic alloy systems, Invariant reactions, their representations and examples, Iron-Iron carbide phase diagram, phases of Fe-Fe3C phase diagram, invariant reactions, slow cooling of plain carbon steels, numerical problems using lever rule, rapid cooling of plain-carbon steels, isothermal transformation of Austenite in eutectoid plain carbon steel, continuous cooling of eutectoid plain carbon steel. T.T.T. diagram.

Unit:VI Heat Treatment, purpose, application, types of heat treatment processes, Annealing, Normalizing, tempering, surface hardening, case hardening techniques.

Text Book:
Materials Science by F. W. Smith

Reference Book:
1. Material Science by Van Black
2. Material Science by A. Mubeen Ahmed.

Question paper pattern:
For examination, the number of questions to be set are Eight, with at least one from each unit. Students are required to answer any five full questions.

B.TECH. CHEMICAL ENGINEERING

IIIrd YEAR V SEMESTER

CHEMICAL REACTION ENGINEERING –II

SUBJECT CODE:- CE-301 **DURATION OF EXAM:- 03Hrs**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Unit-I: Definitions of catalysts, types of catalyst-porous, nonporous, monolithic, supported, unsupported catalyst; characteristics of catalyst, surface area of catalyst, methods of determination of surface area; void volume and solid density; definition of porosity, deactivation of catalyst by aging , fouling or coking and poisoning

Unit-II: Unreacted core model for spherical particle of unchanging size, steps involved in unreacted core model, diffusion through gas film, ash film and chemical reaction control, rate of reaction for shrinking spherical particle, Stoke's regime (small particle), combination of resistances, rate controlling step determination.

Unit-III: Steps in catalytic reaction, types of adsorption, difference in physical and chemical adsorption, adsorption isotherm, Langmuir's treatment of adsorption isotherm. (pressure form and concentration form of equations). Diffusion and reaction in porous catalyst, pore diffusion resistance control, effectiveness factor, external resistance to mass transfer, film resistance control

Unit-IV: (a) Fluid-fluid reaction- kinetic regions for mass transfer and reaction, rate equation for instantaneous reaction, enhancement factor, rate equation for slow reaction, film conversion parameter. (b) Fluid- fluid reactor design- factors
to be considered in selecting a contactor, straight mass transfer, plug flow (G)/ plug flow (L) counter current flowing tower, mass transfer plus not very slow reaction plug flow (G) / mixed flow (L) mass transfer plus reaction in concurrent tower, mixed flow (G) / mixed flow (L) mass transfer plus reaction in agitated tank contactor, plug flow (G) / mixed flow (L) mass transfer reaction in bubble tank contactor.

Unit-V: Packed and fluidized bed catalytic reactor – staged bed adiabatic packed bed reactors, staged packed bed (plug flow), staged packed bed mixed flow reactors, staged packed beds with recycle cold shot cooling, choice of contacting system; slurry reactors- slurry reactors, slurry reactor kinetics, tower height of slurry reactors with or without chemical reaction; fluidized bed reactor with or without recirculation, design of catalytic reactor

Text and Reference Books :

1. Chemical Reaction Engineering – Octave Livenspien, 6th ed.
2. Chemical Reaction Engineering- H.Scott. Fogler, 3rd, ed.
3. Chemical Engg. Kinetics – J.M. Smith

Question paper pattern:
For examination, the number of questions to be set are **Eight,** with atleast one from each unit. Students are required to answer any five full questions.

B.TECH. CHEMICAL ENGINEERING
IIIrd YEAR VI SEMESTER
PROCESS DYNAMICS & CONTROL

SUBJECT CODE:- CE-302 **DURATION OF EXAM:- 03Hrs**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS:40

Unit-I: Dynamic modeling of first and second-order processes, interacting and non-interacting processes, introduction to non-minimum phase processes, distributed parameter processes and Mimo processes, forcing function-step, ramp, pulse, impulse and sinusoidal, step and sinusoidal response of first and second order processes.

Unit-II: Experimental estimation of dynamic process parameters and their identification, modes of control action, classification of controllers and control strategy, closed loop feedback control.

Unit-III: Servo and regulator problems, offset, selection of mode of control action, closed loop response, Routh stability criterion, controller tuning and design, online tuning, closed loop and open loop methods.

Unit-IV: Frequency response technique, phase margin and gain margin, Bode stability criterion, Nyquist stability criterion.

Unit-V: Controller design, root locus plot & stability analysis, cascade & feed forward control, design of controller and analysis of control system, Ratio, adaptive, model-based, multivariable, selection and split range control, computer process control.

Text and Reference Books:

1. Stephanopoulos, G. Chemical Process Control – "An Introduction to Theory and Practice", Prentice Hall of India (1990).
2. Coughanowr, D.R. and Koppel, L.B., "Process System- Analysis and Control", IInd, McGraw Hill (1991).

Question paper pattern:
For examination, the number of questions to be set are **Eight**, with atleast one from each unit. Students are required to answer any five full questions.

B.TECH. CHEMICAL ENGINEERING
IIIrd YEAR V SEMESTER
CHEMICAL ENGINEERING THERMODYNAMICS – II

SUBJECT CODE: - CE-303 **DURATION OF EXAM:- 03Hrs**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS:40

Unit-I: Maxwell's equations, residual properties, thermodynamic properties and their relation, phase rule and phase diagram of NaCl/ water system and sulphur system

Unit-II: Solution thermodynamic properties: - Fundamental properties relation, chemical potential, phase equilibrium, partial molar properties, Gibbs- Duhem equation, Gibb's energy of an ideal gas mixture, fugacity and fugacity coefficient for pure species, Poynting factor, fugacity and fugacity coefficient for species in solution, Lewis- Randall rule, excess properties.

Unit-III: Solution thermodynamics application: - Liquid phase properties from VLE data, fugacity and activity coefficient, excess Gibb's energy, Margules equation, property change on mixing.

