# *Faculty of Engineering & Technology*
# *P.K.University*
# *Shivpuri (MP)*

**Evaluation Scheme & Syllabus for**
**Department of Chemical Engineering**
**B.Tech. First Year**
**(I & II SEM)**

**(Effective from session 2019-20)**

**(Taken From Abdul Kalam Technical University- AKTU)**

# EVALUATION SCHEME

## SEMESTER I

| | | THEORY | | PRACTICAL | | TOTAL |
|---|---|---|---|---|---|---|
| **SUBJECT CODE** | **SUBJECT NAME** | SESS.(30) | EXT.(70) | SESS.(25) | EXT.(25) | |
| BTCH-101 | Engineering Mathematics-I | 30 | 70 | NA | NA | NA |
| BTCH -102 | Engineering Physics-I | 30 | 70 | 25 | 25 | 150 |
| BTCH -103 | Engineering Chemistry | 30 | 70 | 25 | 25 | 150 |
| BTCH -104 | Basic Electrical Engineering | 30 | 70 | 25 | 25 | 150 |
| BTCH -105 | Computer System & Programming in C | 30 | 70 | 25 | 25 | 150 |

## SEMESTER II

| | | THEORY | | PRACTICAL | | TOTAL |
|---|---|---|---|---|---|---|
| **SUBJECT CODE** | **SUBJECT NAME** | SESS.(30) | EXT.(70) | SESS.(25) | EXT.(25) | |
| BTCH -201 | Engg. Maths-II | 30 | 70 | NA | NA | 100 |
| BTCH -202 | Engineering Physics-II | 30 | 70 | 25 | 25 | 150 |
| BTCH -203 | Elements of Mechanical Engg | 30 | 70 | 25 | 25 | 150 |
| BTCH -204 | Professional Communication | 30 | 70 | 25 | 25 | 150 |
| BTCH -205 | Basic Electronics | 30 | 70 | NA | NA | 100 |

# *Department of Chemical Technology*
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## *I Year I Semester*
## BTCH -101: ENGINEERING MATHEMATICS – I

**Unit - 1: Differential Calculus – I**

Successive Differentiation, Leibnitz's theorem, Limit , Continuity and Differentiability of functions of several variables, Partial derivatives, Euler's theorem for homogeneous functions, Total derivatives, Change of variables, Curve tracing: Cartesian and Polar coordinates.

**Unit - 2: Differential Calculus - II**

Taylor's and Maclaurin's Theorem, Expansion of function of several variables, Jacobian, Approximation of errors, Extreme of functions of several variables, Lagrange's method of multipliers (Simple applications).

**Unit - 3: Matrix Algebra**

Types of Matrices, Inverse of a matrix by elementary transformations, Rank of a matrix (Echelon & Normal form), Linear dependence, Consistency of linear system of equations and their solution, Characteristic equation, Eigen values and Eigen vectors, Cayley-Hamilton Theorem, Diagonalization, Complex and Unitary Matrices and its properties

**Unit - 4: Multiple Integrals**

Double and triple integrals, Change of order of integration, Change of variables, Application of integration to lengths, Surface areas and Volumes – Cartesian and Polar coordinates. Beta and Gamma functions, Dirichlet's integral and its applications.

**Unit - 5: Vector Calculus**

Point function, Gradient, Divergence and Curl of a vector and their physical interpretations, Vector identities, Tangent and Normal, Directional derivatives. Line, Surface and Volume integrals, Applications of Green's, Stokes and Gauss divergence theorems (without proof).

**Text Books:**

1. E. Kreyszig, Advanced Engineering Mathematics,John-Wiley & Sons
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw- Hill Publishing Company Ltd.
3. R.K.Jain&S.R.K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House.

**Reference Books:**

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
2. Peter V. O' Neil, Advanced Engineering Mathematics, Thomas ( Cengage) Learning.
3. Thomas & Finley, Calculus, Narosa Publishing House
4. Rukmanadachari, Engineering Mathematics – I, Pearson Education.

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## *I Year I Semester*
## BTCH -102: ENGINEERING PHYSICS-I

**Unit – I: Relativistic Mechanics**

Inertial & non-inertial frames, Galilean transformations, Michelson-Morley experiment, Einstein's postulates, Lorentz transformation equations, Length contraction & Time dilation, Relativistic addition of velocities; Variation of mass with velocity, Mass energy equivalence, Concept of rest mass of photon.

**Unit – II: Modern Physics:** Black body radiation spectrum, Weins law and Rayleigh-Jeans law, Assumption of quantum theory of radiation, Planck's law. Wave-particle duality, de-Broglie matter waves, Bohr's quantization rule, Phase and Group velocities, Davisson-Germer experiment, Heisenberg uncertainty principle and its applications, Wave function and its significance, Schrödinger's wave equation ( Time dependent and time independent) – particle in one dimensional potential box, Eigen values and Eigen function.

**Unit – III: Wave Optics: Interference:** Coherent sources, Interference in thin films (parallel and wedge shaped film), Newton's rings and its applications..

**Diffraction:** Single, double and N- Slit Diffraction, Diffraction grating, Grating spectra, dispersive power, Rayleigh's criterion and resolving power of grating.

**Unit – IV: Polarization and Laser**

**Polarization**: Phenomena of double refraction, Nicol prism, Production and analysis of plane, circular and elliptical polarized light, Retardation Plate, Optical Activity, Fresnel's theory, Specific rotation.

**Laser:** Spontaneous and stimulated emission of radiation, population inversion, Einstein's Coefficients, Concept of 3 and 4 level Laser, Construction and working of Ruby, He-Ne lasers and laser applications.

**Unit – V: Fiber Optics and Holography : Fiber Optics:** Fundamental ideas about optical fiber, Propagation mechanism, Acceptance angle and cone, Numerical aperture, Single and Multi Mode Fibers, Dispersion and Attenuation.

**Holography:** Basic Principle of Holography, Construction and reconstruction of Image on hologram and applications of holography.

**Reference Books:**

1. Concepts of Modern Physics - AurthurBeiser (Mc-Graw Hill)
2. Introduction to Special Theory of Relativity- Robert Resnick (Wielly)
3. Optics –AjoyGhatak( Tata McGraw Hill Education Private Ltd. New Delhi)
4. Optics - Brijlal& Subramanian (S. Chand )
5. Engineering Physics- C. Mani Naidu(Pearson)
6. Lasers Principles, Types and Applications- K R Nambiar (New Age)

# ENGINEERING PHYSICS LAB

## List of Experiments

**Any ten experiments, at least four from each group:**

**Group -A**

1. To determine the wavelength of monochromatic light by Newton's ring.
2. To determine the wavelength of monochromatic light with the help of Fresnel's biprism.
3. To determine the focal length of two lenses by nodal slide and locate the position of cardinalpoints.
4. To determine the specific rotation of cane sugar solution using polarimeter.
5. To determine the wavelength of spectral lines using plane transmission grating.
6. To study the polarization of light by simple reflection using laser.
7. Measurement of Wavelength of a laser (He-Ne) light using single slit diffraction.

**Group – B**

8. To determine the specific resistance of a given wire using Carey Foster's bridge.
9. To study the variation of magnetic field along the axis of current carrying - Circular coil and then to estimate the radius of the coil.
10. To verify Stefan's Law by electrical method.
11. To calibrate the given ammeter and voltmeter by potentiometer.
12. To study the Hall effect and determine Hall coefficient, carrier density and - mobility of a given semiconductor using Hall effect set up.
13. To determine the energy band gap of a given semiconductor material.
14 To determine E.C.E. of copper using Tangent or Helmholtz galvanometer.
15. To draw hysteresis curve of a given sample of ferromagnetic material and from - this to determine magnetic susceptibility and permeability of the given specimen.
16. To determine the ballistic constant of a ballistic galvanometer.
17. To determine the coefficient of viscosity of a liquid.
18. Measurement of fiber attenuation and aperture of fiber.
19. High resistance by leakage method.
20. Magnetic Susceptibility of paramagnetic solution.

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### *I Year I Semester*
### BTCH - 103: ENGINEERING CHEMISTRY

**Unit-1** Molecular orbital theory and its applications to homo-nuclear diatomic molecules. Band theory of solids. Liquid crystals and its applications. Point defects in Solids. Structure and applications of Graphite and Fullerenes. Concepts of nano-materials and its applications

**Unit-2** Polymers: Basic concepts of polymer- blends and composites. Conducting and biodegradablepolymers. Preparations and applications of some industrially important polymers(Buna N, Buna S, Neoprene, Nylon 6, Nylon 6,6 , Terylene). General methods of synthesis of organometallic compound (Grignard Reagent) and their applications in polymerization.

**Unit-3** Electrochemistry: Galvanic cell, electrode potential, Lead storage battery. Corrosion, causes and its prevention. Setting and hardening of cement, applications of cement. Plaster of paris. Lubricants- Classification, mechanism and applications..

**Unit-4** Hardness of water. Disadvantage of hard water. Boiler troubles, Techniques for water softening; Lime-soda, Zeolite, Ion exchange resin, Reverse osmosis. Phase Rule and its application to water system.

**Unit-5** Fuels; Classification of fuels. Analysis of Coal. Determination of Calorific values (bomb calorimeter &Dulong's method). Biogas. Elementary ideas and simple applications of UV, Visible, IR and H1NMR spectral Techniques.

**Textbook**

1. Chemistry for Engineers, by S. Vairam and Suba Ramesh; Wiley India

**Reference Books**

1. Textbook of Engineering Chemistry by Dr. Gopal Krishna Bhatt, Acme Publishers
2. Chemistry (9th ed), by Raymond Chang, Tata McGraw-Hill
3. Chemistry Concepts and Applications by Steven S. Zumdahl; Cengage Learning
4. Engineering Chemistry, Wiley India
5. Engineering Chemistry Author: AbhijitMallick, Viva Books
6. Text Book of Engineering Chemistry by Harsh Malhotra; Sonali Publications
7. Concise Inorganic Chemistry by J.D. Lee; Wiley India
8. Organic Chemistry (6 ed) by Morrison & Boyd; Pearson Education
9. Physical Chemistry by Gordon M. Barrow; Mc-Graw Hill
10. Organic Chemistry, Volume 1(6 ed)& 2 (5ed) by I. L. Finar; Pearson Education

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**BTCH -103: ENGINEERING CHEMISTRY**

## LIST OF EXPERIMENTS

1. Determination of alkalinity in the given water sample.
2. Determination of temporary and permanent hardness in water sample using EDTA .
3. Determination of available chlorine in bleaching powder.
4. Determination of chloride content in water sample.
5. Determination of iron content in the given solution by Mohr's method.
6. pH- metric titration.
7. Viscosity of an addition polymer like polyester by viscometer.
8. Determination of iron concentration in sample of water by colorimetric method.
   The method involves the use of KCN as a chelating agent and the measurements are carried out at 480nm.
9. Element detection and functional group identification in organic compounds.
10. Preparation of Bakelite and Urea formaldehyde resin.

Note: Institute can replace two experiments from the aforesaid experiments as per

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**BTCH -104 BASIC ELECTRICAL ENGINEERING**

## DETAILED SYLLABUS

**Unit-I : Electrical Circuit Analysis:**
Introduction, Circuit Concepts: Concepts of network, Active and passive elements, Voltage and current sources, Concept of linearity and linear network, Unilateral and bilateral elements, Source transformation, Kirchhoff's laws, Loop and nodal methods of analysis, Star-delta transformation, AC fundamentals: Sinusoidal, square and triangular waveforms – Average and effective values, Form and peak factors, Concept of phasors, phasor representation of sinusoidally varying voltage and current.

**Unit-II: Steady- State Analysis of Single Phase AC Circuits:**
Analysis of series and parallel RLC Circuits, Concept of Resonance in series & parallel circuits, bandwidth and quality factor; Apparent, active & reactive powers, Power factor, Concept of power factor improvement and its improvement (Simple numerical problems)
**Network theorems (AC & DC with independent sources):** Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem (Simple numerical problems)

**Unit-III : Three Phase AC Circuits**:
Three phase system-its necessity and advantages, Star and delta connections, Balanced supply and balanced load, Line and phase voltage/current relations, Three-phase power and its measurement (simple numerical problems).
**Measuring Instruments:** Types of instruments, Construction and working principles of PMMC and moving iron type voltmeters & ammeters, Single phase dynamometer wattmeter, Use of shunts and multipliers (Simple numerical problems on shunts and multipliers)

**Unit-IV: Magnetic Circuit:**
Magnetic circuit concepts, analogy between electric & magnetic circuits, B-H curve, Hysteresis and eddy current losses, Magnetic circuit calculations (Series & Parallel).
**Single Phase Transformer:** Principle of operation, Construction, EMF equation, Equivalent circuit, Power losses, Efficiency (Simple numerical problems), Introduction to auto transformer.

**Unit-V: Electrical Machines:**

**DC machines:**Principle & Construction, Types, EMF equation of generator and torque equation of motor, applications of DC motors (simple numerical problems)

**Three Phase Induction Motor:**Principle & Construction, Types, Slip-torque characteristics, Applications (Numerical problems related to slip only)

**Single Phase Induction motor:** Principle of operation and introduction to methods of starting, applications.

**Three Phase Synchronous Machines:** Principle of operation of alternator and synchronous motor and their applications.

**Text Books:**

1 ."Basic Electrical Engineering", S N Singh; Prentice Hall International
2. "Basic Electrical Engineering", KuldeepSahay, New Age International Publishers
3."Fundamentals of Electrical Engineering", B Dwivedi, A Tripathi; Wiley India
4."Principles of Electrical Engineering", V. Del Toro,; Prentice Hall International
5. "Electrical Engineering", J. B. Gupta, Kataria and Sons

**Reference Books:**

1."Electrical and Electronics Technology", Edward Hughes; Pearson
2."Engineering Circuit Analysis", W.H. Hayt&J.E. Kimerly; McGraw Hill
3."Basic Electrical Engineering", C L Wadhwa; New Age International
4."Basic Electrical Engineering", T.K. Nagsarkar,M.S. Shukhija; Oxford University Press

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*I Year I Semester*

**BTCH -104 ELECTRICAL ENGINEERING LABORATORY**

## LIST OF EXPERIMENTS

**Note: A minimum of ten experiments from the following should be performed**

1. Verification of Kirchhoff's laws
2. Verification of Superposition theorem
3. Verification of Thevenin's Theorem and Maximum Power Transfer Theorem.
4. Measurement of power and power factor in a single phase ac series inductive circuit and study improvement of power factor using capacitor
5. Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.
6. Connection and measurement of power consumption of a fluorescent lamp (tube light).
7. Measurement of power in 3- phase circuit by two wattmeter method and determination of its power factor for star as well as delta connected load.
8. Determination of parameters of ac single phase series RLC circuit
9. To observe the B-H loop of a ferromagnetic material in CRO.
10. Determination of (i) Voltage ratio (ii) polarity and (iii) efficiency by load test of a single phase transformer
11. Determination of efficiency of a dc shunt motor by load test
12. To study running and speed reversal of a three phase induction motor and record speed in both directions.

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## BTCH -105 COMPUTER SYSTEM AND PROGRAMMING IN C

**Unit1:**

**Basics of Computer:** Introduction to digital computer, basic operations of computer, functional components of computer, Classification of computers.

**Introduction to operating system:** [DOS, Windows, Linux and Android] purpose, function, services and types.

**Number system:** Binary, octal and hexadecimal number systems, their mutual conversions, Binary arithmetic.

**Basics of programming:** Approaches to Problem Solving, Concept of algorithm and flow charts, Types of computer languages:- Machine Language, Assembly Language and High Level Language, Concept of Assembler, Compiler, Loader and Linker.

**Unit2:**

Standard I/O in "C", **Fundamental data types-** Character type, integer, short, long, unsigned, single and double floating point, Storage classes- automatic, register, static and external, Operators and expression using numeric and relational operators, mixed operands, type conversion, logical operators, bit operations, assignment operator, operator precedence and associatively.

**Fundamentals of C programming:** Structure of C program, writing and executing the first C program, Components of C language. Standard I/O in C.

