**Scheme of courses for B.Tech chemical engineering**
**I$^{ST}$ YEAR**
**B.Tech I year, I Semester**

| SI. 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** |

**B.Tech I year II Semester**

| SI. 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** |

**COURSE STRUCTURE: B.Tech. II Year Chemical Engineering**

Semester III

| 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 |

**COURSE STRUCTURE: B.Tech. II Year Chemical Engineering**

Semester IV

| 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. | Organic Chemical 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 |

**COURSE STRUCTURE: B.Tech. III Year Chemical Engineering**

# Semester V

| S.NO. | SUBJECT CODE | SUBJECTS | CONTACT HOURS / WEEK | | | DURATION OF EXAM. HOURS | CREDITS |
|---|---|---|---|---|---|---|---|
| | | | LECT. | PRACT. | TOTAL | | |
| 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 |

**COURSE STRUCTURE: B.Tech. III Year Chemical Engineering**

Semester VI

| 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 |

**COURSE STRUCTURE: B.Tech. IV Year Chemical Engineering**

## Semester VII

| 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 |

**COURSE STRUCTURE: B.Tech. IV Year Chemical Engineering**

## Semester VIII

| 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 | Modelling Simulation & Optimization | 4 | - | 4 | 3 | 4 |
| 4. | CE-404 | Corrosion and Materials of onstruction | 4 | - | 4 | 3 | 4 |
| 5. | CE-402P * | Prroject 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 in Process 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. FIRST YEAR (FIRST SEMESTER)

**PH-101** **Physics-I**
**Credits-4 LPT(310)**

**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 proarimeters.

**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: Kronig 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


**Chemistry**

**CY-101** **LPT(310)**

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

# B.Tech. First Semester
# Paper: Mathematics-I
# Paper Code: MA-101

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

UNIT:1 **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:2 **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:3 **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.


**English Language and Literature Lab**
**HU 101 LPT 310**

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:
(a) **Pronunciation:** basic sounds of English (vowels and consonants) and word-stress
(b) **Vocabulary:** word-formation (prefixes and suffixes),synonyms and antonyms
(c) **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:
(a) What is literature?
(b) The nature of literary language (mainly "figurative "language)
(c) The literary forms or genres
(d) Literature and socio-cultural context

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

**CS-101 Computer Fundamental & Programming**
**Credits 2(3-0-0)**

**UNIT 1: 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, Joystic, Lighten, MCR MICR,Touch Screen, Graphic Tablet, Voice Input System, Output System, Output Devices-VDU, Printers, Plotters.

**UNIT 2: 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 3: 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 4: Programming in C:** History, Introduction to C Programming, Language, Structure of C Programs, Compilitation 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 5: 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 6: 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

**ME-101** **MANUFACTURING TECHNIQUES**

| **Credit:02** | | **L** | **T** |
|---|---|---|---|
| **P** | **Total** | | |
| **Max. Marks:** | | **2** | **0** |
| **0** | **02** | | |

Unit:1 **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:2 **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:3 **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, $CO_2$, Core making processes.

Unit:4 **Foundry' tools & equipments:-**

Tools used in foundry (hand tools); moulding machine- (Jolt machine, Squeezing machine, Sand Slinger, Push off machine), Furnaces (Pit furnace, cupola furnace).

Unit:5 **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 equipments, Gas welding (oxyacetylene).

Unit:6 **Bench work & fitting:-**

Tools (holding tools, striking tools, cutting tools), various operations performed in fitting shop (detailed).

Unit:7 **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:8 **Jigs & Fixture:** Introduction, Location points, Basic Design of Jigs

& Fixture, Types of Jigs & Fixture.

**Text Book:**

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

**Reference Book:**

Workshop technology by Hazara & Chaudhry,

Production technology by R.'K.Jain

| **ME-103** | **ENGINEERING** | **GRAPHICS (I year: I Sem)** | | | |
|---|---|---|---|---|---|
| **Credits: 03** | | **L** | **T** | **P** | **Total** |
| **Max. Marks:** | | **1** | **2** | **0** | **03** |

Unit:1 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:2 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:3 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:4 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. A Text book of 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

***Subject: Basic Electronics*** ***Code: EI-101T***
***Credits: 4***

***Branches: all branches*** ***Sem: I/II Semester*** ***L P T: 3***
***1 0***

**Unit 1:- 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 2:- 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 3:- Rectifying Circuits and DC Power supplies:** p-n junctions as an 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 4:- 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 doublers, voltage Tripler, Quadrupoler.

**Unit 5:- 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.

Electronic Devices and Circuits theory by Robert L. Boylestad, Lonis nashelsky,

# B.Tech. Second Semester
# Paper: Mathematics-II
# Paper Code: MA-102

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

UNIT:1 **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:2 **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:3 **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 $\int_0^{2\pi} f(\cos\theta, \sin\theta)\, do$ and $\int_{-\infty}^{\infty} fen, dx$.

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.

**EE-101 Basic Electrical Engineering**

**Credits 4 (3-1-0)**

**UNIT 1: Basic Concept:** Definitions & units, Introduction to Basic Laws, Circit 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 2: Magnetic Circuit:** MMF, Flux, Reluctance, Magnetic Effect of Electrical Current, Hysterisis & Eddy Current Losses.

**UNIT 3: Network Theorems:** Superposition, Thevenin, Norton, Maximum Power Transfer & Reciprocity Theorems.

**UNIT 4: 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 5: 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 6: Transient:** Response of RC, RL & RLC Circuit to DC Excitation only (simple problem).