Unit-IV: Phase equilibria: - Equilibrium and stability, liquid-liquid equilibrium (LLE), vapor/ liquid equilibrium (VLE), VLLE and solid-liquid equilibrium with temperature-composition diagram for different conditions

Unit-V: Chemical reaction equilibrium:- The reaction coordinate, mole fraction for single and multiple reactions, Gibb's energy change and the equilibrium constant, homogenous gas phase reactions, effect of operating conditions on degree of conversion at equilibrium, homogenous liquid phase reactions.

Text and Reference Book

1. Chemical Engineering Thermodynamics by J.M. Smith
2. Chemical Engineering Thermodynamics by Y.V. C. Rao

Question paper pattern:
For examination, the number of questions to be set are **Eight,** with atleast one from each unit. Students are required to answer any five full questions.

B.TECH. CHEMICAL ENGINEERING
IIIrd YEAR VI SEMESTER
ATMOSPHERIC ENVIRONMENTAL ENGG.

SUBJECT CODE :- CE-304 **DURATION OF EXAM:- 03Hrs**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS:40

Unit-I: Introduction: Definitions and technologies. Atmospheric structure and composition, scales of air pollution problem- local, urban, regional, continental and global. Air pollution episodes- Bhopal Gas Tragedy, Los Angeles and London smog.

Unit-II: Source and Classification of Air pollutants: Natural, anthropogenic, emission inventory source classification, primary and secondary pollutants, properties of major air pollutants along with source and sinks- particulates and gases. Unit of measurements of air pollutant. Simple problems on Unit conversion. Photochemical air pollutants, Air pollution due to automobiles. Smoke and its measurement.

Unit-III: Effects of Air pollution: Effects on human health and welfare, vegetation, animal, materials and structure/ monuments, visibility and related atmospheric characteristics, Acid rain, Greenhouse effect, Ozone depletion and Heat island effect.

Unit-IV: Air pollution Metrology: Scales. Of metrology, metrological factors-heat, solar radiation, temperature, lapse rate, wind, humidity, precipitation, mixing height, pressure, atmospheric stability condition, wind velocity profile, wind rose diagram. Inversion-types, plume behaviour under different atmospheric stability, effect of topography on pollution dispersion, Effect or air pollutants on metrology. Land/sea breeze effects, industrial plant location and city planning.

Unit V: Measurement of air pollutants And Air pollution Laws: Measurement of gaseous (CO, HC, NOx, SO2) and particulate pollutants, sampling devices, sampling train, sampling method/techniques, stack sampling techniques. Air pollution laws standards: air pollution law/acts, air quality and emission standards, air pollution indices-determination of air pollution index by different methods.

Unit-VI: Atmospheric Dispersion of Stack Effluents: Plume rise, effective stack height, plume rise formulations, guide lines for fixing stack height, problem on plume rise calculations, Gaussian plume model – for point source. Gaussian dispersion coefficient, Pasqual – Gifford atmospheric stability classification. Downwind ground – level concentration computation, maximum ground level concentration. Infinite line source Gaussian model. instantaneous puff dispersion model. estimate for various sampling times and decay of pollutant.

Unit-VII: Air Pollution Control Equipment's: General methods, control by process changes, Design of particulate control device- setting chambers, inertial separators, cyclones, fabric filters, scrubbers (wet collectors), electrostatic precipitators. Control of gaseous pollutants- adsorption, absorption, combustion and condensation.

Unit-VIII: Noise Pollution: Sources of noise, effects of noise pollution, unit & measurement of noise, control of noise pollution, standard. Equation & Applications.

Reference Books

1. Fundamentals of Air Pollution-Bauble, R.W., Donald L.F., Turner, D.B, and Stern A.C, (1994), Academic press.
2. Air Pollution Control Theory- Crawford M., (1980), TMH Addition, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
3. Air Pollution- Henry C. Perkins, (1980) McGraw Hill.

Question paper pattern:

For examination, the number of questions to be set are **Eight,** with atleast one from each unit.
Students are required to answer any five full questions.

B.TECH. CHEMICAL ENGINEERING
IIIrd YEAR V SEMESTER
MASS TRANSFER-I

SUBJECT CODE :- CE-305 **DURATION OF EXAM:- 03Hrs**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS:40

Unit-I: Diffusion:- Basic concept of diffusion, properties of binary mixtures, equimolar counter diffusion, relation between diffusivities, steady state molecular diffusion in fluids at rest, molecular diffusion in gases, steady state diffusion of one component through non-diffusing component, diffusivity of gases, molecular diffusion in liquids, diffusion in solids, general cases of gas phase mass transfer in a binary mixtures.

Unit-II: Theories of mass transfer: - Film theory, two-film theory, penetration theory, surface renewal theory, mass transfer through a stationary second component, unsteady state mass transfer; convective mass transfer, individual and overall mass transfer coefficients, mixing length and eddy kinematic viscosity; simultaneous momentum, heat & mass transfer, mass, heat and momentum transfer analogies, Reynolds analogy, Chilton-Colburn analogy, Taylor- Prandtl analogy, dimensionless numbers.

Unit-III: Humidification & dehumidification: - Definition, dry bulb temperature, wet bulb temperature, dew point, adiabatic saturation temperature, absolute humidity, molar humidity, relative humidity, saturation humidity, percentage humidity, humidity chart, mixing of two streams of humid gases, various methods of determination of humidity, dehumidification, methods of increasing humidity.

Unit-IV: Cooling towers: - various types of cooling towers, design of natural draft towers, introduction of evaporative cooling, height of packing for both natural and mechanical draft tower, temperature and humidity gradient in cooling tower, humidifying towers, systems other than air water.

Unit-V: Drying: - Definition, basic terms, classification and selection of dryers, rate of drying, heat transfer in dryers, temperature patterns in dryers, various interaction patterns, freeze drying, continuous drying, various types of industrial dryers.

Unit-VI: Crystallization:-Factors governing nucleation & crystal growth rates, controlled growth of crystals, industrial crystallizers.

Unit-VII: Adsorption: - Freundlich equation, single stage adsorption, multistage cross current adsorption, multistage counter current adsorption, application of Freundlich equation, ion-exchange, anionic and cationic, ion exchange reactions, ion-exchange column and their design parameters.

Unit–VIII: Leaching: - Single stage leaching, multistage cross current leaching, multistage counter current leaching, retention of liquid after drainage, counter current multiple contact shanks, batch settling, continuous setting typical leaching equipment.