**Unit3:**

**Conditional program execution:** Applying if and switch statements, nesting if and else, use of break and default with switch, program loops and iterations: use of while, do while and for loops, multiple loop variables, use of break and continue statements.

**Functions:** Introduction, types of functions, functions with array, passing values to functions, recursive functions.

**Unit 4:**

**Arrays:** Array notation and representation, manipulating array elements, using multi dimensional arrays. Structure, union, enumerated data types

**Unit 5:**

**Pointers:** Introduction, declaration, applications File handling, standard C preprocessors, defining and calling macros, conditional compilation, passing values to the compiler.

**Reference:**

1. The C programming by Kernighan Brain W. and Ritchie Dennis M., Pearson Education .
2. Computer Basics and C Programming by V.Rajaraman , PHI Learning Pvt. Limited – 2015.
3. Programming in C by Kochan Stephen G. Pearson Education – 2015.
4. Computer Concepts and Programming in C by D.S. Yadav and Rajeev Khanna, New Age International Publication .
5. Computer Concepts and Programming in C by Vikas Gupta, Wiley India Publication
6. Computer Fundamentals and Programming in C. ReemaThareja, Oxford Publication
7. Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill
8. Computer Science- A Structured Programming Approach Using C, by Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Third Edition , Cengage Learning - 2007.
9. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson Addison-Wesley, 2006.
10. Computer Concepts and Programming by Anami, Angadi and Manvi, PHI Publication
11. Computer Fundamental and C programming by K K Gupta, Acme Learning Publication

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## *I Year I Semester*
## BTCH -105 COMPUTER PROGRAMMING LAB

1.WAP that accepts the marks of 5 subjects and finds the sum and percentage marks obtained bythe student.
2.WAP that calculates the Simple Interest and Compound Interest. The Principal , Amount, Rate ofInterest and Time are entered through the keyboard.
3.WAP to calculate the area and circumference of a circle.
4.WAP that accepts the temperature in Centigrade and converts into Fahrenheit using the formula C/5=(F-32)/9.
5.WAP that swaps values of two variables using a third variable.
6.WAP that checks whether the two numbers entered by the user are equal or not.
7.WAP to find the greatest of three numbers.
8.WAP that finds whether a given number is even or odd.
9.WAP that tells whether a given year is a leap year or not.
10.WAP that accepts marks of five subjects and finds percentage and prints grades according to the following criteria:
Between 90-100%----------Print ‘A’
80-90%----------Print ‘B’
60-80%----------Print ‘C’
Below 60%----------Print ‘D’
11.WAP that takes two operands and one operator from the user and perform the operation and prints the result by using Switch statement.
12.WAP to print the sum of all numbers up to a given number.
13.WAP to find the factorial of a given number.
14.WAP to print sum of even and odd numbers from 1 to N numbers.
15.WAP to print the Fibonacci series.
16.WAP to check whether the entered number is prime or not.
17.WAP to find the sum of digits of the entered number.
18.WAP to find the reverse of a number.
19.WAP to print Armstrong numbers from 1 to 100.
20.WAP to convert binary number into decimal number and vice versa.
21.WAP that simply takes elements of the array from the user and finds the sum of these elements.
23.WAP to find the minimum and maximum element of the array.

24.WAP to search an element in a array using Linear Search.
25.WAP to sort the elements of the array inascending order using Bubble Sort technique.
26.WAP to add and multiply two matrices of order nxn.
27.WAP that finds the sum of diagonal elements of a mxn matrix.
28.WAP to implement strlen (), strcat (),strcpy () using the concept of Functions.
29.Define a structure data type TRAIN_INFO. The type contain Train No.: integer type Train name: string Departure Time: aggregate type TIME Arrival Time : aggregate type TIME Start station: string End station : string The structure type Time contains two integer members: hour and minute. Maintain a train timetable and implement the following operations:
(i)List all the trains (sorted according to train number) that depart from a particular section.
(ii)List all the trains that depart from a particular station at a particular time.
(iii)List all he trains that depart from a particular station within the next one hour of a given time.
(iv)List all the trains between a pair of start station and end station.

30. WAP to swap two elements using the concept of pointers.
31.WAP to compare the contents of two files and determine whether they are same or not.
32.WAP to check whether a given word exists in a file or not. If yes then find the number of times it occurs.

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## *I Year II Semester*
## BTCH -201 ENGINEERING MATHEMATICS – II

**Unit - 1: Ordinary Differential Equations**

Linear differential equations of *n*th order with constant coefficients, Complementary function and Particular integral, Simultaneous linear differential equations, Solution of second order differential equations by changing dependent & independent variables, Method of variation of parameters, Applications to engineering problems (without derivation).

**Unit - 2: Series Solution and Special Functions**

Series solution of second order ordinary differential equations with variable coefficient (Frobenius method), Bessel and Legendre equations and their series solutions, Properties of Bessel function and Legendre polynomials.

**Unit - 3: Laplace Transform**

Laplace transform, Existence theorem, Laplace transforms of derivatives and integrals, Initial and final value theorems, Unit step function, Dirac- delta function, Laplace transform of periodic function, Inverse Laplace transform, Convolution theorem, Application to solve simple linear and simultaneous differential equations.

**Unit - 4: Fourier Series and Partial Differential Equations**

Periodic functions, Dirichlet's Conditions, Fourier series of arbitrary periods, Euler's Formulae, Even and odd functions, Half range sine and cosine series, Gibbs Phenomena.

Solution of first order Lagrange's linear partial differential equations, Second order linear partial differential equations with constant coefficients.

**Unit - 5: Applications of Partial Differential Equations**

Classification of second order partial differential equations, Method of separation of variables for solving partial differential equations, Solution of one and two dimensional wave and heat conduction equations, Laplace equation in two dimension, Equation of transmission lines.

**Text Books:**

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw- Hill Publishing Company Ltd.
3. R.K.Jain&S.R.K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House.

**Reference Books:**

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
2. Peter V. O' Neil, Advanced Engineering Mathematics, Thomas (Cengage) Learning.
3. Chandrika Prasad, Advanced Mathematics for Engineers, Prasad Mudranalaya
4. A. C. Srivastava& P. K. Srivastava, Engineering Mathematics, Vol. – II, PHI Learning Pvt. Ltd.
5. Rukmangadachari, Engineering Mathematics – II, Pearson Education.

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## *I Year II Semester*
## BTCH -202 ENGINEERING PHYSICS- II

**Unit – I: Crystal Structures and X-ray Diffraction**

Space lattice, basis, Unit cell, Lattice parameter, Seven crystal systems and Fourteen Bravais lattices, Co-ordination number, Atomic radius and Packing factor of different cubic structures, Crystal structure of NaCl and diamond, Lattice planes and Miller Indices, Diffraction of X-rays by crystal, Laue's experiment, Bragg's Law, Bragg's spectrometer. Compton Effect.

**Unit – II: Dielectric and Magnetic Properties of Materials**

**Dielectric Properties:** Dielectric constant and Polarization of dielectric materials, Relation between E, D and P, Types of Polarization (Polarizability). Equation of internal fields in liquid and solid (One-Dimensional), Claussius-Mossotti equation, Frequency dependence of dielectric constant, Dielectric Losses, Important applications of dielectric material, Ferroelectricity, Piezoelectricity.

**Magnetic Properties:** Magnetization, Origin of magnetic moment, Dia, para and ferro magnetism, Langevin's theory for diamagnetic material, Phenomena of hysteresis and its applications.

**Unit – III: Electromagnetic Theory**

Equation of continuity, Maxwell's Equations (Integral and Differential Forms) and its derivations, Displacement Current, Poynting vector and Poynting theorem, EM - Wave equation and its propagation characteristics in free space, non-conducting and conducting media, energy density of electromagnetic wave, Skin depth.

**Unit – IV: Band Theory of Solids**

Free electron Theory, Formation of bands in Solids, Classification of solids on band theory, Density of states, Fermi-Dirac distribution, Concept of effective mass, Charge carrier density (electrons and holes), Conductivity of semiconductors, carrier concentrations Fermi energy, Position of Fermi level in intrinsic and in extrinsic semiconductors. Temperature dependence of conductivity in semiconductors.

**Unit – V: Physics of some technologically important Materials**

**Superconductors:** Temperature dependence of resistivity in superconducting materials, Effect of magnetic field (Meissner effect), Temperature dependence of critical field, London equations, Josephson theory, persistent currents, Type I and Type II superconductors, BCS theory (Qualitative), High temperature superconductors and Applications of Super-conductors.

**Nano-Materials:** Basic principle of nanoscience and technology, structure, properties and uses of Fullerene, Carbon nanotubes Single and double walled nanotubes, synthesis of nanotubes, Properties and Applications of nanotubes.

**Reference books:**

1. Concept of Modern Physics - by Beiser (Tata Mc-Graw Hill)
2. Solid State Physics - by C. Kittel, 7th edition (Wiley Eastern)
3. Materials Science and Engineering - by V. Raghavan (Prentice- Hall India)
4. Solid State Physics - by S.O. Pillai, 5th edition (New Age International)
5. Introduction to Electrodynamics - by David J. Griffith (PH I)
6. Engineering Physics- C. Mani Naidu(Pearson)
7. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New D

## PROFESSIONAL COMMUNICATION LABORATORY PRACTICALS

**LTP-**

Interactive and Communicative Practical with emphasis on Oral Presentation/Spoken Communication based on International Phonetic Alphabets (I.P.A)

## LIST OF PRACTICAL'S

1. Group Discussion: Practical based on Accurate and Current Grammatical Patterns.
2. Conversational skills for Interviews under suitable Professional Communication Lab conditions with emphasis on Kinesics.
3. Communication Skills for Seminars/Conferences/Workshops with emphasis on Paralinguistics / Kinesics.
4. Presentation Skills of Technical Paper/Project Reports/Professional Reports based on proper Stress and Intonation Mechanics.
5. Official /Public Speaking based on Rhythmic Patterns.
6. Theme-Presentation /Key-Note Presentation based on correct argumentation methodologies.
7. Individual Speech Delivery/Conferences with skills to defend Interjections/Quizzes.
8. Argumentative Skills/Role Play Presentation with Stress and Intonation.
9. Comprehensions Skills based on Reading and Listening Practical on a model Audio-Visual Usage.

**Reference Books**

1. BansalR.K.& Harrison: Phonetics in English, Orient Longman , New Delhi.
2. Sethi&Dhamija: A Course in Phonetics and Spoken English, Prentice Hall, New Delhi.
3. L.U.B. Pandey&R.P.Singh, A Manual of Practical Communication, A.I.T.B.S. Pub. India Ltd. Krishan Nagar, Delhi.
4. Joans Daniel, English Pronouncing Dictionary, Cambridge Univ. Press.

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## *I Year II Semester*
## BTCH -203 ELEMENTS OF MECHANICAL ENGINEERING

**UNIT-I:**

**Force System:** Force, Parallelogram Law, Lami's theorem, Principle of Transmissibility of forces. Moment of a force, Couple, Varignon's theorem, Resolution of a force into a force and a couple. Resultant of coplanar force system. Equilibrium of coplanar force system, Free body diagrams, Determination of reactions.

**Concept of Centre of Gravity and Centroidand Area Moment of Inertia**, Perpendicular axis theorem and Parallel axis theorem

**UNIT-II:**

**Plane Truss:** Perfect and imperfect truss, Assumptions and Analysis of Plane Truss by Method of joints and Method of section.

**Beams:** Types of beams, Statically Determinate Beams, Shear force and bending moment in beams, Shear force and bending moment diagrams, Relationships between load, shear and bending moment.

**UNIT-III:**

**Simple stress and strain:** Normal and shear stresses. One Dimensional Loading; members of varying cross section, bars in series.Tensile Test diagram for ductile and brittle materials, Elastic constants, Strain energy.

**Bending (Flexural) Stresses:** theory of pure bending, neutral surface and neutral axis, stresses in beams of different cross sections.

**Engineering Materials:** Importance of engineering materials, classification, mechanical properties and applications of Ferrous, Nonferrous and composite materials.

**UNI-IV:**

**Basic Concepts and Definitions of Thermodynamics:** Introduction and definition of thermodynamics, Microscopic and Macroscopic approaches, System, surrounding and universe, Concept of continuum, Thermodynamic equilibrium, Thermodynamic properties, path, process and cycle, Quasi static process, Energy and its forms, Work and heat. Thermodynamic definition of work.

**Zeroth law of thermodynamics:** Temperature and its' measurement.

**First law of thermodynamics:** First law of thermodynamics, Internal energy and enthalpy. First law analysis for non-flow processes. Non-flow work Steady flow energy equation; Boilers, Condensers, Turbine, Throttling process, Pumps etc.

**UNIT-V:**

**Second law:** Thermal reservoir, Kelvin Planck statement, Heat engines, Efficiency; Clausius' statement Heat pump, refrigerator, Coefficient of Performance. Carnot cycle, Carnot theorem and it'scorollaries.Clausius inequality, Concept of Entropy.

**Properties of pure substances:** P-v, T-s and h-s diagram, dryness fraction and steam tables. Rankine Cycle.

**Internal Combustion Engines:** Classification of I.C. Engines and their parts, working principle and comparison between 2 Stroke and 4 stroke engine , difference between SI and CI engines. P-v and T-s diagramsof Otto and Diesel cycles, comparison of efficiency.

**Books & References:**


1. Engineering Mechanics: Statics by J.LMeriam , Wiley
2. Engineering Mechanics : Statics and Dynamics by R. C. Hibbler, Pearson
3. Strength of Materials by Thimoshenko& Young
4. Mechanics of Solid by R. C. Hibbler, Pearson
5. Engineering Thermodynamics by P.K.Nag, McGraw Hill
6. Thermodynamics An Engineering Approach by Cengel& Boles, McGraw Hill
7. Engineering Thermodynamics by P. Chattopadhyay, OXFORD Publication
8. Internal Combustion Engine by V Ganesan, McGraw Hill Pub .
9. An Introduction to Mechanical Engineering by Wickert& Lewis, Cengage Learning
10. Engineering Mechanics By S. S. Bhavikatti, K. G. Rajashekarappa, New Age International
11. Engineering Mechanics by R K Bansal, Laxmi Publications
12. Fundamentals of Mechanical Engineering by Sawhney, PHI
13. Basic Mechanical Engineering by Pravin Kumar, Pearson

*Department of Chemical Technology*
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*I Year II Semester*

# ELEMENTS OF MECHANICAL ENGINEERING LAB

**Note: Any 10 experiments (Minimum of 3 from each module) are to be conducted.**

**Module 1:**

1. To conduct the tensile test and determine the ultimate tensile strength, percentage elongation for a mild steel specimen.
2. To conduct the Impact-tests (Izod / Charpy) on Impact-testing machine to find the Impact Strength of the specimen.
3. To determine the hardness of the given specimen using Vicker/Brinell/Rockwell hardness testing machine.
4. To conduct experiment on Torsion of Rod/wire.

**Module 2:**

1. To Study the working of 2 stroke Diesel/Petrol engine.
2. To Study and working of 4 stroke Petrol/Diesel engine.
3. To Study the model of Babcock and Wilcox and Lancashire boiler.
4. To Study various types of Mounting and Accessories of Boilers.

**Module 3:**

1. To verify the parallelogram, and Triangle law.
2. To verify the polygon law of force.
3. To determine the coefficient of friction on inclined surface.
4. To determine the efficiency and Mechanical Advantage of Worm & Worm-wheel.
5. To conduct experiment on Force Analysis on simple truss and Jib-crane Apparatus.
6. To conduce friction experiment on screw-jack.

