**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

B.TECH. CHEMICAL ENGINEERING

II YEAR I semester

COURSE STRUCTURE

Subject	T	P	C
Mathematics-II	4+1*	0	4
Electrical Engineering	4+1*	0	4
Momentum Transfer	4+1*	0	4
Environmental Studies	4+1*	0	4
Analytical Chemistry	4+1*	0	4
Chemical Process Calculations	4+1*	0	4
Momentum Transfer Lab	0	3	2
Analytical Chemistry Lab	0	3	2
Total	30	6	28

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MATHEMATICS – II

UNIT – I
Matrices: Elementary row transformations – Rank – Normal form - Echelon form – Consistency – Solution of system of simultaneous linear homogeneous and non-homogeneous equations.

UNIT – II
Eigen values, Eigen vectors – properties – Cayley-Hamilton Theorem - Inverse and powers of a matrix by Cayley-Hamilton theorem – Diagonolization of matrix. Calculation of powers of matrix – Modal and spectral matrices.

UNIT-III
Real matrices – Symmetric, skew - symmetric, orthogonal, Linear Transformation - Orthogonal Transformation. Complex matrices: Hermitian, Skew-Hermitian and Unitary – Eigen values and Eigen vectors of complex matrices and their properties Quadratic forms- Reduction of quadratic form to canonical form – Rank - Positive, negative definite - semi definite - index - signature - Sylvester law.

UNIT –IV
Fourier Series: Determination of Fourier coefficients – Fourier series – even and odd functions – Fourier series in an arbitrary interval – even and odd   periodic continuation – Half-range Fourier sine and cosine expansions.

UNIT-V
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – solutions of first order linear (Lagrange) equation and nonlinear (standard type) equations.

UNIT –VI
Method of separation of variables – Classification of second order linear Partial Differential Equations, solutions of one dimensional heat equation, wave equation and two-dimensional Laplace's equation under initial and boundary conditions.

UNIT –VII
Fourier integral theorem – Fourier sine and cosine integrals. Fourier transforms – Fourier sine and cosine transforms – properties – inverse transforms – Finite Fourier transforms.

UNIT-VIII
Z-transform – inverse z-transform - properties – Damping rule – Shifting rule – Initial and final value theorems. Convolution theorem – Solution of difference equation by z-transforms.

Text Books:

1. A text Book of Engineering Mathematics, Vol-II T. K. V. Iyengar, B. Krishna Gandhi and Others, S. Chand & Company.
2. A text Book of Engineering Mathematics, C. Sankaraiah, V. G. S. Book Links.
3. A text Book of Engineering Mathematics, Shahnaz Bathul, Right Publishers.
4. A text Book of Engineering Mathematics, P. Nageshwara Rao, Y. Narasimhulu & N. Prabhakar Rao, Deepthi Publications.

References:

1. A text Book of Engineering Mathematics, B. V. Raman, Tata Mc Graw Hill.
2. Advanced Engineering Mathematics, Irvin Kreyszig, Wiley India Pvt. Ltd.
3. A text Book of Engineering Mathematics, Thamson Book Collection.

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ELECTRICAL ENGINEERING

UNIT – I

SI Unit's ohm's law, series, and parallel circuits, Kirchhoffs laws, Star-delta transformation (Simple Problems)– Force on a current carrying conductor in magnetic field– electromagnetic induction, Faraday's law, Lenz's law – Self and mutual inductances.

UNIT – II

Generation of an alternating emf – average and rms values of alternating quantity – representation of alternating quantities by phasors – single phase series and parallel circuits (simple problems)– series and parallel resonance – three phase balanced systems – single and three phase power calculations.

UNIT – III

Principle of operation of DC machines – emf equation – types of generators – Magnetization and Load characteristics of DC generators

UNIT-IV

DC Motor: Principle of operation of DC Motor,Types of Motors, Back EMF Equation, Characteristics of DC motor, Torque Equation,DC Motor Starter (Three Point starter),Efficicency Calculation, Swimbrne's Test and speed control.

UNIT –V

Construction and principle of operation of single phase transformer – emf equation O.C. & S.C. tests – efficiency and regulation

UNIT-VI

Principle and operation of three phase induction motors – types of motors,Squirrel cage and slip ring motor – slip torque characteristics.

UNIT-VII

Principle and operation of alternators – O.C. & S.C. tests – regulation by synchronous impedance method.

UNIT – VIII

Electrical Instruments: Basic principles of indicating instruments – moving coil and moving iron instruments (Ammeters and voltmeters).