**UNIT 7: 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. FIRST YEAR (SECOND SEMESTER)

**PH-102** **Physics-II**
**Credits-4 LPT(310)**

**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.

**2)** Electromagnetic waves & Radiating systems: Jordan and Keith.

**3)** Solid State Physics: C.Kittel

**4)** Nuclear Physics: I. Kaplan

**5)** Modern Physics: A.Beiser

**6)** Electrodynamics: d.Griffith.

**Environmental Studies: Scientific and Engineering Aspects**
**ME-102 L P T(3 0 0)**

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, Grees house effect etc.

**Suggested Books**

1. W.P. Cunningham and M.A. Cunningham, **Principles of Environmental Science,** Tata McGraw-Hill Publishing Company, New Delhi, 2002.

2. J.A. Nathanson, **Basic Environmental Technology**, Prentice Hall of India, New Delhi, 2002.

3. S.J. Arceivala, and S.R. Asolekar, **Wastewater Treatment for Pollution Control and Reuse** (3rd Edition), Tata McGraw Publishing Co. Ltd., New Delhi, 2006.

4. 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 papers

**Fundamentals of Economics**

**HU-102** **LPT(300)**

**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, labour 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. 2. R. Dornbusch, S. Fischer, and R. Startz. **Macroeconomics** (9th Edition), McGraw-Hill Inc. New York, 2004.

**Basic Mechanical Engineering ME-104**

| **Credit: 04** | **L** | **T** | **P** |
|---|---|---|---|
| | **3** | **1** | **0** |

**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' alemberts 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 (Chapter 6, 7 & 9) 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)** Yadav R.: Steam & Gas Turbines.

**7)** Engineering Mechanics by S.S. Bhavikatti & K.G. Rajashekarappa (Chapter 9 & 10) New Age Publications, New Delhi

**8)** F.L. Singer: Strength of Materials.

**9)** Timoshenko: Strength of Materials.

**B.TECH. CHEMICAL ENGINEERING III SEMESTER**

**FLUID AND PARTICLE MECHANICS**

**SUBJECT CODE :- CE-201 DURATION OF EXAM:- 03Hrs**
**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 grezzlies, gyrating 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 fluidization, 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, thickenes, separation of immiscible liquids of different densities,, centifugal settling process, separation of soilds from gases ( cyclones), liquid-solids separation ( hydrocyclone), disk centrifuge)

**Unit-V**: Filtration:- Cake filters, discontinues 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.

**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. Backhurst nad J.H. Harker) Chemical Engineering, Vol2, Pergamon Press, New York(1980)

4. Unit Operation - Brown and Associates


**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.

***Subject: Engineering Mathematics-III Code: MA-201 T Credits: 4***

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

UNIT:1 **Ordinary Differential Equations:** First order equations (linear and non-linear). Linear equations of second and higher orders with constant and variable coefficients. Solution of second order equations by removing first derivative, changing of dependent and independent variables and method of variation of parameters.

UNIT:2 **Special Functions & Partial Diff. Eqns:** Power Series solutions of second order equations by frobenious method. Legendre polynomials and Berel's functions of first kind and their properties method of separation of variable for heat, wave and Laplace equations: Their solutions and related application.

UNIT:3 **Integral Transforms:** Laplace transform, existence theorem, Laplace transform of derivatives and integrals, Laplace transform of special functions. Inverse Laplace transform, convolution theorem. Applications of Laplace transform and its inverse to solve ordinary and partial differential equation.
Introduction to Fourier transforms. Fourier series, half range sine and cosine series, related applications.

References

1. J.N.Sharma: Differential Equations, Krishna Prakashan Media (P) Ltd., Meerut.
2. B.V.Raman: 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. A.R.Vashistha: Integral Transforms Krishan Prakashan Media (P) Ltd., Meerut.

G.G.Simmons: Differential Equations, Tata McGraw Hill Co. Ltd., 1981.

**B.TECH. CHEMICAL ENGINEERING IV SEMESTER**

**HEAT TRANSFER**

**SUBJECT CODE :- CE-202 DURATION OF EXAM:- 03Hrs**
**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 exchanger

**Unit-VI**: Radiation :- Process and properties, salient features and characteristic of radiation, absorptivity, reflectivity, and transmissivity; wave length distribution of black body radiation, Planck's law , total emissive power, Stefan-Boltzman law, Wien's displacement law, Kirchoff'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, numericals 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 (up ward 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. Backhurst nad 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 atleast one from each unit. Students are required to answer any five full questions.

**B.TECH. CHEMICAL ENGINEERING III SEMESTER**

**MATERIAL AND ENERGY BALANCE**

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

**Unit-I**: Mathematical & engineering calculations, units & dimensions, conversion of units, dimensioless 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, vapour pressure, Roult's law, relative humidity, absolute humid volume, humid heat, dew point, effect of temperature on vaporisation ( Clausius – Clapeyron equation), Cox hart 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 plate energy balance :- Heat capacity, calculations of enthalpy changes, heat of vaporisation, 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 and material balance , simultaneous material energy and 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 atleast one from each unit. Students are required to answer any five full questions.