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## *I Year II Semester*
## BTCH -204 PROFESSIONAL COMMUNICATIONS

**LTP-**

| | |
|---|---|
| **Unit-1 Fundamentals of Communications** | Technical Communication: features: Distinction between General And Technical Communication; Language as a tool of communications; Levels of communication: Interpersonal, Organizational, Mass communication; The flow of communication: Downward, Upward, Lateral/Horizontal (Peer group) : Importance of technical communication; Barriers to Communication. |
| **Unit-II Written Communication** | Words and Phrases: Word formation, Synonyms and Antonyms; Homophones; Select vocabulary of about 500-1000 New words; correct Usage: all Parts of Speech; Modals; Concord; Articles; Infinitives; Transformation of sentences; Requisites f Sentence Construction: Paragraph Development: Techniques and Methods- Inductive, Deductive, Spatial , Linear, Chronological etc. |
| **Unit-III Business Communication** | Principles, Sales & Credit letters; Claim and Adjustment Letters; Job Application and Resumes. Reports: Types; Significance; Structure, Style & Writing of Reports. Technical Proposal; Parts; Types; Writing of Proposal; Significance; Negotiation skills. |
| **Unit-IV Presentation Strategies and Soft Skills.** | Nuances and Modes of Delivery; Body Language; Dimensions of Speech: Syllable; Accent; Pitch; Rhythm; Intonation; Paralinguistic features of voice; Interpersonal communication: Definition; Types; Team work; Attitude; Way to improve Attitude Listening Skills : Types; Methods for improving Listening Skills. |
| **Unit –V Value- Based** | Following essays from the prescribed text book with emphasis on Mechanics of writing. |

**Text Readings**

**(i)** Humanistic and Scientific Approaches to Human Activity by Moody E. Prior
**(ii)** The Language of Literature and Science by A. Huxley
**(iii)** Man and Nature by J. Bronowski
**(iv)** Science and Survival by Barry Commoner
**(v)** The Mother of the Sciences by A.J. Bahm.

**Text Book**

1. Improve your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
2. Technical Communication- Principles and Practices by Meenakshi Raman &Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
3. Functional skills in Language and Literature, by R.P. Singh, Oxford Univ. Press, 2005, New Delhi.

**Reference Books**

1. Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt. Ltd, 2011, New Delhi.
2. Business Correspondence and Report Writing by Prof. R.C.,Sharma& Krishna Mohan, Tata McGraw Hill & Co. Ltd. , 2001, New Delhi.
3. Word Power Made Easy by Norman Lewis, W.R. Goyal Pub. & Distributors, 2009, Delhi.

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*I Year II Semester*

## BTCH -205 BASIC ELECTRONICS

**Unit I PNP-N junction diode**: Introduction of Semiconductor Materials Semiconductor Diode: Depletion layer, V-I characteristics, ideal and practical, diode resistance, capacitance, Diode Equivalent Circuits, Transition and Diffusion Capacitance, Zener Diodes breakdown mechanism (Zener and avalanche) Diode Application: Series , Parallel and Series, Parallel Diode Configuration, Half and Full Wave rectification, Clippers, Clampers, Zener diode as shunt regulator, Voltage-Multiplier Circuits Special Purpose two terminal Devices :Light-Emitting Diodes, Varactor (Varicap) Diodes, Tunnel Diodes, Liquid-Crystal Displays.

**Unit-II Bipolar Junction Transistors and Field Effect Transistor:** Bipolar Junction Transistor: Transistor Construction, Operation, Amplification action. Common Base, Common Emitter, Common Collector Configuration DC Biasing BJTs: Operating Point, Fixed-Bias, Emitter Bias, Voltage-Divider Bias Configuration. Collector Feedback, Emitter-Follower Configuration. Bias Stabilization. CE, CB, CC amplifiers and AC analysis of single stage CE amplifier (re Model ). Field Effect Transistor: Construction and Characteristic of JFETs. AC analysis of CS amplifier, MOSFET (Depletion and Enhancement)Type, Transfer Characteristic,

**Unit- III Operational Amplifiers** : Introduction and Block diagram of Op Amp, Ideal & Practical characteristics of Op Amp, Differential amplifier circuits, Practical Op-Amp Circuits (Inverting Amplifier, Non inverting Amplifier, Unity Gain Amplifier, Summing Amplifier, Integrator, Differentiator).

**OPAMP Parameters**: Input offset voltage, Output offset voltage, Input biased current, Input offset current Differential and Common-Mode Operation

**Unit- IV Electronic Instrumentation and Measurements**: Digital Voltmeter : Introduction, RAMP Techniques Digital Multimeters: Introduction Oscilloscope: Introduction, Basic Principle, CRT , Block Diagram of Oscilloscope, Simple CRO, Measurement of voltage, current phase and frequency using CRO, Introduction of Digital Storage Oscilloscope and Comparison of DSO with Analog Oscilloscope.

**Unit- V Fundamentals of Communication Engineering**: Elements of a Communication System, Need of Modulation, Electromagnetic spectrum and typical applications. Basics of Signal Representation and Analysis, Introduction of various analog modulation techniques, Fundamentals of amplitude modulation, Modulation and Demodulation Techniques of AM.

**Text Books:**


1. Robert L. Boylestand / Louis Nashelsky*"Electronic Devices and Circuit Theory*", Latest Edition, Pearson Education.
2. H S Kalsi, "Electronic Instrumentation", Latest Edition, TMH Publication,.
3. George Kennedy, "Electronic Communication Systems", Latest Edition, TMH,


**Reference Books:**


1. David A. Bell, "*Electronic Devices and Circuits",* Latest Edition, Oxford University Press.
2. Jacob Millman, C.C. Halkias, StayabrataJit, "*Electronic Devices and Circuits*", Latest Edition ,TMH.
3. David A. Bell, Electronic Instrumentation and Measurements, Latest Edition, Oxford University Press India.

# *Faculty of Engineering & Technology*
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# *Shivpuri (MP)*

**Evaluation Scheme & Syllabus for**
**Department of Chemical Engineering**
**B.Tech. Second Year**
**(III & IV SEM)**

**(Effective from session 2019-20)**

**(Taken From Abdul Kalam Technical University- AKTU)**

## SEMESTER-III

| | | THEORY | | PRACTICAL | | TOTAL |
|---|---|---|---|---|---|---|
| **SUBJECT CODE** | **SUBJECT NAME** | SESS.(30) | EXT.(70) | SESS.(25) | EXT.(25) | |
| BTCH-301 | Mathematics-III | 30 | 70 | NA | NA | 100 |
| BTCH-302 | Environmental Pollution Monitoring & Control | 30 | 70 | 25 | 25 | 150 |
| BTCH-303 | Mechanical Operation | 30 | 70 | 25 | 25 | 150 |
| BTCH-304 | Material & Energy Balance | 30 | 70 | NA | NA | 100 |
| BTCH-305 | Chemical Engg. Fluid Mechanics | 30 | 70 | 25 | 25 | 150 |
| BTCH-306 | Environment & Ecology | 30 | NA | NA | NA | 100 |

## SEMESTER IV

| | | THEORY | | PRACTICAL | | TOTAL |
|---|---|---|---|---|---|---|
| **SUBJECT CODE** | **SUBJECT NAME** | SESS.(30) | EXT.(70) | SESS.(25) | EXT.(25) | |
| BTCH-401 | Nano Science | 30 | 70 | NA | NA | 100 |
| BTCH-402 | Process Instrumentation | 30 | 70 | NA | NA | 100 |
| BTCH-403 | Heat Transfer | 30 | 70 | 25 | 25 | 150 |
| BTCH-404 | Mass Transfer - I | 30 | 70 | 25 | 25 | 150 |
| BTCH-405 | Chemical Engineering Thermodynamics | 30 | 70 | 25 | 25 | 150 |
| BTCH-406 | Universal Human Values & Professional Ethics | 30 | 70 | NA | NA | 100 |
| | Seminar | NA | NA | 25 | 25 | 50 |

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# *II Year Semester-III*
## BTCH-301: ENGINEERING MATHS–III

**UNIT - I**

**Numerical Techniques – I**: Zeroes of transcendental and polynomial equations, Bisection method, Regula-falsi method, Newton-Raphson method, Rate of convergence of above methods.

**Interpolation**: Finite differences, Newton's forward and backward interpolation. Lagrange's and Newton's divided difference formula for unequal intervals**.**

**UNIT- II**

**Numerical Techniques –II**: Solution of system of linear equations, Matrix Decomposition methods, Jacobi method, Gauss- Seidal method.

**Numerical differentiation & Integration**: Trapezoidal rule, Simpson's one third and three- eight rules, Solution of ordinary differential equations (first order, second order and simultaneous) by Euler's, Picard's and fourth-order Runge- Kutta methods.

**UNIT- III**

**Statistical Techniques**: Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves, Correlation, Linear, non – linear and multiple regression analysis, Binomial, Poisson and Normal distributions. Tests of significations: Chi-square test, t-test.

**UNIT- IV**

**Function of Complex variable**: Analytic function, C-R equations, Harmonic Functions, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of analytic functions, Taylor's and Laurent's series, Singularities, Zeroes and Poles, Residue theorem.

**UNIT -V**

**Integral Transforms**: Fourier integral, Complex Fourier transform, Inverse Transforms, Convolution Theorems, Fourier sine and cosine transform, Applications of Fourier transform to simple one dimensional heat transfer equations, wave equations and Laplace equations, Z- Transform and its application to solve difference equation.

**Text Books:**


1. Peter V. O'Neil, Advance Engineering Mathematics Thomson (Cengage) Learning, 2007.
2. Jain, Iyenger Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, New Delhi
3. J.N. Kapur, Mathematical Statistics, S. Chand & company Ltd.
4. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers


**Reference Books:**


1. R.K. Jain & S.R.K. Iyenger, Advance Engineering Mathematics, Narosa Publication House.
2. Chandrika Prasad, Advanced Mathematics for Engineers, Prasad Mudralaya, 1996.
3. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI Learning Private Limited, New Delhi.
4. E. Balagurusamy, Numerical Methods, Tata McGraw-Hill Publishing Company Limited, New Delhi
5. T. Veerajan & T. Ramchandrandran, Theory & Problems in Numerical Methods, TMH, New Delhi

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*Semester-III*

# BTCH-302: ENVIRONMENTAL POLLUTION MONITORING & CONTROL

**UNIT I**

**Introduction**: Ecology & Environment, Biodiversity, Interaction of man and environment, Overall picture of Environmental pollution, Ambient air and water quality criteria, Standards and Acts-Indian, EPA& EURO, Effects and control of noise, thermal and radioactive pollution.

**UNIT II**

**Air Pollution**: Types of pollutants, Dispersion of pollutant in the atmosphere, Gaussian dispersion model, Meteorological factors, Stability and inversion of atmosphere, Plume Behaviour, Control of air pollution from stationary and mobile sources, Methods of measuring and sampling of gaseous and particulate pollutants in ambient air and industrial waste gases, measurement of smoke density and visibility .Control of gaseous pollutants-SOx, NOx, H2S, VOCS, Auto exhaust. Stack design, Classification, selection and design of equipment's like cyclones, electrostatic precipitators, bag filters, wet scrubbers, settling chambers.

**UNIT III**

**Water Pollution**: Waste water characteristics – Physical and chemical composition, Biochemical oxygen demand (BOD), Pathogenic bacteria and chemical toxicity. Types of pollutants in waste water of chemical industries, Methods of sampling, preservation of samples and analysis. Methods for the treatment of liquid wastes to control pollution, Classification viz. physical, chemical and biological methods, Selection and design of equipment like hydrocyclone, settling tanks, filters, ion- exchange.

**UNIT IV**

**Solid Wastes Management**: Characterization of solid wastes, Problems of collection and handling, Various processing techniques used in solid waste management such as compaction, incineration, Composting, landfills and biological Processing, Solid waste as resource material.

**UNIT V**

Pollution abatement in important chemical industries like fertiliser, petroleum refineries and petrochemicals, Pulp and Paper, Pharmaceuticals, Tannery, Sugar, Distillery, food processing , cement and electroplating.

**Text Books**


1. Howard S. Peavy, DR Rowe & C. Tchobonoglous "Environmental Engineering", McGraw Hill (1984).
2. Metcalf & Eddy, "Waste Water Engineering Treatment, Disposal & Reuse", Tata McGraw Hill (2003).
3. Werner Strauss, 'Air Pollution Control: Measuring and monitoring air pollutant', Wiley (1978).
4. Werner Strauss, 'Air Pollution Control part -II, Wiley (1978).
5. Pandey, GN and Carney, GC, "Environmental Engineering", Tata McGraw Hill (1991).

*Department of Chemical Engineering*
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*P.K. University, Shivpuri (MP)*
*II Year Semester-III*

# BTCH-303: MECHANICAL OPERATIONS

**UNIT I**
Types of Mechanical Operations, screen analysis, particle size distribution, particle size measurement, Surface area measurements, statistical mean diameters, relevant equations and problems.

**UNIT II**
Laws of crushing and grinding. Classification of crushing and grinding equipment. Construction and working principle of crushers and grinders.

**UNIT III**
Classification of conveyors, Storage of solids in bulk protected and unprotected piles, bines, silos, hoppers, mass flow and funnel flow Bins, Flow assisting devices, feeders. Mixing of solids, blending, kneading. Weighing of bulk solids, batch and continuous weighing techniques.

**UNIT IV**
Rare and dense medium separation, classifiers, magnetic separation, electrostatic separator, floatation and elutriation, continuous thickeners, decantation, centrifugal separation, Gravity settling, cyclone separators, bag filters, scrubbers.

**UNIT V**
Classification of filters, theory of filtration, cake resistance. Fluidization with and without carryover of particles, minimum fluidization, terminal velocity of particles, entrainment, pressure drop in fluidization.

**BOOKS:**


1. Momentum transfer operation: S.K. Gupta, TMC, 1979.
2. Unit Operations of Chemical Engineering: McCabe and Smith, TMC
3. Chemical Engineering Vol. I: Coulson & Richardson, Pergamon, 1979

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# *P.K. University, Shivpuri (MP)*
# *II Year Semester-III*

## BTCH-304: MATERIAL & ENERGY BALANCE

**UNIT I**

Basic and derived units, use of model units in calculations, Methods of expression, compositions of mixture and solutions, Ideal and real gas laws - Gas constant - calculations of pressure, volume and temperature using ideal gas law, Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

**UNIT II**

Stoichiometric principles, application of material balance to unit operations like distillation, evaporation, crystallization, drying etc., Material balance with chemical reaction, Limiting and excess reactants, recycle, bypass and purging

**UNIT III**

Unsteady state material balances, calculation of absolute humidity, molal humidity, relative humidity and percentage humidity, use of humidity in condensation and drying, Humidity chart, dew point.

**UNIT IV**

Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels, calculation of excess air from orsat technique and problems, heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy.

**UNIT V**

Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction, effect of pressure and temperature on heat of reaction, Energy balance for systems with and without chemical reaction, unsteady state energy balances. Introduction to Computer aided calculations-steady state material and energy balances.

**BOOKS:**


1. Bhatt, BL, VORA, S.M., “Stoichiomentry", Tata McGraw-Hill, 1976.
2. Hougen, OA, Watson, K.M and Ragatz, RA, "Chemical Process Principles Part-I", John Wiley and Asia Publishing, 1970.
3. Himmelblau, D.M., “Basic Principles and Calculations in Chemical Engineering ", Fourth Edition, Prentice Hall Inc., 1982.
4. Whitwell, JC, Tone, RK, “Conservation of Mass and Energy", McGraw-Hill, 1973.
5. Process Calculation for Chemical Engineering, Second Revised Edition, Chemical Engineering Education Development Centre, IIT Madras, 1981.

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# *II Year Semester-III*

## BTCH-305: CHEMICAL ENGG. FLUID MECHANICS

**UNIT I**

Properties of fluids, fluid statics, Forces on fluids, pressure depth relationship for compressible and incompressible fluids, Forces on submerged bodies, Rigid body motion, pressure measurements, Euler's equation, Bernoulli's theorem.

**UNIT II**

Kinematics of flow, Description of velocity field, Stream functions, Angular velocity, Fluids in circulation, Irrotational flow, Dimensional analysis, Buckingham Pi Theorem, Dimensionless numbers and their physical significance, Similitude Criteria.

**UNIT III**

Fluid flow: Laminar and turbulent flows, Pressure drop in pipes, pipe fittings and pipe network, friction factor, Conservation of mass, momentum and energy, Mechanical engineering Bernoulli's equation .

**UNIT IV**

Flow measuring devices for chemical plants, venturimeter, orifice meter, nozzle, Rotameter, pitot tube and v-notch.