Text and Reference Books:

1. Mass Transfer operations by Robert E.Treybal, McGraw Hill.
2. Unit Operations in Chemical Engg. by McCabe Smith, McGraw Hill.
3. Diffusion: Mass Transfer in Fluid Systems, 2nd ed, E.L. Cusler, Cambridge Univ. Press, (1997).
4. Mass Transfer – Theory and application by KV Narayana; B Lakshmikutty 2017, CBS Publications New Delhi.

Question paper pattern:
For examination, the number of questions to be set are **Eight**, with atleast one from each unit.
Students are required to answer any five full questions.

B.TECH. CHEMICAL ENGINEERING
IIIrd YEAR VI SEMESTER
EQUIPMENT DESIGN

SUBJECT CODE :- CE-306 **DURATION OF EXAM:- 03Hrs**
CREDIT 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS:40

Unit-I: Mechanics of materials: - Stress – strain relationship of elastic materials subjected to tensile, compressive & shear forces, elastic & plastic deformations, bending moment & bending stress, torsion, creep & fatigue, theories of column, thermal stress, membrane stresses in shell of revolutions, stress concentrations, theories of failure.
Unit-II: General design considerations: - Design codes, design pressure, materials, welded joint efficiencies, corrosion allowances, design loads.
Unit-III: Unfired pressure vessels: - pressure vessel codes, classification of pressure vessels, design of cylindrical & spherical shell under internal & external pressures, selection and design of flat plate torispherical, ellipsoidal and conical closures, compensations for openings.
Unit-IV: Tall vertical vessels: - Pressure, dead weight, wind, earthquake and eccentric loads and induced stresses, combined stresses, shell design of skirt supported vessel.
Unit-V: Bolted flanges: - Types of flanges, and selection, gasket, design of nonstandard flanges, specifications of standard flanges.
Unit-VI: Liquid storage tanks: - Storage tank codes, classifications, design of shell, bottom plates, self-supported and column supported roofs, wind guider, nozzles and other accessories.
Unit-VII: High pressures vessels: - Stress analysis of thick-walled cylindrical shell, design of monobloc and multiplayer vessels.
Unit-VIII: Fabrication of equipment: - Major fabrication steps, non-destructive tests of welded joints, inspection and testing, vessel lining, materials used in fabrication of equipment for some selected chemical industries.

Text and Reference Books:

1. Bhattacharya B.C. Introduction to Chemical Equipment Design, Mechanical Aspect", CBS Publication & Distributors
2. Chemical Engineering by Coulson and Richardson Vol-6, J.M. Coulson and J.F. Richardson revised by R.K. Sinnott, Pergamon Press, New York (1980).
3. Joshi M.V. "Process Equipment Design", Macmillan India Ltd, New Delhi.
4. Indian & American Codes used in Designing of Equipment (TEMA & IS Codes)
5. Introduction to Chemical Equipment Design by BC Bhattacharya. 2015, CBS Publication, New Delhi.

Question paper pattern:
For examination, the number of questions to be set are Eight, with atleast one from each unit. Students are required to answer any five full questions

B.TECH. CHEMICAL ENGINEERING
IIIrd YEAR V SEMESTER
TRANSPORT PHENOMENA

SUBJECT CODE :- CE-307 **DURATION OF EXAM:- 03Hrs**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS:40

Unit-I: Introduction to Transport Phenomena: - Similarity between momentum, heat and mass transfer, the continuum hypothesis, basic laws of fluid motion, Newton's second law of motion, principle of balance between momentum, heat and mass transfer, principles of conservation of momentum, mass and energy.
Unit-II: Momentum transport phenomena: - Newton's law of viscosity, non-Newtonian fluids, pressure and temperature dependence of viscosity, theory of viscosity of gases at low density, theory of viscosity of liquid Velocity distribution in laminar flow, flow of falling film, flow of through circular tube and annulus.
Unit-III: Partial time derivative, total time derivative, substantial time derivative, Adjacent flow of two immiscible liquid, use of equation of curvilinear cylindrical coordination to set up steady flow problems; tangential circular flow of a Newtonian fluid.
Unit-IV: Energy transport phenomena: - Temperature and pressure dependence of thermal conductivity in gases and liquids, theory of thermal conductivity of gases at low density, Fourier law of heat conduction. Temperature distribution in solids and in laminar flow, heat conduction with an electrical heat source, heat conduction with a nuclear heat source, heat conduction with a viscous heat source, heat conduction through composite walls.
Unit-V: Mass transfer phenomena: - concentration distribution for laminar flow; shell mass balance, bonding condition, diffusion with homogenous and heterogeneous chemical reaction, diffusion in falling liquids films, equation of continuity for multi component mixture.

Text and Reference Books:

1. Transport Phenomena- R.B. Bird, W.E. Stewart and E.N. Lightfoot, 2nd ed., John Wiley & Son, Inc., Singapore (2003)

Question paper pattern:
For examination, the number of questions to be set are Eight, with atleast one from each unit. Students are required to answer any five full questions.

B.TECH. CHEMICAL ENGINEERING
IIIrd YEAR VI SEMESTER
MASS TRANSFER – II

SUBJECT CODE :- CE-308 **DURATION OF EXAM:- 03Hrs**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS:40

Unit–I: Distillation: - Raoults law, relative volatility, ideal solutions, x-y, Hx-y diagrams, flash vaporization, differential distillation, azeotropic distillation, extractive distillation, low pressure distillation, molecular distillation

Unit-II: McCabe- Thiele method of multistage tray tower, enriching section, exhausting section, introduction of feed (feed line), total reflux, minimum reflux ratio, use of open steam, partial condensers.

Unit–III: Ponchon & Savarit method of multistage tray tower, enriching section, stripping section, complete fractionators, use of open steam, multiple feed

Unit-IV: Optimum reflux ratio, condensers & reflux accumulators, high purity products, plate efficiency, overall efficiency, Murphree efficiency, local efficiency

Unit-V: Liquid- liquid extraction: -Single stage extraction, multistage cross-current extraction, multistage counter- current extraction without reflux, extraction with intermediate feed & reflux, extraction equipment– stage type extractors, agitated vessels, mechanically agitated counter-current extractors, rotating disk contactor (RDC), Scheibel extractors, Karr reciprocating plate extractor, Trey extractors, pulsed extractor, packed tower, spray tower, sieve tray, settlers.