**B.TECH. CHEMICAL ENGINEERING IV SEMESTER**

**CHEMICAL ENGINEERING THERMODYNAMICS –I**

**SUBJECT CODE :- CE-204 DURATION OF EXAM:- 03Hrs**
**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, satruated liquid-vapor mixture, virial equation , compressibility factor, Van der walls equation of state
**(Marks 10)**

**Unit-III**: Ist law:- 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**: II$^{nd}$ law of thermodynamics :- Heat engine, thermal efficiency, 2$^{nd}$ law of thermodynamics by Kelvin and Planck or Clausis 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, and Helmholtz, Gibbs energy relations, specific heat at constant volume and pressure

**Unit-VI**:Refrigeration and liquefaction:- Ideal refrigeration cycle, air vapour 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- Cengal
2. Chemical Engineering Thermodynamics – Van 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 III SEMESTER**

**INROGANIC CHEMICAL TECHNOLOGY**

**SUBJECT CODE :- CE-205 DURATION OF EXAM:- 03Hrs**
**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, vapour 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 and nitrogen - Kellog's process, Linde Frankl cycle
**Unit-III**: Sulphur & sulfuric acid
Nitric acid - Ammonia oxidation process or Montecatini 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 furnance 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, enamels

**Text and Reference Books**:


1. Shreeve Chemical Process Industries – Austin, McGraw Hill Pub., 5th ed. 1984
2. Drydens- 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 atleast one from each unit. Students are required to answer any five full questions.

**B.TECH. CHEMICAL ENGINEERING IV SEMESTER**

**CHEMICAL REACTION ENGINEERING - I**

**SUBJECT CODE :- CE-206 DURATION OF EXAM:- 03Hrs**
**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-dependant 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 varying , volume batch reactor for Ist, $2^{nd}$, 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 $1^{st}$ and $2^{nd}$ 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 $1^{st}$ order reaction in series, $1^{st}$ order followed by zero order zero order followed by first order reactors, 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 Livenspial, $6^{th}$ ed
2. Chemical Reaction Engineering – H.Scott. Fogler, $3^{rd}$ 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 III SEMESTER**

**CHEMICAL ENGINEERING FLUID MECHANICS**

**SUBJECT CODE :- CE-207 DURATION OF EXAM:- 03Hrs**
**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**: Hydrostatics forces on surfaces:- Total pressure and center of pressure, forces on plane and curved surfaces, basic principles of stability of floating and submerged bodies. 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**: Dimensional analysis and similtude:- Model studies, methods of dimensional analysis, uses of dimensional analysis, Buckinghma's $\pi$ theorem, similtudes- types of similtudes.

**Unit-IV**: 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 Cartisean co-ordinate system, stream function, velocity potential function, equi-potential line, stream line, stream tube, path line, relationship between stream function and velocity potential, flownet & its uses.

**Unit-V**: 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-VI**: 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-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.

**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 Mechancis- 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. Backhurst and J.H. Harker) Chemical Engineering, Vol. 1 Pergamon Press, New York(1980)
4. J.G. Kundsen and D.L. Katz, Fluid Mechanics and Heat Transfer, McGraw Hill Book Co., New York, (1958).

**B.TECH. CHEMICAL ENGINEERING IV SEMESTER**

**ORGANIC CHEMICAL TECHNOLOGY**

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

A general review of the chemical industries involving process technology, avability 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 alchol, manufacture of beer, manufacture of wine, manufacture of vinegar, acetic acid, lactic acid, citric acid.

**Unit-IV**: Petroleum processing:- introduction, chemical composion, 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 sulface 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 Nylon6, polyester.
**Unit-VII**: Polymer processing:- introduction, plastics, fibers, compounding, calendring, 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. Shreeve Chemcial Process Industries – Austin, McGraw Hill Pub., 5th ed, 1984
2. Drydens –Outlines of Chemcial 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 atleast one from each unit. Students are required to answer any five full questions.

**B.TECH. CHEMICAL ENGINEERING I V SEMESTER**

**MATERIALS SCIENCE**

**SUBJECT CODE :- ME-207 DURATION OF EXAM:- 03Hrs**

**CREDIT : 04 MAX END SEM MARKS: 50**

**TOTAL CONTACT HOURS:40**

**Unit:1** Introduction to materials science, types of materials, some mechanical properties. Atomic structure and boding, 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:2** 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:3** Crystelline 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 boundries, rate process in solids, Numerical determination of number of vacancies.

**Unit:4** 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:5** Phase diagrams, definition, explaination 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 corbon steel. T.T.T. diagram.

**Unit:6** Heat Treatment, purpose, application, types of heat treatment processes, Annealing, Normalizing, tempering, surface hardening, case hardening techniques.

**Text Book**:

1. Materials Science by F.W.Smith

**Reference Book**:

1. Material Science by Van Vlack
2. Material Science by A.Mubeen Ahmed.

**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.

1. Work study, method study & work measurement including time study, work sampling, production study, PMTS, MTM, importance of time standards, rating & allowance. Work study, incentive schemes, job description, analysis & evaluation.
2. Plant maintenance, preventive maintenance, maintenance strategy, value engineering. Ergonomics, safety health & environmental protection, work physiology job stress & fatigue, ergonomics of manual material handling.
3. Market research, principle of marketing, customers viewpoint & selective selling, functions & scope of marketing, sales forecasting techniques.
4. Performance measures of a Production system, Production, Productivity, Efficiency, Effectiveness, Quality, Flexibility, Agility etc.
5. Organization, organization structure, department on functional charts for business & industrial organization centralized & decentralized organizations, manpower planning, requirement & forecasting, recruitment training & placement.