**UNIT V**

Pumping and compressing of chemicals and gases, reciprocating pumps, rotary pumps, centrifugal pumps and blowers, NPSH and calibrations, mixing and agitation, types of mixers and their selection, power requirement, compressible fluid flow, introductory concepts of two-phase flow.

**BOOKS:**


1. Gupta, Vijay and SK Gupta, "Fluid Mechanics and its Applications", Wiley Eastern, New Delhi (1984).
2. Rajput, RK, "Text Book of Fluid Mechanics", S. Chand and Co., New Delhi (1998).
3. Jain, AK, "Fluid Mechanics including Hydraulic Machines", Khanna Publishers, Delhi (2007).
4. Bansal, RK, "Fluid Mechanics and Hydraulic Machines", Laxmi Publications (P) Ltd., New Delhi (2005).
5. Gupta, SK, "Momentum Transfer Operations", Tata McGraw Hill, New Delhi (1982).

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*II Year Semester-III*

# BTCH -306: ENVIRONMENT& ECOLOGY

**UNIT-I**

Definition, Scope & Importance, Need For Public Awareness• Environment definition, Eco system - Balanced ecosystem, Human activities - Food, Shelter, Economic and social Security. Effects or human activities on environment Agriculture, Housing, Industry, Mining and Transportation activities, Basics of Environmental Impact Assessment. Sustainable Development

**UNIT-II**

Natural Resources• Water Resources· Availability and Quality aspects. Water borne diseases, Water Induced diseases, Fluoride problem in drinking water. Mineral Resources, Forest Wealth, Material cycles-- Carbon, Nitrogen and Sulpher Cycles.

**Energy** - Different types of energy, Electro-magnetic radiation. Conventional and Non-Conventional sources – Hydro-Electric, Fossil Fuel based, Nuclear, Solar, Biomass and Bio.gas. Hydrogen as an alternative future source of Energy.

**UNIT-Ill**

Environmental Pollution and their effects. Water pollution, Land pollution. Noise pollution, Public Health aspects, Air Pollution, Solid waste management, e-waste management

Current Environmental Issues of Importance: Population Growth, Climate Change and Global warming- Effects, Urbanization, Automobile pollution. Acid Rain Ozone Layer depletion, Animal Husbandry,

**UNIT-IV**

V Environmental Protection- Role of Government, Legal aspects, initiatives by Non-Governmental organizations (NGO), Environmental Education, Women Education,

**Text Books**

l. Environmental Studies -Benny Joseph- Tata Mcgraw Hill-2005
2. Environmental Studies- Or. D.L. Manjunath, Pearson Education-2006.
3. Environmental studies - R, Rajagopalan -Oxford Publication • 2005.
4.Text book of Environmental Science & Technology- M. Anji Reddy- US Publication .

**Reference Books**

**l**. Principles of Environmental Science and Engineering -P. Venugoplan Rao, Prentice Hall of India.
2. Environmental Science and Engineering- Meenakshi, Prentice Hall India

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## *P.K. University, Shivpuri (MP)*
## *II Year Semester-III*

### BTCH-302: ENVIRONMENTAL POLLUTION MONITORING & CONTROL LAB

1. To determine the Biochemical Oxygen Demand of a Given Sample of Wastewater
2. To determine Dissolved Oxygen in a Given Sample by Azide Modification Method
3. To find Alkalinity of Water Sample by Indicator Method
4. To determine Suspended Solids of Given Water Sample
5. To determine the Total Hardness of Water using EDTA Method
6. To determine the Turbidity of Water Sample using Nephelometric Method
7. To determine pH Value of a Given Water Sample
8. To determine the COD of Waste Water Sample by using Close Reflux Method.
9. To determine the COD of Waste Water Sample by using Open Reflux Method


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## *II Year Semester-III*


### BTCH-303: MECHANICAL OPERATION LAB

1. Determination of average particle size of a mixture of particles by sieve analysis.
2. Study and operation of Jaw crusher and thereby verification of Ritinger's constant.
3. Determination of reduction ratio, maximum feed size and theoretical capacity of crushing rolls.
4. Study of Ball mill and comparison of its critical speed with the operating speed.
5. Study and operation of a Hammer mill thereby finding its reduction ratio.
6. Study and operation of a cyclone separator and thereby finding its efficiency of separation.
7. Study and operation of a Magnetic separator and thereby finding its efficiency of separation.
8. Study and operation of a Gyratory Crusher and thereby finding its reduction ratio
9. To find the cake and filter medium resistance of Plate and Frame Filter press.
10. To find the filter medium resistance of a Vacuum Leaf Filter.

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*II Year Semester-III*

## BTCH-305: CHEMICAL ENGG. FLUID MECHANICS LAB

1. To find the flow rate using a V notch
2. To find the friction losses in a Straight pipe and in a Bend pipe.
3. Study of Pipe fittings and Valves
4. To study the working principle of a centrifugal pump and determine its efficiency experimentally.
5. Determination of coefficient of velocity, coefficient of resistance, coefficient of contraction.
6. To determine the pressure drop in a packed bed.
7. Determination of discharge coefficient with Reynolds Number in case of an orifice meter and a venturi meter.
8. Study and verification of the flow pattern in a Bernoulli's apparatus
9. To determine the minimum fluidization velocity in a fluidized bed.
10. Determination of the fluidization index, segregation index in a fluidized bed.

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*II Year Semester-IV*

## BTCH-401: NANO SCIENCE

**UNIT I**

**Introduction**: Definition of Nano-Science and Nano Technology, Applications of Nano-Technology.

**Quantum Theory for Nano Science**: Particle in a box, Potential step: Reflection and tunneling (Quantum leak). Penetration of Barrier, Potential box (Traped particle in 3D: Nanodot).

**Physics of Solid State Structures**: Size dependence of properties, crystal structures, face centered cubic nanoparticles; Tetrehedrally bounded semiconductor structures; lattice vibrations.

**Energy Bands**: Insulators, semiconductor and conductors; Reciprocal space; Energy bands and gaps of semiconductors; effective masses; Fermi Surfaces.

**Localized Particles**: Acceptors and deep taps; mobility; Excitons.

**UNIT II**

**Quantum Nanostructure**: Preparation of quantum wells, Wires and Dots, Size and Dimensionality effect, Fermi gas; Potential wells; Partial confinement; Single electron Tunneling, Infrared detectors; Quantum dot laser superconductivity.

**Properties of Individual Nano Particles**: Metal nano clusters; Magic numbers; Theoretical modeling of nano particles; geometric structure; electronic structure; Reactivity, Fluctuations, Magnetic clusters; Bulk to nanostructure, semiconducting nanoparticles, Optical Properties, Photo fragmentation, Coulombic Explosion. Rare Gas & Molecular clusters; Inert gas clusters; Superfluid clusters; Molecular clusters.

**UNIT III**

**Growth Techniques of Nanomaterials**: Litho and Nonlithograpahic techniques, RF Plasma, Chemical methods, Thermolysis, Pulsed laser method, Self-assembly, E-beam evaporation, Chemical Vapour Deposition, Pulsed Laser Deposition.

**UNIT IV**

**Methods of Measuring Properties**: Structure: X-ray Diffraction Technique, Particle size determination, surface structure. Microscopy: Scanning Probe Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy(TEM). Spectroscopy: Infra red and Raman Spectroscopy, X-ray Spectroscopy, Magnetic resonance, Optical and Vibrational Spectroscopy, Luminescence.

**UNIT V**

**Carbon Nano Materials:** Bucky Ball and Carbon Nano- Tubes: Nano structures of carbon (fullerene), Fabrication, Structure. Electrical, Mechanical and Vibrational properties and applications. Nano Diamond, Boron Nitride Nano-tubes, Single Electron Transistors, Molecular Machine, Nano-Biometrics, Nano Robots.

**Text/Reference Books:**

1. CP Poole Jr, FJ Owens, “Introduction to Nanotechnology”.

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*II Year Semester-IV*

# BTCH-402: PROCESS INSTRUMENTATION

**UNIT I**
Importance of measuring of Instruments in Process Control, Classification of Instruments, Elements of an Instruments, Static & Dynamic Characterization of Instruments, Errors in measurements & Error Analysis, Selection of instrument for a particular Measurement, transducers.

**UNIT II**
Measurement of Temperature: Thermocouples, Resistance Thermometer, Expansion Thermometers, Pyrometers.

**UNIT III**
Measurement of Pressure & Vacuum, Hydrostatic type , Elastic Element type, Electrical Type and other type of instruments like McLeod Gauge, Thermocouple gauge, Knudson Gauge, Ionization Gauge.

**UNIT IV**
Instruments for Measurement of Flow rate & level: Variable Area & variable head flow meters, Volumetric and Mass flow rate meters, Linear velocity measurement systems, Anemometers, Pressure type, Resistance & Capacitance type, Sonic & Ultrasonic, Thermal type Level meters.

**UNIT V**
Instruments for Measurement of Viscosity: Redwood, Saybolt, Engler, Cup & Cone type, Rheo & other types of viscometers.

**Books:**
1. Eckman, D.P., Industrial Instrumentation, Wiley Eastern Ltd., New York 1990.
2. Jain, R.K., Mechanical and Industrial Measurements, Khanna Publishers.

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# *II Year Semester-IV*

## BTCH-403: HEAT TRANSFER

**UNIT I**

Introduction to heat transfer and general concepts of heat transfer by conduction, convection and radiation, Conduction: Basic concepts of conduction in solids, liquids, gases, steady state temperature fields and one dimensional conduction without heat generation e.g. through plain walls, cylindrical and spherical surfaces, composite layers, etc. Insulation materials, critical and optimum insulation thickness. Extended surfaces, fins and their applications. Introduction to unsteady state heat transfer.

**UNIT II**

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. Determination of individual and overall heat transfer coefficients, heat transfer in molten metals.

**UNIT III**

Radiation: Basic laws of heat transfer by radiation, black body and gray body concepts, view factors, Kirchhoff's law, solar radiations, combined heat transfer coefficients by convection and radiation.

**UNIT IV**

Heat transfer with phase change: Condensation of pure vapors, film wise and drop wise condensation, loading in condensers and basic calculation on condensers. Heat transfer in boiling liquids, boiling heat transfer coefficients. Evaporation: Elementary principles, types of evaporators, Single and multiple effect evaporators and their calculations.

**UNIT V**

Heat transfer equipment: Classification, principles and design criteria, types of exchangers, viz. double pipe, shell and tube, extended surface. Furnaces and their classification and application.

**BOOKS :**


1. Holman, JP, "Heat Transfer", 9th ed. McGraw Hill (1989).
2. Coulson, JM & Richardson, JF, "Chemical Engineering: Vol-1", 6th ed. Butterworth-Heinemann
3. McAdams, W. H., "Heat Transmission", 3rd ed., McGraw-Hill (1954).
4. Kern, DQ, "Process Heat Transfer", McGraw Hill Book (1950).
5. Badger, WL & Bancharo, JT, "Introduction to Chemical Engineering", Tata McGraw Hill.

# *Department of Chemical Engineering*
# *(Faculty of Engineering & Technology)*
# *P.K. University, Shivpuri (MP)*
# *II Year Semester-IV*

## BTCH-404: MASS TRANSFER-I

**UNIT I**

**Diffusion:** Molecular and turbulent diffusion, diffusion coefficient, Fick's Law of diffusion, dependence of diffusion coefficient on temperature, pressure and composition; measurement and estimation of diffusivity. Diffusion in multi-component gas mixtures. Diffusion in Solids: Molecular, Knudsen &surface diffusion; Inter- phase mass transfer: Mass transfer coefficients, Diffusion between phases, Equilibrium solubility of gases in liquids, Mass transfer theories, Mass transfer in fluidized beds, Flow past solids and boundary layers, Simultaneous heat and mass transfer.

**UNIT II**

**Absorption and Stripping:** Equipments, Gas-liquid equilibria, Henry's law, Selection of solvent, Absorption in tray column, Graphical and analytical methods, Absorption in packed columns, HTU, NTU & HETP concepts, Design equations for packed column, Absorption with chemical reaction and mass transfer.

**UNIT III**

**Humidification and Dehumidification:** Vapour liquid equilibrium and enthalpy for a pure substance, vapour pressure temperature curve, Vapour gas mixtures, Definition and derivations of relationships related with humidity Fundamental concept of humidification, Dehumidification and water cooling, Wet bulb temperature, Adiabatic and non-adiabatic operations, Evaporative cooling ,Classification and design of cooling towers.

**UNIT IV**

**Drying:** Solid-gas equilibria, Different modes of drying operations, Definitions of moisture contents, Types of batch and continuous dryers, Rate of batch drying, Time of drying, Mechanism of batch drying, Continuous drying, Design of continuous dryers.

**UNIT V**

**Crystallisation:** Equilibrium yield of crystallization ,Heat and mass transfer rates in crystallization, Theories of crystallization, Factors governing nucleation and crystal growth rates, Controlled growth of crystal., Classification and design of crystallizers.

**Text Books**


1. Treybal, R "Mass Transfer Operations", 3rd ed. NewYork:McGraw-Hill, (1980).
2. Sherwood T. K., Pigford R. L. and _ilkeP. "Mass Transfer"McGrawHill (1975).


**Reference Books**


1. Foust, AS et.al., "Principles ofUnit Operations" John Wiley (1980).
2. Geankoplis, CJ, "Transport Processes and Unit Operations", 3rd ed. Prentice Hall.(1993)

*Department of Chemical Engineering*
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*II Year Semester-IV*

# BTCH-405: CHEMICAL ENGINEERING THERMODYNAMICS

**UNIT I**

Basic concept and definitions in thermodynamics, first, second and third laws of thermodynamics and it application in engineering problems, energy balance for open and closed systems. Entropy and entropy balance for open systems.

**UNIT II**

An Introduction to Vapour-Liquid Equilibria, qualitative behaviour of the vapour-liquid equilibria (VLE), Simple models for vapour liquid equilibria: Raoult's and Henry's laws, dew point and bubble point calculations, VLE by modified raoult's law and K-value correlations.

**UNIT III**

**Solution Thermodynamics:** Theory and Applications, fundamental property relation. The chemical potential and phase equilibria. Partial properties, equations relating molar and partial molar properties, partial properties in binary solutions, relations among partial properties, ideal gas mixtures, fugacity and fugacity coefficient for pure species, VLE for pure species, fugacity of a pure liquid, fugacity and fugacity coefficient for species in solution, the fundamental residual property relation, fugacity coefficients from the virial equation of state and generalized correlations, the ideal solution, the Lewis/Randall rule, excess properties. The excess Gibbs energy and the activity coefficient, nature of excess properties.

**UNIT IV**

**Chemical Reaction Equilibria:** The reaction coordinate. Multireaction stoichiometry. Application of equilibrium criteria to chemical reactions. The standard Gibbs energy change and equilibrium constant. Effect of temperature on the equilibrium constant. Evaluation of equilibrium constants. Relation of equilibrium constants to composition. Gas-phase and liquid-phase reactions. Equilibrium conversions for single reactions. Single phase reactions.

**UNIT V**

Topics in Phase Equilibria The gamma/phi formulation of VLE.VLE from cubic equations of state. Equilibrium and stability. Liquid-liquid equilibrium. Vapour-liquid-liquid equilibrium. Solid-liquid equilibrium. Osmotic equilibrium and osmotic pressure.

**BOOKS**


1. Cenjel Y.A. and Boles M.A.; Thermodynamics: An Engineering Approach
2. Smith, J. M.; Introduction to chemical engineering thermodynamics.

# *Department of Chemical Engineering*
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# *II Year Semester-IV*
# BTCH-406: UNIVERSAL HUMAN VALUES & PROFESSIONAL ETHICS

Human Values and Professional Ethics [L-T-P: 3-0-0]

Course Objectives
This introductory course input is intended

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings

2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way

3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature

Thus, this course is intended to provide a much needed orientational input in value education to the young enquiring minds.

**Course Methodology**

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. It is free from any dogma or value prescriptions.
3. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.
4. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.
5. This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs.