Unit-VI: Absorption of gases: - Mechanism of absorption, rate of absorption, design of plate absorption column, concept of number of transfer units (NTU) and height of transfer units (HTU), choice of solvent for absorption. Concept of operating line, concept of ideal stage, stage efficiencies, design of continuous contact equipment, equipment of gas-liquid operations, Sparged vessels, mechanically agitated vessels, Tray column.

Text and Reference Books:

1. Mass Transfer operation by Robert E. Treybal, McGraw Hill.
2. Unit Operations in Chemical Engg. by McCabe Smith, McGraw Hill.
3. Mass Transfer – Theory and application by KV Narayana; B Lakshmikutty 2017, CBS Publications New Delhi.

Question paper pattern:

For examination, the number of questions to be set are Eight, with atleast one from each unit. Students are required to answer any five full questions.

B.TECH. CHEMICAL ENGINEERING
IIIrd YEAR V SEMESTER
ENERGY ENGINEERING

SUBJECT CODE :- CE-309 **DURATION OF EXAM:- 03Hrs**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS:40

Unit-I: Coal: - Classification, properties, washing and storage, combustion, carbonization, liquefaction and gasification, briquetting of pulverized coal, proximate and ultimate analysis, merits and demerits of solid, liquid and gaseous fuels. Liquid fuels: Properties, handling, storage and transportation, combustion characteristics and associated problems, fuel specification and standards. Origin of petroleum, classification and refining of crude petroleum, knocking, octane rating and cetane rating of fuels Gaseous fuels: Manufacture, properties and characteristics of natural gas, CNG, LPG, coal gas, coke oven gas, producer gas and water gas.
Unit-II: Alternate energy sources: Biomass combustion and pyrolysis, bio-gas production. Solar energy: - Flat plate collector, analysis and construction of solar water heater, solar pond, solar desalination, solar space heating and cooling. geothermal energy sources and their harnessing, energy from wind and tides, energy storage and distribution.
Unit-III: Combustion process: - Nature of combustion, mechanism of combustion reactions, chain reaction – hydrogen-oxygen reaction, velocity of flame propagation, limits of inflammability, structure of flame, kinematics of liquid and solid fuel combustion.
Unit-IV: Energy conservation measures: - Waste heat recovery, use of low-grade hot streams, condensate and flue gases, improvement in heat energy, steam trap, Energy auditing: - Mapping of distribution of energy supply and demand in a chemical plant, identification of energy intensive areas, energy auditing and acts.

Text and Reference Books:

1. Fuel and Combustion – Smith N.L. & Stainson K.W.
2. Principles of Solar and Energy Handbook: Kreider J.F., Frank and Kreith, F
3. Unconventional energy sources: G.D. Rai, Khanna Publishers.
4. Renewable Energy Resources: John Twidell and Tony Wein
5. Industrial Energy Conservation: A hand book for engineers and managers - Reay D.A.
6. Fuels & Combustion: Samir, Sirkar, Orient Longman Pub. 2nd ed. Mumbai.
7. Solar Energy Engineering – S.P. Sukhatma, 2nd ed, TMH Pub, Ltd. New Delhi (1984)
8. Solar Engineering of Thermal Processes, J.A. Duffiex, W.A. Beckman, John Wile & Sons, New York (1980)
9. Fuel Combustion & Refractory- O.P.Gupta, Khanna Publishers.

Question paper pattern:
For examination, the number of questions to be set are Eight, with atleast one from each unit. Students are required to answer any five full questions.

B.TECH. CHEMICAL ENGINEERING
III[rd] YEAR VI SEMESTER
INDUSTRIAL POLLUTION CONTROL

SUBJECT CODE :- CE-310 **DURATION OF EXAM:- 03Hrs**
CREDIT: 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS:40

Unit-I: Pollution & Pollutants, Contamination, Definition of Water Pollution, Sources of Water Pollution, Types of Water Pollution: i) Physical pollution ii) Chemical pollution iii) Bacteriological pollution, Types of Water Pollutants: i) Biological agents ii) Chemical agents iii) Physical agents, Point sources and Non-point sources, Ground Water pollution, Harmful effects of Water Pollution (Fluoride, Arsenic, Lead, Chromium, Cobalt, Pesticides, Mercury etc).
Unit- II: Environmental legislation, Difference between influent and effluent, Guidelines for Discharge of effluents on land, into Municipal sewers and natural waters, Characterization of Effluent streams, Oxygen demanding wastes and their determination (DO, BOD, COD & TOC), Oxygen Sag curves, Self-Purification of running streams, Streeter-Phelps Oxygen-Sag Equation.
Unit –III: Unit Operation & Unit processes, Reactors, Process Flow-sheet for common w/w treatment system, Primary treatment (Physical unit)- Screening, Comminutor, Grit chamber, Primary sedimentation.

Unit –IV: Secondary treatment (Biological unit)- Suspended & Fixed Growth system, Aerobic & Anaerobic systems, Activated Sludge process and modifications, trickling filters, Rotating Biological contractor, Bio filter, Secondary sedimentation tank, Stabilization ponds- Aerobic, Facultative & Anaerobic lagoons, Septics tanks.
Unit –V: Process line Diagrams: Characteristics, Effects & Treatment 0f Industrial wastes of Sugar Industry, Dairy, Distilleries, Pulp & Paper, Oil refineries, Petrochemical complex, Pharmaceuticals, Tanneries, Food Processing, Textile, Fertilizer & Steel Industries.

Text and Reference Books:

1. Pollution Control in Process Industry by S.P. Mahajan TMH.
2. Waste Water Treatment by M.Naryana Rao, A.K. Datta, Oxford and IHB Publ., New Delhi.
3. Air Pollution Control by P. Pratap Mouli and N. Venkata Subbayya, Divya Jyoti Prakashan , Jodhpur
4. Introduction to Wastewater Treatment by R.S. Ramalho, Academic Press, N.Y.
5. Fundamental of Air Pollution Control by A.C. Stern, Academic Press

Question paper pattern:
For examination, the number of questions to be set are Eight, with at least one from each unit. Students are required to answer any five full questions.