6. Role of IT in Systems - MIS, FMS, Japanese intherenes; JIT, Kanban, Decision, Support Systems.

Text Book:

1. Engineering Management by:
Fraidoon Mazda

Reference:

2. Marketing Management by: Philip Kotler

**B.TECH. CHEMICAL ENGINEERING III SEMESTER**

**APPLIED ORGANIC CHEMISTRY**

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

**Structure Activity Relationship**: Structure Activity Relationship (SAR) in simple organic molecules like salicylic acid analogues, P-aminophenols barbiturates etc.

**Nucleophilic substitution reactions** : Aliphatic nucleophilic substitution, aromatic nucleophilic substitution, mechanism and factors affecting nucleophilic substitution.

**Dienes & Polyenes** : Nomenclature, preparation and important reactions like cycloaddition reactions.

**Chemistry of Polymers** : Polymerization and some commercially important polymers: Thermoplastic and thermosetting resins, fibres, rubbers etc.

**Heterocyclic Chemistry** : Introduction to heterocyclic chemistry including synthesis, reactivity and application mainly3,4,5,6-membered rings containing NSO as hetero atom eg Pyrrole, Furan, Thhiophene and Pyridine.

**Organic Catalysis** : Catalysis involving transition metal complexes with examples eg. Lindler's Catalyst.

**Pericyclic reactions**: Electrocyclic reactions, sigmatropic reaction, cycloaddition reactions, their mechanism & stereochemistry with the help of suitable examples.

**Organic reagents**: Preparation, properties and uses of few important reactions namely: sodium borohydride, Lithium aluminium hydride, N-bromosuccinimide, Lead tetraacetate, Diazomethane, Aluminium iso propoxide, grignard reagent etc.

**Books** :

1. Organic Chemistry : Morrisson and Boyed
2. Reaction Mechanism : Jerry March
3. Reaction Mechanism : Peter & Sykes
4. Medicinal Chemistry : Foye et al
5. Engineering Chemistry : S.S. Dara

**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 III SEMESTER

### FLUID AND PARTICLE MECHANICS LAB

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

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

### B.TECH. CHEMICAL ENGINEERING IV SEMESTER

### HEAT TRANSFER LAB

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

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

### B.TECH. CHEMICAL ENGINEERING III SEMESTER

### CHEMICAL ENGINEERING FLUID MECHANICS LAB

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

Selected laboratory experiments based on the course CE-203: Chemical Engineering Fluid Mechanics.

### B.TECH. CHEMICAL ENGINEERING IV SEMESTER

### CHEMICAL PROCESS LAB

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

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

### B.TECH. CHEMICAL ENGINEERING III SEMESTER
### CHEMISTRY LAB - II

**SUBJECT CODE :- CY-201P DURATION OF EXAM:- 03Hrs**
**CREDIT : 02 MAX END SEM MARKS:**
**TOTAL CONTACT HOURS:20**
Selected laboratory experiments based on the course CY-201: Applied Organic Chemistry.

**B.TECH. CHEMICAL ENGINEERING V SEMESTER**

**CHEMICAL REACTION ENGINEERING –2**

**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, Langmur'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
**(20 marks)**

**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 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.**(15 Marks)**

**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 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 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, break even 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 **( 10 marks**)

**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, 3rd ed., McGraw Hill Book Co., New York, (1980).
2. J.M. Coulson and J.F. Richardson ( revised by L.D. Sinnot), Chemical Engineerng, Vol. 6, Pergamon Press, New York (1980)

**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 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 od 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).


**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 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, selfsupported 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 Chemcial Equipment Design, Mechanical Aspect", CBS Publication & Distributors
2. Chemical Engineering by Coulson and Richardson Vol-6, J.M. Culson and J.F. Richardson revised by R.K. Sinnot, Pergamon Press, New York (1980).
3. Joshi M.V. " Process Equipment Design", Macmillon India Ltd, New Delhi..
4. Indian & American Codes used in Designing of Equipment ( TEMA & IS Codes)


**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 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, subestantial time derivative, Adjacent flow of two immiscible liquid, use of equation of curvilinear cylinderical coordinations 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. Stewartand 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 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 :- Raults law, relative volatility, ideal solutions, x-y, $H_x$-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, Treybal 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.
**(20 marks)**

**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.


**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 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 demerites 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 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**: Types of emission from chemical industries and effects on environment, environmental legislation, types of pollution, sources of waste water, effluent guidelines and standards, characterization of effluent streams, oxygen demands and their determination ( BOD, COD and TOC), oxygen sag curve, BOD curve, mathematical relation controlling BOD curve, self-purification of running streams.

**Unit-II**: Air pollutants, sources and characteristics, role of meteorological factors in air pollutants dispersion ( ALP and ELP), plume behaviour and characteristics, chill index and equivalent ambient temperature, chimney design considerations, plume rise, effective stack height, removal of particulate matters, principles and design of settling chambers, solid traps, cyclone separators, fabric and fiber filter, scrubbers and electrostatic precipitators.