**Course Syllabus: Universal Human Values and Professional Ethics [L-T-P: 3-0-0]**

The whole course is divided into 5 modules.
After every two lectures of one hour each, there is a 2 hour practice session.
The teachers are oriented to the inputs through an eight to ten day workshop (Teachers' Orientation Program).
The Teacher's Manual provides them the lecture outline. The outline has also been elaborated into presentations and provided in a DVD with this book to facilitate sharing.
The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue. The process of dialogue is enriching for both, the teacher as well as the students. The syllabus for the lectures is given below:

**UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfill the above human aspirations: understanding and living in **harmony** at various levels

**UNIT 2: Understanding Harmony in the Human Being - Harmony in Myself!**

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' - *Sukh* and *Suvidha*
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: *Sanyam* and *Swasthya*; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure *Sanyam* and *Swasthya*

- Practice Exercises and Case Studies will be taken up in Practice Sessions.

**UNIT 3: Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship**

1. *Understanding Harmony in the family – the basic unit of human interaction*
2. Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*;
   Trust (*Vishwas)* and Respect (*Samman)* as the foundational values of relationship
3. Understanding the meaning of *Vishwas*; Difference between intention and competence
4. Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship
5. Understanding the harmony in the society (society being an extension of family): *Samadhan, Samridhi, Abhay, Sah-astitva* as comprehensive Human Goals
6. Visualizing a universal harmonious order in society- Undivided Society (*Akhand Samaj),* Universal Order (*Sarvabhaum Vyawastha )*- from family to world family!

- Practice Exercises and Case Studies will be taken up in Practice Sessions.

**UNIT 4: Understanding Harmony in the Nature and Existence - Whole existence as Co-existence**

7. Understanding the harmony in the Nature
8. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature
9. Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space
10. Holistic perception of harmony at all levels of existence

- Practice Exercises and Case Studies will be taken up in Practice Sessions.

**UNIT 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics**

11. Natural acceptance of human values
12. Definitiveness of Ethical Human Conduct
13. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
14. Competence in professional ethics:
    a) Ability to utilize the professional competence for augmenting universal human order
    b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,
    c) Ability to identify and develop appropriate technologies and management patterns for above production systems.
15. Case studies of typical holistic technologies, management models and production systems
16. Strategy for transition from the present state to Universal Human Order:
    a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers
    b) At the level of society: as mutually enriching institutions and organizations

**Guidelines and Content for Practice Sessions**

**UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**

**PS 1:** Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? How do you differentiate between right and wrong? What have been your achievements and shortcomings in your life? Observe and analyze them.

**Expected outcome:** the students start exploring themselves; get comfortable to each other and to the teacher and start finding the need and relevance for the course.

**PS 2:** Now-a-days, there is a lot of voice about many techno-genic maladies such as energy and natural resource depletion, environmental pollution, global warming, ozone depletion, deforestation, soil degradation, etc. – all these seem to be man-made problems threatening the survival of life on Earth – What is the root cause of these maladies & what is the way out in your opinion?

On the other hand, there is rapidly growing danger because of nuclear proliferation, arms race, terrorism, criminalization of politics, large scale corruption, scams, breakdown of relationships, generation gap, depression & suicidal attempts, etc – what do you think, is the root cause of these threats to human happiness and peace – what could be the way out in your opinion?

**Expected outcome:** the students start finding that technical education without study of human values can generate more problems than solutions. They also start feeling that lack of understanding of human values is the root cause of all problems and the sustained solution could emerge only through understanding of human values and value based living. Any solution brought out through fear, temptation or dogma will not be sustainable.

**PS 3:**

1. Observe that each one of us has Natural Acceptance, based on which one can verify right or not right for him. Verify this in case of

i) What is Naturally Acceptable to you in relationship- Feeling of respect or disrespect?

ii) What is Naturally Acceptable to you – to nurture or to exploit others? Is your living the same as your natural acceptance or different?

2. Out of the three basic requirements for fulfillment of your aspirations- right understanding, relationship and physical facilities, observe how the problems in your family are related to each. Also observe how much time & effort you devote for each in your daily routine.

**Expected outcome:**

1. The students are able to see that verification on the basis of natural acceptance and experiential validation through living is the only way to verify right or wrong, and referring to any external source like text or instrument or any other person cannot enable them to verify with authenticity; it will only develop assumptions.
2. The students are able to see that their practice in living is not in harmony with their natural acceptance most of the time, and all they need to do is to refer to their natural acceptance to remove this disharmony.
3. The students are able to see that lack of right understanding leading to lack of relationship is the major cause of problems in their family and not the lack of physical facilities in most of the cases, while they have given higher priority to earning of physical facilities in their life ignoring relationships and not being aware that right understanding is the most important requirement for any human being.

**UNIT 2: Understanding Harmony in the Human Being - Harmony in Myself!**

**PS 4:** List down all your desires. Observe whether the desire is related to Self (I) or Body. If it appears to be related to both, see which part of it is related to Self (I) and which part is related to Body.

**Expected outcome:** the students are able to see that they can enlist their desires and the desires are not vague. Also they are able to relate their desires to 'I' and 'Body' distinctly. If any desire appears related to both, they are able to see that the feeling is related to I while the physical facility is related to the body. They are also able to see that 'I' and 'Body' are two realities, and most of their desires are related to 'I' and not body, while their efforts are mostly centered on the fulfillment of the needs of the body assuming that it will meet the needs of 'I' too.

**PS 5:**

1. a. Observe that any physical facility you use, follows the given sequence with time :

Necessary & tasteful→ unnecessary & tasteful → unnecessary & tasteless → intolerable

b. In contrast, observe that any feeling in you is either naturally acceptable or not acceptable at all. If naturally acceptable, you want it continuously and if not acceptable, you do not want it any moment!

2. List down all your activities. Observe whether the activity is of 'I' or of Body or with the participation of both 'I' and Body.
3. Observe the activities within 'I'. Identify the object of your attention for different moments (over a period of say 5 to 10 minutes) and draw a line diagram connecting these points. Try to observe the link between any two nodes.

**Expected outcome:**

1. The students are able to see that all physical facilities they use are required for a limited time in a limited quantity. Also they are able to see that in case of feelings, they want continuity of the naturally acceptable feelings and they do not want feelings which are not naturally acceptable even for a single moment.
2. the students are able to see that activities like understanding, desire, thought and selection are the activities of 'I' only, the activities like breathing, palpitation of different parts of the body are fully the activities of the body with the acceptance of 'I' while the activities they do with their sense organs like hearing through ears, seeing through eyes, sensing through touch, tasting through tongue and smelling through nose or the activities they do with their work organs like hands, legs etc. are such activities that require the participation of both 'I' and body.
3. The students become aware of their activities of 'I' and start finding their focus of attention at different moments. Also they are able to see that most of their desires are coming from outside (through preconditioning or sensation) and are not based on their natural acceptance.

**PS 6:**

1. Chalk out programs to ensure that you are responsible to your body- for the nurturing, protection and right utilisation of the body.
2. Find out the plants and shrubs growing in and around your campus. Find out their use for curing different diseases.

**Expected outcome:** The students are able to list down activities related to proper upkeep of the body and practice them in their daily routine. They are also able to appreciate the plants wildly growing in and around the campus which can be beneficial in curing different diseases.

**UNIT 3: Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship**

**PS 7:** Form small groups in the class and in that group initiate dialogue and ask the eight questions related to trust. The eight questions are :

1a. Do I want to make myself happy? 2a. Do I want to make the other happy?
3a. Does the other want to make him happy?
4a. Does the other want to make me happy?

*What is the answer?*

Intention (Natural Acceptance)

1b. Am I able to make myself always happy?
2b. Am I able to make the other always happy?
3b. Is the other able to make him always happy?
4b. Is the other able to make me always happy?

*What is the answer?*

Competence

Let each student answer the questions for himself and everyone else. Discuss the difference between intention and competence. Observe whether you evaluate your intention & competence as well as the others' intention & competence.

**Expected outcome:** The students are able to see that the first four questions are related to our Natural Acceptance i.e. Intention and the next four to our Competence. They are able to note that the intention is always correct, only competence is lacking! We generally evaluate ourselves on the basis of our intention and others on the basis of their competence! We seldom look at our competence and others' intention as a result we conclude that I am a good person and other is a bad person.

**PS 8:**

1. Observe on how many occasions you are respecting your related ones (by doing the right evaluation) and on how many occasions you are disrespecting by way of under- evaluation, over-evaluation or otherwise evaluation.
2. Also observe whether your feeling of respect is based on treating the other as yourself or on differentiations based on body, physical facilities or beliefs.

**Expected outcome:** The students are able to see that respect is right evaluation, and only right evaluation leads to fulfillment in relationship. Many present problems in the society are an outcome of differentiation (lack of understanding of respect), like gender biasness, generation gap, caste conflicts, class struggle, dominations through power play, communal violence, clash of isms, and so on so forth. All these problems can be solved by realizing that the other is like me as he has the same natural acceptance, potential and program to ensure a happy and prosperous life for him and for others though he may have different body, physical facilities or beliefs.

**PS 9:**

1. Write a note in the form of story, poem, skit, essay, narration, dialogue to educate a child. Evaluate it in a group.
2. Develop three chapters to introduce 'social science- its need, scope and content' in the primary education of children

**Expected outcome:** The students are able to use their creativity for educating children. The students are able to see that they can play a role in providing value education for children. They are able to put in simple words the issues that are essential to understand for children and comprehensible to them. The students are able to develop an outline of holistic model for social science and compare it with the existing model.

**Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Co-existence**

**PS 10:** List down units (things) around you. Classify them in four orders. Observe and explain the mutual fulfillment of each unit with other orders.

**Expected outcome:** The students are able to differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them. They are also able to see that human beings are not fulfilling to other orders today and need to take appropriate steps to ensure right participation(in terms of nurturing, protection and right utilization) in the nature.

**PS 11:**

1. Make a chart for the whole existence. List down different courses of studies and relate them to different units or levels in the existence.
2. Choose any one subject being taught today. Evaluate it and suggest suitable modifications to make it appropriate and holistic.

**Expected outcome:** The students feel confident that they can understand the whole existence; nothing is a mystery in this existence. They are also able to see the interconnectedness in the nature, and point out how different courses of study relate to the different units and levels. Also they are able to make out how these courses can be made appropriate and holistic.

**UNIT 5: Implications of the above Holistic Understanding of Harmony at all Levels of Existence**

**PS 12:** Choose any two current problems of different kind in the society and suggest how they can be solved on the basis of natural acceptance of human values. Suggest steps you will take in present conditions.

**Expected outcome:** The students are able to present sustainable solutions to the problems in society and nature. They are also able to see that these solutions are practicable and draw roadmaps to achieve them.

**PS 13:**

1. Suggest ways in which you can use your knowledge of Technology/Engineering/ Management for universal human order, from your family to the world family.
2. Suggest one format of humanistic constitution at the level of nation from your side.

**Expected outcome:** The students are able to grasp the right utilization of their knowledge in their streams of Technology/Engineering/ Management to ensure mutually enriching and recyclable productions systems.

**PS 14:** The course is going to be over now. Evaluate your state before and after the course in terms of

a. Thought b. Behavior and c. Work d. Realization

Do you have any plan to participate in the transition of the society after graduating from the institute? Write a brief note on it.

**Expected outcome:** The students are able to sincerely evaluate the course and share with their friends. They are also able to suggest measures to make the course more effective and relevant. They are also able to make use of their understanding in the course for a happy and prosperous society.

## Reference Material:

The primary resource material for teaching this course consists of

a. The text book

R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

b. The teacher's manual

R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics – Teachers Manual, Excel books, New Delhi, 2010

c. A set of DVDs containing

- Video of Teachers' Orientation Program
- PPTs of Lectures and Practice Sessions
- Audio-visual material for use in the practice sessions

In addition, the following reference books may be found useful for supplementary reading in connection with different parts of the course:


1. B L Bajpai, 2004, *Indian Ethos and Modern Management*, New Royal Book Co., Lucknow. Reprinted 2008.
2. PL Dhar, RR Gaur, 1990, *Science and Humanism*, Commonwealth Purblishers.
3. Sussan George, 1976, *How the Other Half Dies,* Penguin Press. Reprinted 1986, 1991
4. Ivan Illich, 1974, *Energy & Equity,* The Trinity Press, Worcester, and HarperCollins, USA
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, limits to Growth, Club of Rome's Report, Universe Books.
6. Subhas Palekar, 2000, *How to practice Natural Farming,* Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
7. A Nagraj, 1998, *Jeevan Vidya ek Parichay,* Divya Path Sansthan, Amarkantak.
8. E.F. Schumacher, 1973, *Small is Beautiful: a study of economics as if people mattered*, Blond & Briggs, Britain.
9. A.N. Tripathy, 2003, *Human Values*, New Age International Publishers.


**Relevant websites, movies and documentaries**

1. Value Education websites, http://uhv.ac.in, *http://www.uptu.ac.in*
2. Story of Stuff, *http://www.storyofstuff.com*
3. Al Gore, *An Inconvenient Truth*, Paramount Classics, USA
4. Charlie Chaplin, *Modern Times*, United Artists, USA
5. IIT Delhi, *Modern Technology – the Untold Story*
6. *Gandhi A., Right Here Right Now, Cyclewala Productions*

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## *II Year Semester-IV*

### BTCH-403: HEAT TRANSFER LAB

1. To find out the thermal conductivity of liquids.
2. To find out the thermal conductivity of a metal rod.
3. Find out the Heat Transfer Coefficient during drop wise and film wise condensation.
4. Find out the Heat Transfer Coefficient in a vertical and a horizontal condenser.
5. To find out the emissivity of a surface.
6. To find out the overall thermal conductance and plot the temperature distribution in case of a composite wall.
7. To find out the average heat transfer co-efficient of vertical cylinder in natural convection.
8. To find out the Stefan Boltzman's constant and compare with the theoretical value.
9. To find out the relation between insulation thickness and heat loss.
10. To find out the overall heat transfer co-efficient of a double pipe heat exchanger.
11. To find out the overall heat transfer co-efficient of 1-2 shell & tube heat exchanger.
12. Study and operation of a long tube evaporator.

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### BTCH-404: MASS TRANSFER-I LAB

1. Study the performance and determination of Equilibrium relationships
2. Mass transfer coefficients
3. Diffusion coefficients
4. Separation factors of the experiments with differential distillation
5. Flash vaporization, vapor liquid equilibrium
6. Liquid-liquid extraction
7. Solid-liquid extraction

Ion exchange and membrane separation

### : SEMINAR

The purpose of this course is to prepare our students for better communication skill and discussions.