B.TECH. CHEMICAL ENGINEERING
IIIrd YEAR V SEMESTER
PROCESS INSTRUMENTATION

SUBJECT CODE :- CE-311 **DURATION OF EXAM:- 03Hrs**
CREDIT: 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS:40

Unit-I: Introduction to process variables, static & dynamic characteristics of instruments and their general classification.
Unit-II: Elements of measuring systems and their function, signal transmission, transmitters- electronic, pneumatic etc.
Unit-III: Principles, construction and operation of instruments for the measurement, transmission, control/ indications /recording of various process variables such as temperature, pressure, flow, liquid level, humidity and composition.
Unit-IV: Principle and construction of electro-pneumatic transducer, pneumatic to electrical converters, multiplexers.
Unit-V: Construction and characteristics of final control elements such as pneumatic control valve, stepper motor, motorized valve; principles and construction of pneumatic and electronic controllers.
Unit-VI: Introduction of data acquisition system and intelligent instruments, analog to digital conversion, process instrumentation diagrams and symbols. Instrumentation of process equipment such as distillation column, heat exchanger etc.

Text and Reference Books:

1. B.C. Nakra & K.K. Choudhary, Instrumentation Measurement & Analysis, TMH Publication Delhi
2. L.F. Adams, Engineering Measurement & Instrumentation, ELBS, London
3. Eckman, D.P., "Industrial Instrumentation", John Wiley

Question paper pattern:
For examination, the number of questions to be set are Eight, with atleast one from each unit. Students are required to answer any five full question.

B.TECH. CHEMICAL ENGINEERING
IIIrd YEAR VI SEMESTER
PROCESS ENGINEERING & ECONOMICS

SUBJECT CODE: - CE-304 **DURATION OF EXAM: - 03Hrs**
CREDIT: 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS:40

Unit-I: Process design development: - project design procedures, types of design, feasibility survey, process development, design, construction and operation, design information from literature, flow diagrams, preliminary design, literature survey.
Unit-II: Comparison of different processes, batch versus continuous operation, equipment design & specifications, scale up design, safety factors, specifications, material of construction. plant location, selection of plant site, plant layout, preparation of the layout, plant operation and control, instrumentation, maintenance, utilities, structural design, storage, material handling.
Unit-III: General procedure for determining optimum conditions, procedure with one, two or more variables, analytical and graphical methods and their composition, break even chart, breakeven point, optimum production rates, optimum condition in cyclic operations, cycle time for maximum amount of heat transfer, cycle time for minimum cost per unit of heat transfer, optimum economic pipe diameter, pumping or blowing costs, fixed charges for piping system, optimum flow rate of cooling water in condenser, optimum reflux ratio.
Unit-IV: Profitability alternative investments and replacement, profitability standards, cost of capital, bases for evaluating project profitability, mathematical methods for profitability evaluation, determining acceptable returns. alternative investments, methods of profitability, replacement, evaluation for replacements, book values and unamortized values, net realizable value.
Unit V: Types of taxes: - property tax, excise taxes, income taxes, normal taxes, sur tax, capital gain tax, tax exemption for dividends received, excess profit tax, tax return. Interest: - Types of interest: - simple interest, ordinary and exact simple interest, compound interest, normal & effective interest rates, continuous interest, present worth & discount annuities, special types of annuities.
Unit-VI: Depreciation and insurance: - types of depreciation (physical & functional), methods for determine depreciation, straight line method, decline balance method, Insurance: - Legal responsibility, types of insurance, self-insurance.
Unit-VII: Cost estimation- cash flow for industrial operations, factors effecting investment & production cost, capital investment, cost factors in capital investment, estimation of total product cost.

Text and Reference Books:

1. M.S. Peters nad K.D. Timmerhaus, Plant Design and Economics for Chemical Engineers, 5rd ed., McGraw Hill Book Co., New York, (2017).
2. J.M. Coulson and J.F. Richardson (revised by L.D. Sinnot), Chemical Engineerng, Vol. 6, 4th edition. Elsevier Butterworth-Heinemann Publication (2005), Oxford.

Question paper pattern:

For examination, the number of questions to be set are Eight, with atleast one from each unit. Students are required to answer any five.

PRACTICALS

B.TECH. CHEMICAL ENGINEERING V SEMESTER
REACTION ENGINEERING LAB

SUBJECT CODE :- CE-301P **DURATION OF EXAM:- 03Hrs**
CREDIT : 02 **MAX END SEM MARKS: 70**
TOTAL CONTACT HOURS:20

Selected laboratory experiments based on the course CE-206T: Chemical Reaction Engineering – I and CE – 301T: Chemical Reaction Engineering - II.

B.TECH. CHEMICAL ENGINEERING VI SEMESTER
ENERGY LAB

SUBJECT CODE :- CE-302P **DURATION OF EXAM:- 03Hrs**
CREDIT : 02 **MAX END SEM MARKS:70**
TOTAL CONTACT HOURS:20

Selected laboratory experiments based on the course CE-309T: Energy Engineering.

B.TECH. CHEMICAL ENGINEERING V SEMESTER
INSTRUMENTATION AND ANALYISIS LAB

SUBJECT CODE:- CE-303P **DURATION OF EXAM:- 03Hrs**
CREDIT : 02 **MAX END SEM MARKS:70**
TOTAL CONTACT HOURS:20

Selected laboratory experiments based on the course CE-311T: Process Instrumentation.

B.TECH. CHEMICAL ENGINEERING VI SEMESTER
MASS TRANSFER LAB

SUBJECT CODE :- CE-304P **DURATION OF EXAM:- 03Hrs**
CREDIT : 02 **MAX END SEM MARKS:70**
TOTAL CONTACT HOURS:20

Selected laboratory experiments based on the course CE-305T: Mass Transfer – I and CE-308T: Mass Transfer - II.