**Unit-III**: General methods of control and removal of sulfur dioxide, oxides of nitrogen and organic vapors from gaseous effluent, vehicular emissions and their control
**Unit-IV**: Introduction to waste water treatment- methods of pre-and primary treatment- screening , sedimentation floatation, neutralization.
**Unit-V**: Biological treatment of waste water, bacterial and bacterial growth curve, aerobic processes, suspended growth processes, activated aerated lagoons and stabilization ponds, attached growth processes, trickling filters, rotary drum filters, anaerobic processes, methods of tertiary treatment, a brief study of carbon adsorption, ion-exchange reverse osmosis, ultra-filtration, chlorination, ozonation**)**

**Unit-VI**: Sources and characteristic of pollutants in fertilizer, paper and pulp, petroleum and petrochemical industry and their control with possible case studies

**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 atleast one from each unit. Students are required to answer any five full questions.

**B.TECH. CHEMICAL ENGINEERING 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.
(**10 Marks)**

**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 questions.

**B.TECH. CHEMICAL ENGINEERING VI SEMESTER**

**COMPUTER AIDED DESIGN**
**(Departmental Elective-I)**

**SUBJECT CODE :- CE-350 DURATION OF EXAM:- 03Hrs**
**CREDIT : 04 MAX END SEM MARKS:**
**TOTAL CONTACT HOURS:40**

**Unit-1**: Introduction to CAD, definition of CAD and its role in product cycle, significance and importance of CAD; microcomputer based CAD system, general features, hardware components and configuration, IBM PC compatible CAD system, microcomputer based CAD software, operating system, mechanical application 2D drafting, symbol libraries, report generation, parametric design, 3D functions, finite element, analysis, kinematics & functions analysis

**Unit-2**: Microprocessor :- introduction, microcontroller, software development aids systems, text editor, operating system, multi and multi'user, rom and disc resistant OS, constituents of an OS, assembly techniques, the marco – assembler, computers; hardware aids:- single – bone computer, system design kit, miscellaneous hardware development aids.

**Unit-3**: CAD software:- Introduction, graphic standard, basic definitions, data structure, database, database management system (DBMS), user interface, software modules, operating system, graphics, applications, programming, communication, modeling & viewing, software documentation & development, CAD hardware, types of systems, CAD systems evaluation criteria, input devices, output devices, hardware integration & networking, hardware trends, IBM PC compatible CAD hardware.

**Unit-4**: Geometric modeling:- types of curves:- introduction, wireframe models, wireframe entities, curve representation, analytic & synthetic curves, hermite cubic spline, bezier curves, B-spline curves-types of surfaces:- introduction , surface models, surface entities, surfaces like plane surface, ruled surfaces, surface of revolution, tabulated cylinder, hermite bicauic surface, B-spline surface, coons surface, blending surface, offset surface, triangular patches, scapltured surfaces, rotational parametric surface, design & engineering application.

**Unit-5**: Types of solids:- Introduction, solid models, solid entities, solid representation, fundamentals of solid modeling , boundary representation ( B-rep_, constructive solid geometry (CSG), sweep representation, other representations, organization of solid model's, solid modeling based applications, engineering applications.

**Unit-6**: Two & three dimensional graphic concept, geometric transformation, introduction, transformation – translation , scaling, reflection, rotation, mapping of geometric models, projection of geometric models, orthographic projections, perspective projection

**Unit-7**: Virtual realism:- introduction, model clean up, hidden line removal, hidden surface removal, z-butter algorithm, hidden solid removal , ray tracing algorithm, shading , shading models, coloring, coloring models.

**Unit-8** Graphic aids :- intro, geometric modifiers, names layers, colors, grids groups, dragging & rubber banding, clipping, graphic manipulation editing:- intro, entity selection methods, manipulation operations, editing operators, design & engineering application.

**Text and Reference Books**:

1. Cad/Cam – Ibrahim Zied
2. Cad/Cam- Zimmer & Grover

**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 VI SEMESTER**

**COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING**
**(Departmental Elective-I)**

**SUBJECT CODE :- CE-352 DURATION OF EXAM:- 03Hrs**
**CREDIT : 04 MAX END SEM MARKS:**
**TOTAL CONTACT HOURS:40**
Application of the following techniques for problems of interest to chemical engineering, writing and testing of programs written in C languages.

**Unit-I**: Numerical solution of first order differential equations with initial condition, Euler's method, Runge-Kutta method.
**Unit-II**: Systems of liner equations, solution by the methods of determinants, matrix inversion for the solution of liner equations, Guass elimination method.
**Unit-III**: Roots of algebraic and transcendental equations, iteration methods, Regulafalsi method, Newton-Raphson method, roots of simultaneous and solution set of transcendental and algebraic equations, development of equations for heat transfer, fluid mechanics and reaction engineering problems.
**Unit-IV**: Regression analysis-least squares, error approach, approximation by Chebychev orthogonal plynomial **(**
**Unit-V**: Elements of optimization techniques; single variable function optimization; direct search, with and without acceleration; method of regular intervals and Fibonacci searh method; gradient methods.