# *Faculty of Engineering & Technology*
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# *Shivpuri (MP)*

**Evaluation Scheme & Syllabus for**
**Department of Chemical Engineering**
**B.Tech. Third Year**
**(V & VI SEM)**

**(Effective from session 2019-20)**

**(Taken From Abdul Kalam Technical University- AKTU)**

## B.TECH.CHEMICAL ENGG. SEMESTER-V

| | | THEORY | | PRACTICAL | | TOTAL |
|---|---|---|---|---|---|---|
| **SUBJECT CODE** | **SUBJECT NAME** | SESS.(30) | EXT.(70) | SESS.(25) | EXT.(25) | |
| BTCH-501 | Managerial Economics | 30 | 70 | NA | NA | 100 |
| BTCH-502 | Chemical Reaction Engineering-I | 30 | 70 | 25 | 25 | 150 |
| BTCH-503 | Sociology | 30 | 70 | NA | NA | 100 |
| BTCH-504 | Mass Transfer-II | 30 | 70 | 25 | 25 | 150 |
| BTCH-505 | Chemical Technology | 30 | 70 | 25 | 25 | 150 |
| BTCH-506 | Computational Fluid Dynamics | 30 | 70 | NA | NA | 100 |
| | Soft Computing Lab | | | 25 | 25 | 150 |

## B.TECH.CHEMICAL ENGG. SEMESTER-VI

| | | THEORY | | PRACTICAL | | TOTAL |
|---|---|---|---|---|---|---|
| **SUBJECT CODE** | **SUBJECT NAME** | SESS.(30) | EXT.(70) | SESS.(25) | EXT.(25) | |
| BTCH-601 | Industrial Management | 30 | 70 | NA | NA | 100 |
| BTCH-602 | Transport Phenomena | 30 | 70 | NA | NA | 100 |
| BTCH-603 | Process Dynamics & Control | 30 | 70 | 25 | 25 | 150 |
| BTCH-604 | Chemical Reaction Engineering -II | 30 | 70 | 25 | 25 | 150 |
| BTCH-605 | Process Integration | 30 | 70 | NA | NA | 100 |

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## BTCH - 501: MANAGERIAL ECONOMICS

**L-T-P: 3-0-0**

| Unit | Topic | |
|---|---|---|
| I | **Introduction of Engineering Economics and Demand Analysis**: Meaning and nature of Economics, Relation between science, engineering, technology and economics; Meaning of Demand, Determinants of Demand, Shifts in demand, Law of Demand, Price Elasticity of Demand &Types, Income Elasticity, Cross price Elasticity, Determinants of Elasticity, uses and importance of elasticity. | **06** |
| **II** | **Concept of Supply**: Law of Supply, Factors affecting Supply, Elasticity of supply. **Demand Forecasting**: Introduction, Meaning and Forecasting, Methods or Techniques of Demand Forecasting, Criteria for Good Demand Forecasting, Demand Forecasting for a New Product; | **06** |
| **III** | **Cost Analysis**- Introduction, Types of Costs, Cost-Output Relationship: Cost Function, Cost-Output Relationships in the Short Run, and Cost-Output Relationships in the Long Run; Short run and long run, Break- Even Analysis; Production functions: laws of variable proportions, law of returns; Economies of scale: Internal and external. | **06** |
| **IV** | Market Structure: Market Structure Perfect Competition, Imperfect competition – Monopolistic, Oligopoly, duopoly sorbent features of price determination and various market conditions. | **06** |
| **V** | Nature and characteristics of Indian economy, concepts of LPG, elementary concepts of National Income, Inflation and Business Cycles ,Concept of N.I. and Measurement., Meaning of Inflation, Types and causes , Phases of business cycle .Investment decisions for boosting economy(National income and per capital income) | **06** |

**References:**


1. Premvir Kapoor, Sociology and Economics for Engineers, Khanna Publishing House (Edition 2018)
2. Salvatore D, "Principles of Microeconomics", Oxford University Press.
3. Koutsoyiannis A, "Modern Microeconomic", Macmillan Education Ltd.
4. Dwivedi DN, "Principles of Microeconomics", Pearson Education.
5. Cowell, FA, "Microeconomic Principles and Analysis", Oxford University Press.

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*III Year Semester-V*

# BTCH-502: CHEMICAL REACTION ENGINEERING-I

**UNIT 1**

Rate of Reaction, Elementary and non-elementary homogeneous reactions, Molecularity and order of reaction, Mechanism of reaction, temperature dependency from thermodynamics, collision and activated complex theories. Integral and differential methods for analyzing kinetic data, interpretation of constant volume reactor, zero, first, second and third order reactions, half life period, irreversible reaction in parallel and series, catalytic reaction, auto catalytic reaction, reversible reactions.

**UNIT 2**

Interpretation of variable volume batch reactions for zero, first and second order reactions, design equation for batch, continuous stirred tank, plug flow reactors for isothermal reaction.

**UNIT 3**

Optimum reactor size, plug flow/mixed flow reactors in series and parallel, recycle reactor.

**UNIT 4**

Design of reactors for multiple reactions, parallel and series reactions. Temperature and pressure effects for single reaction.

**UNIT 5**

Residence time distribution of fluids in vessels, E, F and C curves, Dispersion model, Tank in series model. Non Isothermal PFR and CSTR, Safety issues in Non Isothermal Reactors.

**Text Books:**


1. Smith, J, M, "Chemical Engineering Kinetics", 3rd Edition, McGraw-Hill (1990).
2. Levenspiel, O., "Chemical Reaction Engineering", 3rd Edition, John Wiley (1998).
3. Fogler, H.S., 2016. Elements of chemical reaction engineering.


**Reference Book:**


1. Keith J. Laidler, "Chemical Kinetics" 3rd Edition, Pearson (2013)

# *Department of Chemical Engineering*
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# *P.K. University, Shivpuri (MP)*
# *III Year Semester-V*

## BTCH-503: SOCIOLOGY

**L-T-P: 3-0-0**

| Unit | Topic | |
|---|---|---|
| I | Industrial Sociology: Nature, Scope and Importance of Industrial Sociology. Social Relations in Industry, Social Organisation in Industry- Bureaucracy, Scientific Management and Human Relations. | **06** |
| **II** | Rise and Development of Industry: Early Industrialism – Types of Productive Systems – The Manorial or Feudal system. The Guild system, The domestic or putting-out system, and the Factory system. Characteristics of the factory system. Causes and Consequences of industrialization. Obstacles to and Limitations of Industrialization. | **06** |
| **III** | Industrialization in India. Industrial Policy Resolutions – 1956.Science. Technology and Innovation Policy of India 2013. | **06** |
| **IV** | Contemporary Issues: Grievances and Grievance handling Procedure. Industrial Disputes: causes, Strikes and Lockouts. Preventive Machinery of Industrial Disputes: Schemes of Workers Participation in Management- Works Committee, Collective Bargaining, Bi-partite & Tri-partite Agreement, Code of Discipline, Standing Orders. Labour courts & Industrial Tribunals. | **06** |
| **V** | Visualizing the future: Models of industrialization- Collectivist, anarchist, free market, environmentalist, etc. Cultural issues, consumer society and sociological concerns. | **06** |

# *Department of Chemical Engineering*
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# *III Year Semester-V*

## BTCH-504: MASS TRANSFER– II

**UNIT 1**

**Distillation:** Basic fundamentals of distillation, Pressure-composition, Temperature-concentration, Enthalpy- concentration diagrams for ideal and non-ideal solutions, Raoult's law and its application, Maximum and minimum boiling mixtures, concept of relative volatility, Single Stage Distillation Differential distillation, Flash vaporization, Vacuum, molecular and steam distillation.

**UNIT 2**

**Continuous Distillation of Binary Mixtures :** Multistage contact operations, Characteristics of multistage tower, McCabe Thiele method, Ponchon Savarit method, Reflux, maximum, minimum and optimum reflux, Use of open steam, Tray efficiency, Determination of height and column diameter, Multistage batch distillation; Principles of azeotropic and extractive distillation, Introduction & Design of multicomponent distillation system.

**UNIT 3**

**Liquid-Liquid Extraction:** Ternary liquid equilibria, Triangular graphical representation concept of theoretical or ideal stage, Equipment used for single stage and multistage continuous operation; Analytical and graphical solution of single and multistage operation Super critical fluid extraction.

**UNIT 4**

**Solid /Liquid Extraction:** Leaching, Solid liquid equilibrium, Equipment used in solid – liquid extraction, Single and multistage cross current contact and counter current operations. Concept of an ideal stage, Overall stage efficiency, Determination of number of stages.

**UNIT 5**

**Adsorption:** Description of adsorption processes and their application, Types of adsorption, Nature of adsorbents adsorption equilibria and adsorption hysteresis, Stage wise and continuous

contact adsorption operations, Determination of number of stages, Ion exchange Equipments, Equilibrium relationship, Principle, techniques and applications of Ion-exchange, , Principles and application of Dialysis, Osmosis, Reverse osmosis, Thermal diffusion, Sweep diffusion.

**Text Books:**


1. Treybal, R "Mass Transfer Operations", 3rd Editon, New York: McGraw-Hill, (1980).
2. Sherwood T. K., Pigford R. L. and Wilke P. "Mass Transfer" McGraw Hill (1975)


**Reference Books:**


1. Foust A. S. et.al., "Principles of Unit Operations" John Wiley (1980).
2. Geankoplis, C.J.. "Transport Processes and Unit Operations", 3rd Editon, Prentice Hall. (1993)

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# *III Year Semester-V*

## BTCH-505: CHEMICAL TECHNOLOGY

Introduction of CPT with reference to Indian resources, industries, trade and export potential, small scale industries and rural development. Preparation of process flow diagrams, Instrumentation diagrams and Process symbols. ; Introduction to the following industries lying emphasis on process flow sheet, material requirements, process conditions, material of construction and design aspects.

**UNIT 1**

Introduction - Mono and Disaccharides - Important reactions - Polysaccharides - Starch and Cellulose - Derivatives of Cellulose - Carboxy Methyl Cellulose and gun cotton - Structural aspects of cellulose.

**UNIT 2**

Sugar, Glucose, Starch, Fermentation products such as Alcohol,
Acetic acid, Citric acid and antibiotics

**UNIT 3**

Soap and Surfactants, Glycerin, Fatty acids, Hydrogenation of edible oils, paper and pulp

**UNIT 4**

Synthetic and natural fibers: Nylon, Dacron, Terylyne, Polyester and other new products, Viscose rayon, acetate rayon , synthetic rubber with special reference to manufacture, vulcanization and reclaiming of rubber, SBR, Plastics, Thermosetting and Thermo Plastics (PVC, Polyethylene, Polyurethane, Teflon )

**UNIT 5**

Crude oil distillation, Thermal conversion processes (visbreaking, coking), Catalytic conversion processes (fluid catalytic cracking, catalytic reforming, hydro cracking, alkylation, isomerisation, polymerization) Finishing processes, sulphur removal process, lub oil manufacture; Petrochemicals (ethylene, propylene, formaldehyde, methanol, ethylene oxide, ethanolamine, cumene, ethylene glycol, ethyl benzene)

**Text Books:**


1. Dryden, C. E. “Outlines of Chemical Technology” (Edited and Revised by M. Gopala Rao and M. Sittig) East West Press. Pvt. Ltd, New Delhi, 3rd Edition (1997).
2. Austin G. T. Shreve’s Chemical Process Industries”, 5th Edition, McGraw Hill (1984).
3. O P Gupta, "Chemical Process Technology", Khanna Publishing House.

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*III Year Semester-V*

## BTCH -506: COMPUTATIONAL FLUID DYNAMICS

**UNIT 1**

**Basic Concepts of Fluid Flow:** Philosophy of computational fluid dynamics, conservation principles of mass, energy, and momentum, simplified flow models such as incompressible, inviscid, potential and creeping flows, classification of flows.

**UNIT 2**

**Turbulence and its Modelling:** Transition from laminar to turbulent flow, Effect of turbulence on time- averaged Navier-Stokes equations, Characteristics of simple turbulent flows, Free turbulent flows, Flat plate boundary layer and pipe flow, Turbulence models, Mixing length model, The k-e model, Reynolds stress equation models, Algebraic stress equation models.

**UNIT 3**

**Grid Generation:** Structured and unstructured grids, choice of grid, general transformation of equations, some modern developments in grid generation in solving the engineering problems.

**Finite Difference Method:** Discretization of ordinary and partial differential equations, approximation of first, second and mixed derivatives, implementation of boundary conditions, discretization errors, applications to the engineering problems.

**UNIT 4**

**Finite Volume Method:** Discretisation methods, approximations of surface integrals and volume integrals, interpolation and differentiation practices, implementation of boundary conditions, applications to the engineering problems. Introduction, one-dimensional steady state diffusion, two-dimensional diffusion problems, three-dimensional diffusion problems. The Finite Volume Method for Unsteady Flows and Implementation of Boundary Conditions: On e-dimensional unsteady heat conduction .

**UNIT 5**

**Special Topics:** Flow in a sudden pipe contraction / expansion, flow and heat transfer in a complex tubes and channels, reactive flow, multiphase flow, and turbulent flow processes.

**Books:**


1. Sengupta T. K., "Fundamentals of Computational Fluid Dynamics", University Press. 2013
2. Anderson Jr J. D., "Computational Fluid Dynamics: The Basics with Applications", McGraw Hill. 1995
3. Muralidhar K. and Sundararajan T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House. 2003

## *Department of Chemical Engineering*
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## *III Year Semester-V*

### BTCH-502: CHEMICAL REACTION ENGG LAB

1. Find out kinetic constant and study conversion of a given reaction in a batch reactor
2. Find out kinetic constant and study conversion of a given reaction in a plug flow reactor
3. Find out kinetic constant and study conversion of a given reaction in a CSTR
4. Study and operation of an adiabatic batch reactor
5. Study of a reversible reaction in a batch reactor
6. To determine energy of activation of reaction of ethyl acetate with sodium hydroxide
7. Find out specific rate contant and activation energy of a reaction in a plug flow reactor
8. To determine reaction equilibrium constant of reaction of acetic acid with ethanol.
9. To determine changes in free energy, enthalpy and entropy for the reaction of potassium iodide with iodine.
10. Study and operation of a cascade CSTR

The reaction of disappearance of phenolphthalein in NaOH solutions may be used for experiments 1,


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## *III Year Semester-V*


### BTCH-504: MASS TRANSFER LAB - II

1. Determination of ternary curve for the system acetic acid-water-carbon tetrachloride.
2. Determination of distribution coefficient of a solute in two immiscible liquids.
3. Solid-Liquid extraction – Soxhlet's experiment.
4. Liquid - liquid extraction in packed bed.
5. Determination of adsorption kinetics and isotherm at solid-liquid interface.
6. Determination of the rate of drying in a tray dryer.
7. Estimation of efficiency of the fluidized bed dryer

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## BTCH-505: CHEMICAL TECHNOLOGY LAB

Preparation and Quality evaluation of following items:-

1. Cement Paint
2. Dry Distemper
3. Oil bound Distemper
4. Plastic Emulsion Paint
5. Polystyrene by Bulk Polymerization Technique
6. PMMA by Bulk Polymerization Technique
7. Transparent Soaps
8. Powdered Detergent
9. Liquid Detergent

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*III Year Semester-V*

## BTCH 506: COMPUTATIONAL FLUID DYNAMICS (3:1:0)


1.
Ferziger J. H. and Peric M., "Computational Methods for Fluid Dynamics", 3rd Ed., Springer. 2002
2.
Ranade V. V, "Computation Flow Modeling for Chemical Reactor Engineering", Academic Press. 2002

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*III Year Semester-V*

## BTCH-507: SOFT COMPUTING LAB

Use of following Techniques in C/C++ Language

1. Solution of single non-linear algebraic equations by Newton Raphson method.
2. Solution of single non-linear equations by Regulafalsi method.
3. Solution of system of linear simultaneous by Gauss Elimination method.
4. Solution of system of linear simultaneous equation by gauss seidel method and successive over relaxation method.
5. Solution of single first order ordinary differential equations by fourth order Runge-Kutta method.
6. Solution of Heat equations (Parabolic equations) by finite difference method.
7. Solution of Laplace equations (elliptic equation) by finite difference method.
8. Solution of wave equations (Hyperbolic equation) by finite difference method.
9. Finding Newton's interpolatory polynomial for n points.
10. Finding Newton's interpolatory polynomial based on finite difference table for n points.
11. Simpson's 3/8-rule.

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## *III Year Semester-VI*
## BTEE – 601: INDUSTRIAL MANAGEMENT

**L-T-P: 3-0-0**

| Unit | Topic | |
|---|---|---|
| **I** | **Introduction:** Concept and scope of Industrial Management. Productivity: Definition, measurement, productivity index, types of production system, Industrial Ownership. | **06** |
| **II** | **Functions of Management,** Taylor's Scientific Management Theory, Fayol's Principles of Management, Social responsibilities of Management,<br>Introduction to Human resources management: Nature of HRM, functions and importance of HRM. | **06** |
| **III** | **Work Study:** Introduction, definition, objectives, steps in work study, Method study: definition, objectives, steps of method study, Work Measurement: purpose, types of study — stop watch methods — steps — allowances — standard time calculations — work sampling, Production Planning and Control<br>Inventory Control: Inventory, Cost, Models of inventory control: EOQ, ABC, VED | **06** |
| **IV** | **Quality Control**: statistical quality control, Control charts for variables and attributes, Acceptance Sampling- Single sampling- Double sampling plans, Introduction to TQM. | **06** |
| **V** | **Project Management**: Project network analysis, CPM, PERT and Project crashing and resource Leveling | **06** |

**References:**


1. Engineering Management (Industrial Engineering & Management)/ S.C. Sharma & T.R. Banga, Khanna Book Publishing Co. (P) Ltd., Delhi (ISBN: 978-93-86173-072)
2. Industrial Engineering and Management/ P. Khanna, Dhanpatrai publications Ltd.
3. Production & Operation Management /PaneerSelvam /PHI.
4. Industrial Engineering Management/NVS Raju/Cengage Learning.
5. Industrial Engineering Management I RaviShankar/ Galgotia.