B.TECH. CHEMICAL ENGINEERING V SEMESTER
PROCESS CONTROL LAB

SUBJECT CODE :- CE-305P **DURATION OF EXAM:- 03Hrs**
CREDIT : 02 **MAX END SEM MARKS:70**
TOTAL CONTACT HOURS:20

Selected laboratory experiments based on the course CE-311T: Process Instrumentation and CE –302T: Process Dynamics & Control.

B. TECH CHEMICAL ENGINEERING

IVth YEAR VII SEMESTER

PROCESS EQUIPMENT DESIGN

SUBJECT CODE: - CE-401T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Unit-I: Process design of fixed & floating head shell & tube heat exchanger.

Unit-II: Process design of evaporators, crystallizers.

Unit-III: Process design of plate & packed column for distillation & absorption.

Unit-IV: Process design of flash drum, kettle reboiler, cooling tower, rotary dryer.

Unit-V: Process design of fixed bed adsorption column.

Unit-VI: Process design of catalytic and noncatalytic reactors.

Text and Reference Books:

1. Chemical Engg. Vol-6, J.M. Coulson and J.F. Richardson revised by R.K. Sinnott.

Question paper pattern:

For examination, the number of questions to be set are **Eight,** with atleast one from each unit. Students are required to answer any five full questions.

B. TECH CHEMICAL ENGINEERING

IVth YEAR VIII SEMESTER

MODELING, SIMULATION AND OPIMIZATION

SUBJECT CODE: - CE-402T **DURATION OF EXAM: - 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Unit-I: Optimization: - Introduction, Engineering application of optimization, optimization techniques, structure of design problem by biparte method and acyclic order diagram, unimodel (single variable) problem.

Unit-II: Linear programming: - Introduction, important definitions, assumptions of linear programming, applications & advantages of linear programming, formulation of linear programming problem (LPP), graphical solution of problems, general formulation of LPP, slack & surplus variables, standard form of linear programming

Unit-III: Simplex method, duality in linear programming – introduction, concept, general rules, advantages of duality, artificial variable technique.

Unit-IV: project formulation and management concepts, network analysis, critical path method (CPM), program evaluation and review technique (PERT).

Unit-V: Nonlinear programming (one dimensional minimization): - Introduction, unimodel function, elimination method, fibonacci method, golden section method.

Unit-VI: Geometric programming: - Introduction, unconstrained minimization problems of solutions.

Unit-VII: Modeling: - Classification of models, population balance models & applications, empirical models-forms of empirical model, model parameters estimation, experimental design.

Unit-VIII: Simulation: - sequential modular, simultaneous modular & equation-oriented approaches, partitioning & tearing, simulation examples of fluid flow, heat transfer, mass transfer & reaction processes, Monte Carlo simulation.

Text and Reference Books:

1. Higher Engineering Mathematics – B.S. Grewal
2. Operation Research – S.D. Sharma
3. Frank R.G.E., “Modeling & Simulation in Chemical Engineering”, Wiley
4. Luyben W.L., “Process Modeling, Simulation and Control for Chemical Engineering”, McGraw Hill
5. Ashgar Hussain, “Chemical Process Simulation “
6. Himmenblau D.M. “Process Analysis and Simulation”.

Question paper pattern:

For examination, the number of questions to be set are **Eight,** with atleast one from each unit. Students are required to answer any five full questions.

B. TECH CHEMICAL ENGINEERING

IVth YEAR VII SEMESTER

PROCESS UTILITY AND SAFETY

SUBJECT CODE :- CE-403T **DURATION OF EXAM :- 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Unit-I: Process utilities: - Role of process utilities in process industries Heat transfer media: - Characteristics properties, classification, selection and their industrial applications

Unit-II: Steam systems: - Application in chemical process plants, design of efficient steam heating systems, condensate utilization and flash steam traps: - Types and characteristics.

Unit-III: Water: - Water and its characteristics and conditioning for process industries e.g. boiler feed, cooling etc, recycling aspects of water, Air: - Characteristics of air and air receivers.

Unit-IV: Piping network: - Piping networks for water, steam, condensate and air, Process safety: - introduction to process safety, accident and loss statistics, nature of the accident/ hazardous processes.

Unit-V: Toxicology: - toxic materials and biological response, dose- response relationships and models, threshold dose and its definition; material safety data sheets and industrial hygiene evaluation.

Unit-VI: Personnel safety devices and general hygiene management- ventilation.

Unit-VII: Fire & explosion: - Definition, flammability characteristics and explosion, design to prevent fires and explosions by inverting, purging, ventilation, sprinkler system, static electricity controls. Relief's and relief's sizing in vapour /gas, liquid and run-away reaction services.

Text and Reference Books:

1. Geiriunger, P.L., "Hand Book of Heat Transfer media, "Reinhold Publishing Corp (1962).
2. Checketchin A.V., High Temp. Heat Carrier, "Pergamon Press (1963).
3. Goodall, P.M., "Efficient Use of Steam," Guildford (1980).
4. Danial, A Crowl and Joseph, F.L., "Chemical Process. Safety: Fundamental with Application". Int. series in Physical & Chemical Engg. Sciences, Prentice Hall (1990).

Question paper pattern:

For examination, the number of questions to be set are **Eight,** with atleast one from each unit. Students are required to answer any five full questions.

B. TECH CHEMICAL ENGINEERING
IVth YEAR VIII SEMESTER
CORROSION AND MATERIAL OF CONSTRUCTION

SUBJECT CODE :- CE-404T **DURATION OF EXAM :- 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Unit-I: Introduction to corrosion, types of corrosion – uniform or general attack corrosion, galvanic or two metal corrosion, pitting corrosion, crevice corrosion, erosion corrosion, cavitation corrosion, fretting corrosion, selective leaching or dealloying corrosion, hydrogen damage, measurement of corrosion. Electrochemical corrosion of metals, galvanic cells, galvanic cells with acid or alkali's electrolytes with no metal ions present , corrosion of single cell, iron concentration cell, oxygen concentration cells, galvanic cells created by difference in composition, structure and stress corrosion rates (kinetics), Oxidation of metal protective oxide films, P.B. ratio, mechanism of oxidation, oxidation rates (kinetics), Corrosion control material selection, coating , design, cathodic and anodic protection , environmental control.