**Text and Reference Book** :
Digital Computation for Chemical Engineers by Leon Lapidus, McGraw Hill, 1962.

**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 V SEMESTER**
**REACTION ENGINEERING LAB**
**SUBJECT CODE :- CE-301P DURATION OF EXAM:- 03Hrs**
**CREDIT : 02 MAX END SEM MARKS:**
**TOTAL CONTACT HOURS:20**

Selected laboratory experiments based on the course CE-206: Chemical Reaction Engineering – I and CE – 301: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:**
**TOTAL CONTACT HOURS:20**

Selected laboratory experiments based on the course CE-309: 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:**
**TOTAL CONTACT HOURS:20**
Selected laboratory experiments based on the course CE-311: 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:**
**TOTAL CONTACT HOURS:20**

Selected laboratory experiments based on the course CE-305: Mass Transfer – I and CE-308: 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:**
**TOTAL CONTACT HOURS:20**

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

**B.TECH. CHEMICAL ENGINEERING VI SEMESTER**

**COMPUTER APPLICATIONS LAB**

**SUBJECT CODE :- CE-306P DURATION OF EXAM:- 03Hrs**
**CREDIT : 02 MAX END SEM MARKS:**
**TOTAL CONTACT HOURS:20**

Selected laboratory experiments based on the course either CE-350: Computer Aided Design or CE-352: Computer Application in Chemical Engineering.

**B.TECH. CHEMICAL ENGINEERING VII SEMESTER**

**PROCESS EQUIMENT DESIGN**

**SUBJECT CODE :- CE-401 DURATION OF EXAM:- 03Hrs**
**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, crystallizes
**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 absorption column
**Unit-VI**: Process design of catalytic and noncatalatic reactors
**Text and Reference Books** :

Chemical Engg. Vol-6, J.M. Coulson and J.F. Ricardson revised by R.K. Sinnot.

**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 VIII SEMESTER**

**MODELLING, SIMULATION AND OPTIMIZATION**

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

**Unit-I**: Optimization:- Introduction, engg. application of optimization, optimization technique, structure of design problem by biparte method any 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**: Non linear 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**: Modelling:- 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 VII SEMESTER**

**PROCESS UTILITY AND SAFETY**

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

**Unit-1**: Process utilities: - Role of process utilities in process industries
Heat transfer media: - Characteristic properties, classification, selection and their industrial applications
**Unit-2**: Steam systems: - Application in chemical process plants, design of efficient steam heating systems, condensate utilization and flash steam
Steam traps: - Types and characteristic
**Unit-3**: Water:- Water, its characteristic and conditioning for process industries e.g. boiler feed, cooling etc.; recycling aspects of water.
Air:- Characteristic of air and air receivers.
**Unit-4**: 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-5**: 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-6**: Personnel safety devices and general hygiene management- ventilation.
**Unit-7**: Fire & explosion:- Definition, flammability characteristic 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 Josph, 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 VIII SEMESTER**

**CORROSION AND MATERIAL OF CONSTRUCTION**

**SUBJECT CODE :- CE-404 DURATION OF EXAM:- 03Hrs**
**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 demage, 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 , magnese 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 , moulding

**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. Sinnot


**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 VIII SEMESTER**

**MEMBRANE SEPARATION PROCESSES**
**( Departmental Elective-III)**

**SUBJECT CODE :- CE-450 DURATION OF EXAM:- 03Hrs**
**CREDIT : 04 MAX END SEM MARKS:**
**TOTAL CONTACT HOURS:40**

**Unit-I**: Definition of membrane, porosity, solution – diffusion mechanism, transport mechanism – viscous flow, Knudsen flow, ultramicroporous membrane, membrane modules-hollow-fiber capillary, monolith, spiral, plate & frame, membrane preparation & characterization.

**Unit-II:** Electrodialysis :- Process description & application, membranes structure of cationic and anoinic exchange membrane, transfer of ions, concentration polarization, limiting current density, water splitting, electrodialysis reversal

**Unit-III**: Reverse osmosis & nanofiltration- process description & application, driving force, effect of operating variable, RO & NF membrane, method of production, process limitation, osmotic pressure, membrane chemistry, chlorine tolerance, concentration polarization, plugging fouling, pretreatment, osmotic pitch effect, brine staging

**Unit-IV**: Ultrafiltration: - process description & application, UF membrane, celluose membrane, polymeric membrane, ceramic membrane, water flux, molecular weight cutoff, process limitation of concentration polarization, osmotic pressure, gel effect, fouling, process configuration process objective, stages in series

**Unit-V**: Microfilteration: - process description & application, MF membrane, bubble point, charged membrane, process limitation by concentration polarization, fouling

**Unit-VI**: Gas separation membrane:- process description & application, basic principles of operation, basic equation. Driving force, plasticization, selectivity and permeability, temperature effect, plasticization and other time effect, gas separation membrane, organic caulked, metallic advanced materials, catalytic membrane, system design features, partial pressure pinch, fouling,
Pervaporation: - process description & application, hydrophilic and hydrophobic membrane, operational factor. **(15 marks)**

**Reference Books**: - Advance Separation Processes By C.J.KING
Chemical Engineering Vol-2, Coulson & Richardson
Perry's Chemical Engg. Hand book
McCabe Smith – Unit operation

**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 VII SEMESTER**

**PETROLEUM REFINING AND PETROCHEMICAL TECHNOLOGY**
**( Departmental Elective-II)**

**SUBJECT CODE :- CE-451 DURATION OF EXAM:- 03Hrs**
**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, hydro cracking
**Unit-II**: Catalytic reforming, polymerization, isomerization, hydrogenation, production of aviation gasoline, motor fuel, kerosene, disel oil and jet fuel.
**Unit-III**: Vacuum distillation, solvent extraction, uses of lubricating oils and petroleum waxes, chemical and clay treatment of petroleum products, pesuifirization process for petroleum product, catalyst delayed coking, hydrotreating & visbreaking. **Unit-IV**: Introduction to petrochemical industries in India, structure of petrochemical complexes, product profile of petrochemicals units, Olefin production (Neptha & gas cracking)seperation of aromatics ( Benzene, xylene and toluene), Aromatic conversion processes ( dipropartination, isomerisation, 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. Petrochemical processes: part I & II chaval A and Lafabnye, G.L.
2. Catalytic reforming – Little, D.M.
3. Petrochemical – Wiseman, Peter
4. Petroleum refining engg. – Dr. Prasad
5. Chemical Technology vol-II : S.N. Pandey
6. Petroleum refining engineering – Nelson W.L.
7. 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 VIII SEMESTER**