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# *III Year Semester-VI*

## BTCH-602: TRANSPORT PHENOMENA

**UNIT 1**

Vectors/Tensors, Newton's law of viscosity, Temperature, pressure and composition dependence of viscosity, Kinetic theory of viscosity, Fourier's law of heat conduction, Temperature, pressure and composition dependence of thermal conductivity, Kinetic theory of thermal conductivity, Fick's law of diffusion, Temperature, pressure and composition dependence of diffusivity, Kinetic theory of diffusivity.

**UNIT 2**

Shell Momentum balances, velocity profiles, average velocity, momentum flux at the surfaces, Equations of Change (Isothermal), equation of continuity, equation of motion, equation of energy (isothermal).

**UNIT 3**

Shell energy balances, temperature profiles, average temperature, energy fluxes at surfaces, Equations of change (non-isothermal), equation of continuity, equation of motion for forced and free convection, equation of energy (non-isothermal).

**UNIT 4**

Shell mass balances, concentration profiles, average concentration, mass flux at surfaces, Equations of change (multi-component), equations of continuity for each species, equation of energy (multi-component).

**UNIT 5**

Introduction to the concept of heat and mass transfer coefficients. Interphase mass transfer, various coefficient of mass transfer and their determination, resistance concept, controlling phase concept, Mass transfer in turbulent flow, Analogies of mass transfer, Empirical equations. Theories of mass transfer, two film theory, Higbies penetration theory, Derivation of flux equation, surface renewal theory.

**Text Book:**

1. Byron, R. B., Stewart, W. E., Lightfoot, E. N., "Transport Phenomena", John Wiley & Sons, 1960.

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# *III Year Semester-VI*

## BTCH-603: PROCESS DYNAMICS & CONTROL

**UNIT 1**

Dynamic modeling of first and second-order process; Interacting and non-interacting processes; Nonlinear and integrating processes; introduction to non-minimum phase processes; Distributed parameter processes and MIMO processes; Response of first and second order processes with respect to different types of forcing functions.

**UNIT 2**

Experimental estimation of dynamic process parameters and identification. Modes of control action: Classification of controllers and control strategy.

**UNIT 3**

Closed loop feedback control: Servo and regulator problems; Offset; Selection of mode of control action; Closed loop response;

**UNIT 4**

Routh stability criterion; Controller tuning and design:, Online tuning- closed loop and open loop methods. Frequency response technique: Phase margin and gain margin; Bode stability criterion; Nyquist stability criterion; Controller design. Root locus plot and stability analysis.

**UNIT 5**

Cascade and feed forward control: Design of controller and analysis of control system. Ratio, Adaptive, Model-based, Multivariable, Selective and Split range control. Computer process control

**Text Book:**


1. Coughnaowr, D. R., “Process Systems Analysis and Control”, McGraw-Hill, Inc.
2. Stephanopolous, G., “Chemical Process Control”, Prentice-Hall.


**Reference Books:**


1. Seborg, D. E., Edgar, T., and Mellichamp, D. A., “Process Dynamics and Control”, John Wiley and Sons.
2. Bequette, B. W., “Process Control: Modeling, Design, and Simulation”, Prentice-Hall, Inc.
3. Chidambaram, M., “Computer Control of Processes” Narosa Publishing House Pvt. Ltd., Ind.
4. D.C. Sikdar, " Instrumentation and Process Control", Khanna Book Publishing

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# *III Year Semester-VI*

## BTCH-604: CHEMICAL REACTION ENGINEERING -II

**UNIT 1**

Introduction to heterogeneous reactions, rate equation for surface kinetics, pore diffusion resistance combined with surface kinetics, Fluid-fluid reactions: kinetics and design.

**UNIT 2**

Fluid-solid reactions, experimental methods for finding rates, selection of a model, shrinking-core model for spherical particles of unchanging size, rate of reaction for shrinking spherical particles, determination of rate controlling step, kinetic and design, Design of packed bed and fluidized bed reactors.

**UNIT 3**

Nature of catalysis, Determination of surface area, void volume and solid density, pore-volume distribution, physical and chemical adsorption, adsorption isotherms, Physical properties of catalysts, preparation, testing and characterization of solid catalysts, catalyst selection, catalyst preparation, promoters and inhibitors, catalyst poisoning and mechanisms of catalytic reactions, catalyst deactivation.

**UNIT 4**

Reaction and diffusion within porous catalysts, effectiveness factor, various resistances to transfer of reactants to the catalyst site, intrinsic and global rate of reaction, kinetic regimes, heat effects during reaction, Performance equations for reactors containing porus catalyst particles, design of solid catalytic reactors.

**UNIT 5**

Biochemical reactors, polymerization reactors.

**Books:**

1. Smith, J, M, “Chemical Engineering Kinetics”, 3rd Edition, McGraw-Hill (1990).
2. Levenspiel, O., “Chemical Reaction Engineering”, 3rd Edition, John Wiley, (1998).

Reference Books:

1. Daizo Kunii & Octave Levenspiel, “Fluidization Engineering” 2nd Edition, Elsevier (India Print 2005)
2. Coulson and Richardson's Chemical Engineering Volume 3 - Chemical and Biochemical Reactors and Process Control (3rd Edition)

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*III Year Semester-VI*

# BTCH-605: PROCESS INTEGRATION

**UNIT 1**

Process Integration and its Building Blocks: Definition of Process Integration (PI), Areas of application and Techniques available for Process Integration, Role of thermodynamic laws.

**UNIT 2**

Basic Elements of Pinch Technology: Data extraction, Targeting, Designing,Grid diagram, Composite curve, Problem table algorithm, Grand composite curve.

**UNIT 3**

Targeting of Heat Exchanger Network (HEN): Energy targeting, Area targeting, Number of units targeting, Shell targeting, cost targeting.

**UNIT 4**

Designing of HEN: Pinch design methods, Heuristic rules, Stream splitting, Design of maximum energy recovery (MER), Design of multiple utilities and pinches.

**UNIT 5**

Heat Integration of Equipments: Heat engine, Heat pump, Distillation column, Reactor, Evaporator, Drier, Refrigeration systems.

**Books:**


1. Linnhoff, B. Townsend D.W., Boland D., Hewitt G.F., Thomas, B.E.A., Guy, A. R. and Marsland, R. H., "A User's guide on process integration for the efficient use of energy", Inst. of Chemical Engineers, London (1982).
2. V. Uday Sheno, Heat Exchanger network synthesis, Gulf Publishing Co, USA, 1995
3. James M. Douglas Conceptual Design of Chemical Process, McGraw Hill, New York, 1988.
4. Smith, R., "Chemical Process Design", McGraw Hill (1995).

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*III Year Semester-VI*

## BTCH-603: PROCESS DYNAMICS & CONTROL LAB-I

1. Transient response to single tank system with storage & Flow to (a) step change (b) impulse change in put.
2. Transient response of non-interacting system in series.
3. Transient response of interacting system in series.
4. Study the operation of ON-OFF electronic temperature controller & determination of its performance to control the temperature of a system having capacity to store thermal energy.
5. Study the principle of operation & working of pneumatic servo system with various input functions.
6. Transient response of a CSTR System to step change.
7. Controlling a batch reactor using digital PID controller.
8. Study the dynamics of parallel & counter flow shell & tube heat exchanger.
9. Controlling of Parallel Flow & counter flow STHE using digital PI controller to have desired output.
10. Dynamics characteristics of mercury & water manometers.
11. Study of control value characteristics.

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*III Year Semester-VI*

## BTCH-604: CHEMICAL REACTION ENGINEERING LAB-II

1. Study and operation Trickle bed reactor
2. Study and operation Condensation polymerization reactor
3. Study and operation Emulsion polymerization reactor
4. RTD study in a CSTR
5. RTD study in a plug flow reactor
6. Study and operation of a coiled tubular reactor
7. Study of heterogeneous catalytic reactor
8. Determination of porosity and pore volume of a substance. (kieselguhr, alkaline earth or alumina may be used as substance)
9. To study toluene hydrogenation over Raney nickel catalyst
10. To study acetaldehyde decomposition over copper gauze catalyst

# *Faculty of Engineering & Technology*
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**Evaluation Scheme & Syllabus for**
**Department of Chemical Engineering**
**B.Tech. Fourth Year**
**(VII & VIII SEM)**

**(Effective from session 2019-20)**

**(Taken From Abdul Kalam Technical University- AKTU)**

## B.TECH.CHEMICAL ENGG. SEMESTER-VII

| | | THEORY | | PRACTICAL | | TOTAL |
|---|---|---|---|---|---|---|
| **SUBJECT CODE** | **SUBJECT NAME** | SESS.(30) | EXT.(70) | SESS.(25) | EXT.(25) | |
| BTCH-701 | Entrepreneurship Development | 30 | 70 | NA | NA | 100 |
| BTCH-702 | Petrochemical Technology | 30 | 70 | NA | NA | 100 |
| BTCH-703 | Process Equipment Design | 30 | 70 | NA | NA | 100 |
| BTCH-704 | Energy Technology | 30 | 70 | 25 | 25 | 150 |
| BTCH-705 | Fertilizer Technology | 30 | 70 | NA | NA | 100 |
| | Industrial Training | NA | NA | 25 | 25 | 50 |
| | Mini Project | NA | NA | 25 | 25 | 50 |

## B.TECH.CHEMICAL ENGG. SEMESTER-VIII

| | | THEORY | | PRACTICAL | | TOTAL |
|---|---|---|---|---|---|---|
| **SUBJECT CODE** | **SUBJECT NAME** | SESS.(30) | EXT.(70) | SESS.(25) | EXT.(25) | |
| BTCH-801 | Non-Conventional Energy Resources | 30 | 70 | NA | NA | 100 |
| BTCH-802 | Plant Design & Project Engineering | 30 | 70 | NA | NA | 100 |
| BTCH-803 | Process Utility & Safety In Chemical Plant | 30 | 70 | NA | NA | 100 |
| BTCH-804 | Petroleum Engineering | 30 | 70 | NA | NA | 100 |
| | Project | NA | NA | 25 | 25 | 50 |
| | Seminar | NA | NA | 25 | 25 | 50 |

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# *IV Year Semester-VII*
## BTCH-701: ENTREPRENEURSHIP DEVELOPMENT

**L T P**
**3 1 0**

**UNIT -I**

**Entrepreneurship-** definition. growth of small scale industries in developing countries and their positions vis-a-vis large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries and sub-control types. Government policy for small scale industry; stages in starting a small scale industry.

**UNIT -II**

**Project identification**- assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, benefit cost analysis, discounted cash flow, internal rate of return and net present value methods.

**UNIT -III**

**Accountancy**- Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, quality control, marketing, industrial relations, sales and purchases, advertisement, wages and incentive, inventory control, preparation of
financial reports, accounts and stores studies.

**UNIT -IV**

**Project Planning and control:**

The financial functions, cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. profit planning and programming, planning cash flow, capital expenditure and operations. control of financial flows, control and communication.

**UNIT -V**

Laws concerning entrepreneur viz, partnership laws, business ownership, sales and income taxes and workman compensation act. Role of various national and state agencies which render assistance to small scale industries.

**Text / Reference Books:**


1. Forbat, John, “Entrepreneurship” New Age International.
2. Havinal, Veerbhadrappa, “Management and Entrepreneurship” New Age International
3. Joseph, L. Massod, “Essential of Management", Prentice Hall of India.

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*IV Year Semester-VII*

# BTCH-702: PETROCHEMICAL TECHNOLOGY

**Unit 1**
Production and consumption pattern of petrochemicals in India, Feedstocks for petrochemicals-Natural gas, LPG, Refinery off-gases, Hydroforming of petroleum stocks, Naphtha and fuel oils, Petroleum coke

**Unit 2**
Steam reforming and partial oxidation processes for syngas, Manufacture of Methanol, Formaldehyde, Chloromethanes, Trichloroethylene, Perchloroethylene, Acetic acid, adipic acid

**Unit 3**
Ethylene and acetylene via steam cracking of hydrocarbons, Manufacture of Ethylene dichloride, Vinyl chloride, Ethylene oxide, Ethanolamines, Acetaldehyde, Vinyl acetate, Ethyl acetate, Ethylene glycol

**Unit 4**
Manufacture of Isopropanol, Acetone, Methyl ethyl ketone, Methyl isobutyl ketone, Cumene, Acrylonitrile, Propylene oxide, Butadiene, Oxo process

**Unit 5**
Manufacture of Benzene, Toluene, Xylenes, Phenol, Styrene, Phthalic anhydride, Maleic anhydride, Nitrobenzene, Aniline, Bisphenol-A, Caprolactum

**Books Recommended:**


1. Mall, I D, Petrochemical Process Technology, McMillan India
2. Rao Bhaskar, Modern Petroleum Refining Processes, Oxford & IBH Publishing
3. Speight J., Chemistry & Technology
4. Robert Mayer, Handbook of Petroleum Refining Processing, McGraw Hill

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*IV Year Semester-VII*

## BTCH-703: PROCESS EQUIPMENT DESIGN

**UNIT-I**

Introduction , Basic design procedure and theory , Heat exchanger analysis: the effectiveness NTU method , Overallheat-transfer coefficient , Fouling factors (dirt factors) ,Shell and tube exchangers: construction details , Heat exchangerstandards and codes ,Tubes , Shells , Tube-sheet layout (tube count) ,Shell types (passes) , Shell and tubedesignation ,Baffles , Support plates and tie rods , Tube sheets (plates) ,Shell and header nozzles (branches) ,Flow inducedtube vibrations ,Mean temperature difference (temperature driving force) , Shell and tube exchangers:general design considerations , Fluid allocation: shell or tubes ,Shell and tube fluid velocities ,Stream temperatures , Pressure drop ,Fluid physical properties ,Tube-side heat-transfer coefficient and pressure drop (single phase) ,Heat transfer , Tube-side pressure drop ,Shell-side heat-transfer and pressure drop (single phase) ,Flow

pattern , Design methods ,Kern's method ,Bell's method , Shell and bundle geometry ,Effect of fouling on pressure drop , Pressure droplimitations.

**UNIT –II**

Condensers ,Heat-transfer fundamentals , Condensation outside horizontal tubes ,Condensation inside and outside vertical tubes , Condensation inside horizontal tubes , Condensation of steam , Mean temperature difference , Desuperheating and sub-cooling Condensation of mixtures Pressure drop in condensers , Design of forced circulation reboilers , Design of thermosyphon reboilers ,Design of kettle reboilers , Heat transfer to vessels Jacketed vessels , Internal coils , Agitated vessels .

**UNIT –III**

Design methods for binary distillation systems , Basic equations , McCabe-Thiele method ,Low product concentrations , The Smoker equations ,Batch distillation , Steam distillation, Plate efficiency, Prediction of plate efficiency :O'Connell's correlation , Van Winkle's correlation , AIChE method , Entrainment , Approximate column sizing , Plate contactors , Selection of plate type , Plate construction , Plate hydraulic design,Plate-design procedure, Plate areas ,Diameter , Liquid-flow arrangement ,Entrainment ,Weep point , Weir liquid crest , Weir dimensions , Perforated area , Hole

size , Hole pitch ,Hydraulic gradient ,Liquid throw , Plate pressure drop , Downcomer design

**UNIT–IV**

Design of packed columns for absorption/stripping, Types of packing, Packed-bed height- Prediction of the height of a transfer unit (HTU), Prediction of the number of transfer units (NTU), Column diameter (capacity) , Column internals , Wetting rates , Column auxiliaries

**UNIT –V**

Analysis of Cost Estimates: Factors affecting investment and production costs, Capital investment, Types of capital cost estimates, Methods for estimating capital investment, Estimation of Revenue, Estimation of total product cost, Gross Profit, Net Profit and Cash flow Simple and Compound interest, Loan Payments, Cash flow pattern –Discrete cash flow & Continuous cash flow, Profitability, Alternative investments by different profitability methods, Effect of inflation on profitability analysis, Methods of profitability evaluation for replacements. Depreciation: Straight line, Declining balance, Double declining balance, sum-of-the-digit, Sinking-fund, Accelerated cost recovery system, Modified accelerated cost recovery system.