Unit-II: Material of construction, classification of materials, properties of material, (physical, chemical, mechanical, technological properties) , examples and their definitions only, composition of steel, types of steels, (tools steel , high speed steel, stainless steel), composition of cast iron, types of cast iron, (Grey cast iron, white cast iron, malleable cast iron, mottled cast iron), non-ferrous metals & their example and uses, aluminum, and its alloys (duralumin, Y- alloy, Magnalium, Hindalium) & copper and its alloys (cartridge brass, yellow brass, leaded brass, German silver, muntze brass, brazing brass, red brass, high brass, low brass, phosphor bronze, silicon bronze , manganese bronze, gun metal), their composition and uses.

Unit-III: Introduction to ceramics, classification of ceramic products, advantage of ceramic materials, application of ceramics, processing of ceramics, material preparation, forming (pressing, isostatic pressing, hot pressing), slip casting, extrusion, thermal treatment (drying & binder removal, sintering, vitrification), properties of ceramic materials (mechanical properties, electrical properties, thermal properties, chemical properties).

Unit-IV: Introduction to elastomers (rubbers), natural rubber (structure, vulcanization, properties), types of rubbers, styrene-butadiene rubbers, nitrile rubbers, polychloroprene (neoprene), silicon rubber, thermoplastic, polyurethane elastomers (TPUE), uses of rubber, forms of rubbers, compounding, extruding, molding.

Text and Reference Books: -

1. Corrosion Engineering – Fontana.
2. Principles of Materials Science & Engineering – William F.Smith.
3. Material Science & Engineering – R.K. Rajput.
4. Chemical Engineering – G.M. Coulson and G.F. Richardson revised by R.K. Sinnott.

Question paper pattern:

For examination the number of questions to be set are **Eight,** with atleast one from each unit. Students are required to answer any five full questions.

B. TECH CHEMICAL ENGINEERING
IVth YEAR VII SEMESTER
PETROLEUM REFINING AND PETROCHEMICAL TECHNOLOGY

SUBJECT CODE :- CE-451T **DURATION OF EXAM :- 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Unit-I: Origin and occurrence of petroleum crude, status of petroleum refining industry in India, classification and physical properties of petroleum testing, uses and blending of petroleum products. Petroleum refining processes, atmospheric and vacuum distillation, thermal and catalytic cracking, vapor-liquid and mixing phases, hydrocracking.

Unit-II: Catalytic reforming, polymerization, isomerization, hydrogenation, production of aviation gasoline, motor fuel, kerosene, diesel oil and jet fuel.

Unit-III: Vacuum distillation, solvent extraction, uses of lubricating oils and petroleum waxes, chemical and clay treatment of petroleum products, desulfurization process for petroleum products, catalyst delayed coking, hydrotreating & vis-breaking.

Unit-IV: Introduction to petrochemical industries in India, structure of petrochemical complexes, product profile of petrochemicals units, Olefin production (Naphtha & gas cracking) separation of aromatics (Benzene, xylene and toluene), Aromatic conversion processes (disproportionation, isomerization, dealkylation).

Unit-V: Manufacture of major petrochemical, methanol and formaldehyde, ethylene oxide and ethylene glycol, acetaldehyde, butadiene, linear alkyl benzene.

Text and Reference Books:

1. Petroleum Refining Technology – Prof. I.D. Mall.
2. Petrochemical Process Technology – Prof. I.D. Mall.
3. Catalytic reforming – Little, D.M.
4. Petrochemical processes: part I & II chaval A and Lafabnye, G.L.
5. Chemical Technology vol-II: S.N. Pandey.
6. Petroleum refining engg. – Dr. Prasad.
7. Petrochemical – Wiseman, Peter.
8. Petroleum refining engineering – Nelson W.L.
9. Chemical Technology of petroleum – Gruse, W.A. and Stevens D.R.

Question paper pattern:

For examination, the number of questions to be set are **Eight,** with atleast one from each unit. Students are required to answer any five full questions.

B. TECH CHEMICAL ENGINEERING
IVth YEAR VII SEMESTER
FLUIDIZATION ENGINEERING

SUBJECT CODE :- CE-452T **DURATION OF EXAM :- 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Unit-I: Flow through packed beds, fluidization of particles, particulate and aggregative fluidization, spouted beds, circulating fluidized beds.

Unit-II: Fluidization & mapping regimes- fixed beds of particles of single and mixed size, fluidization with and without carryover of particles, minimum fluidization and terminal velocities of particles, mapping of regimes, distributors for dense beds, power consumption of fluidized beds.

Unit-III: Bubbling fluidized beds – emulsion phase, gas flow, bubble properties, physical & flow models.

Unit-IV: Entrainment & elutriation from fluidized beds- free board behavior gas outlet location, entrainment from short & tall vessels.

Unit-V: High velocity fluidization – turbulent & fluidized beds, fast fluidization, pressure drop in turbulent & fast fluidization.

Unit-VI: Fluidized bed coal combustors and their essential features.

Unit-VII: Bubble behavior and bed properties: - single rising bubble models, wake region and solids within bubbles, interaction and coalescence of bubbles, bubble formation, slug flow.

Text and Reference Books:

1. Kunii D. & O Levenspiel. “Fluidization Engineering.”, II Ed, Butterworth-Heinemann

Question paper pattern:

For examination, the number of questions to be set are **Eight,** with atleast one from each unit. Students are required to answer any five full questions.

B. TECH CHEMICAL ENGINEERING
IVth YEAR VIII SEMESTER
MUNICIPAL AND BIOMEDICAL WASTE MANAGEMENT

SUBJECT CODE :- CE-460T **DURATION OF EXAM :- 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Unit-I: Introduction: Objectives, principles, functional elements of municipal solid waste management (MSW), management system- Major problems. Environmental implications of open dumping of MSW, MSW rules, construction debris-management & handing, Rag pickers and their role.

Unit-II: Engineering Principles-Waste generation rates, frequency, storage and refuse collection, processing at source, physical and chemical composition, quantity of waste, engineering properties of MSW waste prediction, modeling concepts.