**FLUIDIZATION ENGINEERING**
**( Departmental Elective-III)**

**SUBJECT CODE :- CE-452 DURATION OF EXAM:- 03Hrs**
**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 behaviour 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 behaviour 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. & Levenspiel O. " 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 V II SEMESTER**

**FERTILIZER TECHNOLOGY**
**( Departmental Elective-II)**

**SUBJECT CODE :- CE-453 DURATION OF EXAM:- 03Hrs**
**CREDIT : 04 MAX END SEM MARKS:**
**TOTAL CONTACT HOURS:40**

**Unit–I**: Introduction to Indian fertilizer industry, history of Indian fertilizer industry, raw material scenario in fertilizer industry, factors affecting the economy of fertilizer industry, types of fertilizer

**Unit–II**: Process details of manufacturing of nitrogeneous fertilizers, phosphate fertilizers, potassium fertilizers and complex fertilizers.

**Unit–III**: Biofertilizer- definition, classification, nitrogen fixing biofertilisers, phosphate mobilizing biofertiliser, biofertiliser production present status and potential demand, constraints in biofertiliser use, research and development needs.

**Unit–IV**: Environmental pollution, monitoring and control in all types of fertilizer industries, solid waste disposal management in fertilizer industries, safety, risk and hazard in fertilizer industries, improvement & modernization in fertilizer plants.

**Unit–V**: Design consideration of some important equipments used in fertilizer industries like reformers, $CO_2$ absorber, ammonia reactor, prilling towers, granulation unit.

**Text and Reference Books**:

1. Hand book of Fertilizer Technology
2. Drydens- Outlines of Chemical Technology- revised and edited by M.Gopal Rao and M. Sitting, East West Press Pvt. Ltd., New Delhi (1977)

**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.

## SOLID WASTE MANAGEMENT
**( Departmental Elective-IV)**

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

**Unit-I**: Introduction:- Definition, sources, classification and quantity, household and street wastes, demolition and construction wastes,characteristics-sampling , physical and chemical analysis, industrial solid wastes, density and quantity measurement

**Unit-II**: Collection and transportation in municipal areas:- House to house collection and community bin systems, their merits and demerits; frequency of collection, transportation through narrow and broad roads, carts, motorized vehicles, container routes, vehicle maintenance.

**Unit-III**: Disposal:- Dumping , sanitary land fill, composting methods, mechanical and semi- mechanical methods, merits and demerits, leachate & gas collection from sanitary land fills.

**Unit-IV**: Separation of wastes at the source, benefits, reuse and recycle of solid wastes, design of collection systems

**Unit-V**: Industrial solid wastes:- Biodegradable and non-biodegradable wastes; hazardous wastes – identification, classification, sources, storage, transportation, handling, disposal, incineration; composting of distillery and other wastes, medical wastes.

**Unit-VI**: Pyrolysis:- Biogas from solid wastes; chemicals and energy from bio-mass

**Unit-VII**: Incineration:- Processes, types of incinerators, heat recovery, incineration products, air pollution and control, design of incinerators

**Text and Reference Books:**

1. Bhide and Sundaresan : Solid Waste Management in Developing Countries, Indian National Scientific Documentation Center, New Delhi
2. Techobanaglous, Theissen & Eliassen, Solid Wastes Engineering – Principles and Management Issues, McGraw Hill, New York.
3. WHO Manual on Solid Waste Management.

**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 VII SEMESTER**

**ENVIRONMENTAL MANAGEMENT**
**( Pool Elective)**

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

**Unit-I**: Organizational structure of environmental management at central & state levels, acts & rules related to environmental management – water, air, hazardous waste, biomedical waste , noise pollution and general aspects of environment protection,.

**Unit-II**: Environmental audit:- General procedure, types of audits, features of effective auditing, program planning, commitment by management, confidentiality, organization of an auditing team, audit protocol, schedule, onsite audit, evaluation & presentation, audit report of action plan, water audit & energy audit, 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 aforestation, 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**: Engineering ethics:- Scope and aim of engineering ethics, engineering as social experimentation; code of ethics, responsibilities and rights; rights of engineers; engineer as managers; consultants and leaders, environmental ethics, ethical audit, case studies

**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 Schenzinger & 3rd Edition MC Graw-Litt NewYork 1997.
5. Engineering Ethics- Concept and Cases by Harrs C.L., etal word sworth Publishing, Belmot CA 1995
6. Engineering Ethics – M. Govindarajan, S. Natarajan, V.S. Senthilkumar, 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.

**B.TECH. CHEMICAL ENGINEERING VIII SEMESTER**

**SAFETY & HAZARD ANALYSIS IN PROCESS INDUSTRY**
**( Departmental Elective-IV)**

**SUBJECT CODE :- CE-462 DURATION OF EXAM:- 03Hrs**
**CREDIT : 04 MAX END SEM MARKS:**
**TOTAL CONTACT HOURS:40**

**Unit-I**: Why safety? What means safety? chemical hazards and worker safety, safety aspects of the site selection, plant layout and unit plot, safety education and training.