BOOKS:

1. Towler G. and Sinnott R. K., "Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design", Butterworth-Heinemann.2008
2. Seader J. D. and Henley E. J., "Separation Process Principles", 2nd Ed., Wiley-India.2006
3. I.S.: 4503-1967, "Indian Standard Specification for Shell and Tube Type Heat Exchangers", Bureau of Indian Standards.2007
4. Hewitt G. F., Shires G. L. and Bott T. R., "Process Heat Transfer", CRC Press.1994
5. Serth R.W., "Process Heat Transfer: Principles and Applications", Academic Press.2007
6. Coker A. K., "Ludwig's Applied Process Design for Chemical and Petrochemical Plants", Vol. 1, 4th Ed., Gulf Publishers.2007
7. Ludwig E. E., "Applied Process Design for Chemical and Petrochemical Plants", Vol. 2, 3rd Ed., Gulf Publishers.1997
8. Ludwig E. E., "Applied Process Design for Chemical and Petrochemical Plants", Vol. 3, 3rd Ed., Gulf Publishers.
9. Peters M. S. and Timmerhaus K. D., "Plant Design And Economics For Chemical Engineers", 5th Ed., McGraw Hill, International Ed.2004

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## BTCH-704: ENERGY TECHNOLOGY

**UNIT-I:** Introduction: Conventional (fossil energy) and non-conventional (alternative energy) resources &reserves. Global Energy production & consumption pattern. Production &consumption pattern in India. Solid Fuels: Biomass, Wood and Charcoal. Classification & Rank of Coal, Peat ,Lignite, Sub-Bituminous coal, Bituminous coal, Anthracite coal, Cannel &Bog head coal. Physical Properties of coal, Proximate & Ultimate Analysis of Coal, Cleaning, washing & Storage of coal. Theory of coal Pyrolysis and Carbonization: Low Temperature Carbonization(LTC),HighTemperatureCarbonization(HTC),Horizontal & VerticalGas Retorts, Coke Ovens-Beehive& Byproduct Slot type. Recovery of byproducts. Details of Structural configuration and Operating principles.

**UNIT –II:**10L Liquid Fuels: Constitution of petroleum, theory of formation of crude petroleum oil.Characterization of crude oil & petroleum fuels. Operation and flow-sheet of crude distillation plant. Thermal & catalytic cracking and reforming processes, coking, visbreaking, Process of a typical Indian refinery. Parameters and testing logistics of petroleum products— Octane no.; Cetane no.; Aviation fuel,Power no.; Pour point; Smoke point; Char point; Cloud point; Flash point; Fire point; Aniline point and Diesel index. Liquid fuel from coal: Bergius and Fischer Tropsch process. Other Synthetic Liquid fuels.(Benzol,shaleoil,Gashol, power alcohol Colloidal fuel).

Module III: 10L Gaseous Fuels: Classification of gaseous fuel;Physico-chemical principles, Calorific Value, Wobbes index, and flame speed. Flow sheet &operation of Producer gas, Water gas, Carburetted water gas, oil gas, coke-oven gas, blast furnace gas, Natural Gas and LPG. Coal Bed Methane.

**UNIT –III**: 10 L Solar Energy: Devices for measurement of solar flux. Different types of Solar collectors (Flat plate,parabolic,concentric&heliostat), Utilization of Solar Energy- For room heating, water heating other industrial uses -solar Pond, Photovoltaic cells, Chemical storage etc. Geothermal Energy & Wind Energy: Utilization of Geo thermal Energy;Operating principles of different types of Wind Energy Mills. Energy from Ocean Nuclear energy:Sources of Nuclear fuels,Indian scenario; Nuclear reactions and power generation by Nuclear reactorsBreeder reactor- reaction &operation.

**UNIT –IV**: 10 L Solar Energy: Devices for measurement of solar flux. Different types of Solar collectors (Flat plate,parabolic,concentric&heliostat), Utilization of Solar Energy- For room heating, water heating other industrial uses -solar Pond, Photovoltaic cells, Chemical storage etc. Geothermal Energy & Wind Energy: Utilization of Geo thermal Energy;Operating principles of different types of Wind Energy Mills. Energy from Ocean Nuclear energy:Sources of Nuclear fuels,Indian scenario; Nuclear reactions and power generation by Nuclear reactorsBreeder reactor- reaction &operation.

**Text Books:**

1. Fuels & Combustion: Dr. Samir Sarkar,Orient Longmans
2. Elements of Fuels. Furnace and Refractories

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## BTCH-705: FERTILIZER TECHNOLOGY

**Unit I** Introduction of Indian fertilizer industries, types of fertilizers process details. [8]

**Unit II** Manufacture of Nitrogeneous, Phosphatic, potassic, complex, NPK, mixed, Dio and other fertilizers.

**Unit III** Discussion of existing Indian plants pollution and its control, abetment and disposal of waste of fertilizer units.

**Unit IV** Retrofits and modernization, computer control and Instrumentation, Energy conservation and diversification.

**Unit V** Design of Ammonia converters and other reactors, cooling water, expansion, capacity utilization and other problem of fertilizers industry.

Books: 1.Mortvedt J.J.,Murphy L.S.& Follett R.H., Fertilizer Technology & Application, Meister Publishing Company 2. Shreves Chemical Process Industries, McGraw Hill 3. Drydens Outlines of Chemical Technology, East West Press

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## BTCH-704: ENERGY TECHNOLOGY LAB

1. Determination of composting of the supplied sample of Coal by Proximate Analysis.
2. To find the effect to temperature on viscosity of the supplied samples of liquid fuel using Red wood viscometer/ lubricating oil using Engler's Viscometer.
3. To find the Flash and Fire point of the supplied samples of liquid fuel using (i) Penslery Martein closed cup apparatus (ii) Abel open cup apparatus.
4. To find the Aniline point of the supplied samples of liquid fuels using Aniline point apparatus and hence find out the Diesel Index Number of the Diesel oil.
5. To find the moisture content of the supplied samples of liquid fuel/ Crude oil using Dean and Stark apparatus.
6. To find the Pour point and Solidification point of the supplied samples of liquid fuels.
7. To determine the Gross calorific value of the supplied sample of coal using Bomb Calorimeter (on ash free basis).
8. To determine the Smoke Point of Kerosene oil using Smoke Point appar

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## BTCH-753: INDUSTRIAL TRAINING

The students must submit the report to their institute complete 4 week Industrial Training after the completion of their $6^{th}$ semester. Students may opt this course at any Industry/ Research Lab for 4 weeks.

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## BTCH-754: MINI PROJECT

The students would be allotted an industrial project or any Research Project in the beginning of the VII semester itself. He/ She may continue this project in details, later in the ($8^{th}$) semester. The assessment of ESE will be done the faculty member of the other department within the same institute.

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## BTCH- 801: NON-CONVENTIONAL ENERGY RESOURCES

**L T P 3 1 0**

**UNIT-I Introduction Various non-conventional energy resources-** Introduction, availability, classification, relative merits & demerits.

**Solar Cells:** Theory of solar cells. solar cell materials, solar cell array, solar cell power plant, limitations.

**UNIT-II Solar Thermal Energy:**

Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

**UNIT-III Geothermal Energy:**

Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.

**Magneto-hydrodynamics (MHD):**

Principle of working of MHD Power plant, performance and limitations.

**Fuel Cells:**

Principle of working of various types of fuel cells and their working, performance and limitations.

**UNIT-IV**

**Thermo-electrical and thermionic Conversions:**

Principle of working, performance and limitations.

**Wind Energy:**

Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems.

**UNIT-V Bio-mass:** Availability of bio-mass and its conversion theory.

Ocean Thermal Energy Conversion (OTEC):
Availability, theory and working principle, performance and limitations.

**Wave and Tidal Wave:** Principle of working, performance and limitations. Waste Recycling Plants.

**Text/References Books:**


1. Raja etal, "Introduction to Non-Conventional Energy Resources" Scitech Publications.
2. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
3. M.V.R. Koteswara Rao, " Energy Resources: Conventional & Non-Conventional " BSP Publications,2006.
4. D.S. Chauhan,"Non-conventional Energy Resources" New Age International.
5. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning

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# BTCH-802: PLANT DESIGN & PROJECT ENGINEERING

**Unit 1**

Project identification, preliminary techno-economic feasibility, laboratory development and research, pilot plant level studies, scale-up methods. Process selection, alternative processes. Flow sheet preparation, different components of PFD, equipment numbering, stream designation, battery limit and off sites

**Unit 2**

Selection of process equipments, standard versus special equipments, selection Criteria, specification sheet of equipment, Process auxiliaries - piping design, layout, process control and instrumentation, Process utilities- process water, boiler-feed water, waste treatment & disposal, oil heating system, chilling plant., compressed air, instrumentation air.

**Unit 3**

Interest-types & calculations, Cost estimation-factors involved in project cost estimation, total capital investment, fixed capital and working capital, process equipment cost estimation. Cost index and scaling for equipment cost. Estimation of total product cost-factors involved

**Unit 4**

Depreciation-types & methods of determination, Profitability – criteria of profitability, payout period, return on investment, present value, cash flow analysis, alternative investment and replacement methods, factors in alternative & replacement investment, project profitability analysis

**Unit 5**

Project management, scheduling a project using CPM/PERT, Inventory control methods, Optimum conditions- production schedule, optimum production rates in plant operations, optimum conditions in batch and cyclic operations, Design reports, Plant location and layout principles- factors involved, case studies for specific plants

**Text Books:**

(1) Peters, M. S. and Timmerhaus, K. D., "Plant Design & Economics for Chemical Engineers", McGraw Hill
(2) Vilbrandt and Dryden, "Chemical Engineering Plant Design", McGraw Hill
(3) Ulrich, G. D., "A Guide to Chemical Engineering Process Design & Economics", John Wiley and Sons

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# BTCH-803: PROCESS UTILITY & SAFETY IN CHEMICAL PLANT

**Unit -1 V**arious process utilities, their role and importance in chemical plants. Water Sources of water and their characteristics: Treatment storage and distribution of water; water for use in boilers, cooling purposes, drinking and process; Reuse and conservation of water: Water resource management.

**Unit-2 Steam Generation and Utilization**

Steam Generation and its application in chemical process plants, distribution and utilization: Design of efficient steam heating systems: steam economy, steam condensers and condensate utilization Expansion joints, flash tank design, steam traps their characteristics, selection and application, waste heat utilisation; Lagging, selection and thickness. Selection and sizing of boilers; waste heat boilers.

**Unit-3 Compressors, blowers and Vacuum Pumps**

Compressors, blowers and vacuum pumps and their performance characterisstics; Methods of developing vacuum and their limitations, material handling under vacuum, Piping systems; Lubrication and oil removal in compressors and pumps. Air filters. Air gas leakage. Inert gas systems. Compressed air for process, Instrument air.

**Insulation** Importance of insulation for meeting the process requirements, installation materials and their effect on various material of equipment piping, fitting and valves etc, insulation for high intermediate, low and sub zero temperatures, including cryogenic insulation.

**Unit-4**

**Elements of safety** Elements of safety, safety and site selection; Plant and unit plot planning; Definition of risk and hazard Identification and assessment of the hazard and risk, Industrial between hazards and risk, Industrial hygiene, toxicological studies, Hazard operability (HAZOP) hazard analysis (HAZAN);

Assessment of the risk, fault tree, event tree, scope of risk assessment; control of hazards, controlling toxic chemicals and controlling flammable materials. Prevention of losses Prevention of losses, Pressure relief, fire & explosions, Provision of fire fighting equipment, Technology selection and transfer, choosing the right process.

**Unit -5 Control of Process**

Control of process, Prevention of hazardous deviation in process variable, e.g. pressure, temperature

flow by Provision of automatic control systems-interlocks, alarms, trips together with good operating practices and management. Accidental analysis, Regulations and legislation, Role of gevemment role,risk management routines and tackling disaster,case studies.

**Text Books:**

1. Nordell Eskel, “Water Treatment for Industrial and Other Uses”, Reinhold Publishing Corporation, New York. (1961)
2. Crowl, D.A. & Louvar, J.F.. “Chemical Process Safety: Fundamentals with applications”, New Jersey: Prentice-Hall. (1989)
3. Goodall, P.M., “The Efficient use of Steam” IPC Science and Technology (1980)

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## BTCH-804: PETROLEUM ENGINEERING

**Unit I -**Petroleum Exploration Production and Refining of Crude oils Crude oils: Chemistry and composition (Characteristics and constituents of crude oils, Classification of crude oils).
**Unit II** Quality Control of Petroleum Products Classification of laboratory tests, distillation, vapour pressure, flash and fire points, octane number, performance number, cetane number, aniline point, viscosity index, calorific value, smoke point, char value, viscosity, viscosity index, penetration tests, cloud and pour points, drop point of grease, melting and settling points of wax, softening point of Bitumen, induction period of gasoline, thermal stability of jet fuels, gum content, Total Sulphur, Acidity and Alkalinity,, Copper Strip Corrosion Test, Silver – Strip Corrosion Test for ATF, Ash, Carbon Residue (Conradson method, Ramsbottom method) Colour, Density and Specific gravity, Refractive index of hydrocarbon liquids, water separation index (modified) (WSIM), ductility.
**Unit III** Petroleum Products Composition, Properties & Specification of LPG, Naphthas, motor spirit, Kerosine, Aviation Turbine Fuels, Diesel Fuels, Fuel Oils, Petroleum Hydrocarbon Solvents, Lubricating oils (automotive engine oils, industrial lubricating oils electrical insulating oils, Jute Batching oils, white oils, steam turbine oils, metal working oils, etc.) Petroleum Waxes Bitumens, Petroleum coke. Crude Oil Distillation Desalting of crude oils, Atmospheric distillation of crude oil, Vacuum distillation of atmospheric residue. Thermal Conversion Process Thermal Cracking Reactions, Thermal Cracking, Visbreaking, (Conventional Visbreaking and Soaker Visbreaking) Coking (Delayed Coking, Fluid Coking, Flexicoking), Calcination of Green Coke.
**Unit IV** Catalytic Converson Process Fluid catalytic cracking; Catalytic reforming; Hydrocracking Catalytic Alkylation, Catalytic Isomerization; Catalytic Polymerization. Finishing Process Hydrogen sulphide removal processes; Sulphur conversion processes; Sweetening processes (Caustic treatment, Solutizer process; Doctor treating process; Copper chloride sweetening,; Hypochlorite sweetening ;Air and inhibitor treating process; Merox processes;Sulphuric acid treatment; Clay treatment); Solvent extraction processes (Edeleanu process, Udex process, Sulfolane process), Hydrotreating processes.
**Unit V** Lube Oil Manufacturing Process Evaluation of crude oils for lube oil base stocks, Vacuum distillation, Solvent deasphalting Solvent extraction of lube oil fractions (Furfural, NMP and Phenol), Solvent dewaxing, Hydrofinshing, Manufacture of petroleum waxes (Wax sweating, Solvent deoiling) Manufacture of Bitumens Selection of crude oil, Methods of manufacture of bitumens, (Distillation, Solvent 45 precipitation, Air blowing).

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### BTCH-851: SEMINAR

Students have to present a detailed power point presentation on their own project topics. Tjis seminar will help them to enhance their personality.

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### BCH-852: PROJECT-2

This project course may be in continuation of Project-I (RCH-754) allotted in the beginning of the VII semester. Here, the students are supposed to do the detailed work as scheduled in the last semester. Finally, he/she will be required to submit the detailed project report on which viva-voice examination will be conducted by a committee having at least one external examiner.