Unit-III: Collection and Transport-Access and point of collection, primary and secondary collection- economics, equipment types, personnel, collection routes-optimization, transfer station (regional concept), system dynamic problems.

Unit-IV: 4R-reduce, recovery, recycle and reuse- Source segregation, waste minimization, recovery potential and recycling practices, recycle of non-biodegradable materials, reuse cycles.

Unit-V: Biomedical Waste (BMW)-Health care system, sources, categories, generation and handling of BMW, segregation, BMW (management and Handling) rules 2011/12.

Unit-VI: Treatment options for MSW and BMW-Composting, vermi composting, bio-gasification, thermal processing-combustion, incineration, pyrolysis-types and design criteria, plasma technique, radioactive waste containment.

Unit-VII: Disposal Options-Engineered sanitary landfills, gases and leachate control, opportunity costs, siting considerations and design problems, sharps and needles disposal.

Unit-VIII: Recent Trends-Community based waste management, waste as a resource concept, public partnership (PPP) in MSW and biomedical waste management.

Text and Reference Books:

1. Sasikumar K and Sanoop Gopi Krishna (2009), “Solid Waste Management”, Eastern economy addition, PHI New Delhi.
2. CPHEEO Manual on Municipal Solid Waste Management (Recent addition).
3. Bhide and Sundareshan (1985), “Solid Waste Management in developing Countries”, UN Publications.
4. Science Direct journals.
5. MSW and BMW – rules and guidelines (CPCB and UPSPCB)
6. Techobanaglous, Theissen & Eliassen, Solid Wastes Engineering–Principles and Management Issues, McGraw Hill, New York.
7. WHO Manual on Solid Waste Management.

B. TECH CHEMICAL ENGINEERING
IVth YEAR VIII SEMESTER
ENVIRONMENTAL MANAGEMENT

SUBJECT CODE :- CE-461T **DURATION OF EXAM :- 03 Hrs.**
CREDIT : 04 **MAX END SEM MARKS:**
TOTAL CONTACT HOURS: 40

Unit-I: Organizational structure of environmental management at central & state level-Duties and responsibilities of CPCB, SPCB, List of Projects requiring Environment clearance in India, acts & rules related to environmental management – water, air, hazardous waste, biomedical waste, noise pollution and general aspects of environment protection, sustainable development, provision for protection of environment in constitution of India, NGT Act 2010.

Unit-II: Environmental audit, Water audit and Energy audit with case studies.

Unit-III: Cleaner technologies and their roles in environmental management

Unit-IV: Total quality management, salient features of ISO 9000, ISO 14000 and ISO 18000 certifications.

Unit-V: Environmental impact assessment, role NGO's, life cycle assessment

Unit-VI: Pollution tragedies: - Case studies, environmental politics, environmental economics, eco-labeling.

Unit-VII: National environmental policies: – Air and water policies, phasing out CFC's, phasing out of lead from petrol, implementation of CNG, biodegradable plastics, land use planning- land for afforestation, agriculture and urbanization, promotion of mass transit system, recycling of waste, resources recovery from waste, ground water contamination and prevention, rain water harvesting.

Unit-VIII: Global warming and greenhouse effect, acid rain, depletion of ozone layer, eutrophication, genetic erosion, lead pollution, pesticide pollution, increasing sea level, environmental ethics, artificial rain, environmental scenario in India, Rio summit, Kyoto protocol, Copenhagen summit, BASIC, BRIC, CSR, green economy, carbon credits, carbon footprints.

Text and Reference Books:

1. Lohani B.N. Environmental Quality Management, 1984 South Asian Publish, New Delhi.
2. Chanlett E.T. Environment Protection, 1979, McGraw Hill- Kogakusha Ltd.
3. ISO 9000 ISO 14 000 and ISO 18000- Volumes.
4. Ethics on Engineering by Mastum M.W. and Scherzinger & 3rd Edition MC Graw-Lit New York 1997.
5. Engineering Ethics- Concept and Cases by Harris C.L., etal word swarth Publishing, Belmont CA 1995.
6. Engineering Ethics – M. Govindarajan, S. Natarajan, V.S. Senthil Kumar, EEE, Prentice Hall of India, New Delhi.

Question paper pattern:

For examination, the number of questions to be set are **Eight,** with atleast one from each unit. Students are required to answer any five full questions.

PRACTICALS

B.TECH. CHEMICAL ENGINEERING VII SEMESTER
DESIGN LAB

SUBJECT CODE :- CE-401P **DURATION OF EXAM:- 03Hrs**
CREDIT : 02 **MAX END SEM MARKS: 70**
TOTAL CONTACT HOURS:20

Selected laboratory experiments based on the course CE-401T: Process Equipment Design.

B.TECH. CHEMICAL ENGINEERING VII SEMESTER
INDUSTRIAL POLLUTION CONTROL LAB

SUBJECT CODE :- CE-403P **DURATION OF EXAM:- 03Hrs**
CREDIT : 02 **MAX END SEM MARKS:70**
TOTAL CONTACT HOURS:20

Selected laboratory experiments based on the course CE-310T: Industrial Pollution Control (Wastewater).

B.TECH. CHEMICAL ENGINEERING VII SEMESTER
REPORT WRITING, SEMINAR AND GROUP DISCUSSION

SUBJECT CODE:- CE-405 **DURATION OF EXAM:- 03Hrs**
CREDIT : 03 **MAX END SEM MARKS: 70**
TOTAL CONTACT HOURS:20

B.TECH. CHEMICAL ENGINEERING VII SEMESTER
INDUSTRIAL TRAINING (COLLOQUIUM)

SUBJECT CODE:- TRN-401 **DURATION OF EXAM:- 03Hrs**
CREDIT : 03 **MAX END SEM MARKS: 70**
TOTAL CONTACT HOURS:20

B.TECH. CHEMICAL ENGINEERING VIII SEMESTER
PROJECT WORK & VIVA VOCE

SUBJECT CODE:- CE-402P **DURATION OF EXAM:- 03Hrs**
CREDIT : 12 **MAX END SEM MARKS: 70**
TOTAL CONTACT HOURS:20