**Unit-II**: Hazard identification in a process plant, checklist, hazards survey, HAZOP and safety review.

**Unit-III**: Regulating provisions: Environment Protection Act ( 1986) and regulations framed there under, subsequent modification / revisions, regulations for storage and handling of hazardous substances and labeling

**Unit-IV**: Hazard analysis : Dows fire and explosion index, hazard classification, code procedure for index calculation and application.

**Unit-V**: HAZOP: Guide words and their meaning, applications of guide words to hazardous operation – deviation, possible causes, consequences and action required, safety reviews components and examples.

**Unit-VI**: Risk Assessment:- Probability of equipment failure and interactions between process units, MTBF and MTBC, Event trees
and fault trees, logic transfer component, examples.

**Unit-VII**: Consequences: Sources and dispersion models – release through a hole due to repture of storage vessels or a pipeline, Emergency releases, Explosions, Damage zoning

**Unit-VIII**: Case histories : Case history of one or two hazardous accidents

**Text and Reference Books:**

1. Crowl, D.A. and Louvar, J.F. " Chemical Process Safety Fundamentals with Applications" Prentice Hall ( 1990)

2. Safety and Accident Prevention in Chemical Operations by Feweett H.H. and W.S. Wood, John Wiley and Sons, Inc 1965

**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 VII SEMESTER**

**POLYMER SCIENCE AND TECHNOLOGY**
**( Pool Elective)**

**SUBJECT CODE :- CE-463 DURATION OF EXAM:- 03Hrs**
**CREDIT : 04 MAX END SEM MARKS:**
**TOTAL CONTACT HOURS:40**

**Unit-1**:- Polymers and their classification, natural and synthetic polymer, type of synthetic polymer

**Unit-2**: Polymer Rhelogy introduction, stress & strain, ideal elastic solid, ideal or Newtonian fluid, the power law, apparent viscosity, viscosity as a function of molecular weight, Rhelogy of polymers: Hooks equation, Newton equation, Maxwell and voight model for viscoelasticity, deformation of polymeric material.

**Unit-3**: Measurement model of flow or rhelogical properties of fluids, mechanical model of viscoelastic material, relaxation or strain enhancement under constant stress, creep and relaxation of typical plastics.

**Unit-4**: Method of testing of polymer material by static testing ( tensile test and compressive test), impact testing, fatigue testing

**Unit-5**: Mechanism and kinetics of step growth polymerization, condensation polymerization, molecular weight control, anion polymerization cation polymerization.

**Unit-6**: Physical and mechanical properties of polymers, glass transition temperature, and its importance, amorphous and crystalline polymers , their properties influence surface coating.

**Unit-7**: Manufacturing process of important polymers: plastic-polyethylene, polypropelene, PVC, and coplymers, polystyrene, urethane, tafflon, polymer degration, thermal, mechanical, ultrasonic, phot, high energy reaction, oxidation and hyrolatic degradation, ecology and environmental aspect of polymer industry

**Reference book**

1) Polymer science by Gwarikor
2) Polymer science by Goel fried

**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.

**PRACTICAL**

**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:**
**TOTAL CONTACT HOURS:30**

Each student will be required to design a report for an assigned topic by collecting , recording , evaluating, and analyzing the data and information, format and make up and to present and defend the report to a gathering of staff and students.

Group discussion will be organized to develop the skill of presentation, organization and impromptu discussion.

**B.TECH. CHEMICAL ENGINEERING VII SEMESTER**

**INDUSTRIAL TRAINING ( COLLOQUIUM)**

**SUBJECT CODE :- TRN-401 DURATION OF EXAM:- 03Hrs**
**CREDIT : 03 MAX END SEM MARKS:**

Note: Industrial training for 6 weeks.

Industrial Training report to be submitted organized by the department during inter semester break.

**B.TECH. CHEMICAL ENGINEERING VII SEMESTER**

**DESIGN LAB**

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

Selected laboratory experiments based on the course CE-306: Equipment Design and CE-401 : Process Equiment 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: TOTAL CONTACT HOURS:20**

Selected laboratory experiments based on the course CE-310: Industrial Pollution Control.

## B.TECH. CHEMICAL ENGINEERING VII SEMESTER

## PROJECT WORK

**TOTAL CONTACT HOURS PER WEEK:15**

The project work shall be assigned to the students at the beginning of VII semester. The project work shall be in any of the following s:

1. Experimental ( work related to Chemical Engineering)
2. Design Project

The project work assigned must be of a substantive nature and should involve investigation, analysis, design of a complete project as a unit.

During VII semester there will be no internal assessment and end semester examination marks for this.

Note : Refer CE-402P of VIII Semester

## B.TECH. CHEMICAL ENGINEERING VIII SEMESTER

## PROJECT WORK AND VIVA VOCE

**SUBJECT CODE :- CE-402P DURATION OF EXAM:- 03Hrs**
**CREDIT : 02 MAX END SEM MARKS: 50**
**TOTAL CONTACT HOURS:20**

The project work consisting of report on analysis, design drawing and estimate shall be submitted in bound form by the candidate by the end of VIII semester. It shall be done under the guidance of a teacher. The report shall be certified by the Guide and the Head of the department The number of students in a batch for Project work should not be more than four.