TEXT BOOKS :

1. Introduction to Electrical Engineering by M.S.Naidu and S.Kamakshiah, TMH
2. Basic Electrical Engineering by T.K. Nagasarkar and M.S.Sukhija, Oxford University Press, 2005

REFERENCES:
1. Theory and Problems of Basic Electrical Engineering by D.P.Kothari & I.J. Nagrath Pearson Education/PHI
2. Essentials of Electrical and Computer Engineering by David V.Kerns,Jr, J.David Irwin; Pearson Education.
3. Basic electrical Engineering, V.N. Mittle, 2nd edition, TMH
4. Principles of electrical engineering, V.K. Mehta, S.Chand publications

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MOMENTUM TRANSFER

UNIT –I

Unit operations and unit processes, unit systems, dimension analysis, basic concepts, nature of fluids, hydrostatic equilibrium, applications of fluid statics.

UNIT- II

Fluid flow phenomena-Laminar flow, Shear rate, Shear stress, Rheological properties of fluids, Turbulence, Boundary layers, Basic equation of fluid flow –Mass balance in a flowing fluid; continuity, differential momentum balance; equations of motion, Macroscopic momentum balances, Mechanical energy equations

UNIT-III

Incompressible Flow in pipes and channels- shear stress and skin friction in pipes, laminar flow in pipes and channels, turbulent flow in pipes and channels, friction from changes in velocity or direction.

UNIT-IV

Flow of compressible fluids- Definitions and basic equations, Processes of compressible flow, Isentropic flow through nozzles, adiabatic frictional flow, and isothermal frictional flow.

UNIT-V

Flow past immersed bodies, Drag and Drag coefficient, flow through beds of solids, motion of particles through fluids.

UNIT-VI

Fluidization, Conditions for fluidization, Minimum fluidization velocity, Types of fluidization, Expansion of fluidized bed, Applications of fluidization. Continuous fluidization; slurry and pneumatic transport

UNIT-VII

Transportation and Metering of fluids- Pipes, fittings and valves, pumps: positive displacement pumps, and centrifugal pumps.

UNIT-VIII

Fans, blowers, and compressors, Measurement of flowing fluids- full bore meters, insertion meters.

Text Books:
1. Unit Operations of Chemical Engineering by W.L.McCabe, J.C.Smith & Peter Harriot, McGraw-Hill, 6th ed, 2001

References:
1. Transport processes and unit operations by Christie J. Geankoplis, PHI
2. Unit operations, Vol-1 –Chattopadhya, Khanna publishers
3. P rinciples of Unit Operations, Foust et. al, 2nd ed., John Wiley, 1999
4. Chemical Engineering, Vol-I, Coulson and Richardson, **Pergamon Press.**

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ENVIRONMENTAL STUDIES

UNIT - I

Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance – Need for Public Awareness.

UNIT – II

Natural Resources : Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. - Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources. Case studies. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT – III

Ecosystems: Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and function of the following ecosystem:
a. Forest ecosystem
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT – IV

Biodiversity and its conservation: Introduction - Definition: genetic, species and ecosystem diversity. - Bio-geographical classification of India - Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - . Biodiversity at global, National and local levels. - . India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – V

Environmental Pollution: Definition, Cause, effects and control measures of :
a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards
Solid waste Management: Causes, effects and control measures of urban and industrial wastes. - Role of an individual in prevention of pollution. - Pollution case studies. - Disaster management: floods, earthquake, cyclone and landslides.

UNIT – VI

Social Issues and the Environment: From Unsustainable to Sustainable development -Urban problems related to energy -Water conservation, rain water harvesting, and watershed management -Resettlement and rehabilitation of people; its problems and concerns. Case Studies -Environmental ethics: Issues and possible solutions. -Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. -Wasteland reclamation. –Consumerism and waste products. -Environment Protection Act. -Air (Prevention and Control of Pollution) Act. -Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act -Issues involved in enforcement of environmental legislation. -Public awareness.

UNIT – VII
Human Population and the Environment: Population growth, variation among nations. Population explosion - Family Welfare Programme. -Environment and human health. -Human Rights. -Value Education. -HIV/AIDS. -Women and Child Welfare. - Role of information Technology in Environment and human health. -Case Studies.

UNIT – VIII
Field work : Visit to a local area to document environmental assets River /forest grassland/hill/mountain - Visit to a local polluted site-Urban/Rural/industrial/ Agricultural Study of common plants, insects, birds. - Study of simple eco systems pond, river, hill slopes, etc.

TEXT BOOK:
1   Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2   Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE:

1 Textbook of Environmental Sciences and Technology by M. Anji Reddy, BS Publication.

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ANALYTICAL CHEMISTRY

UNIT – I

Principle of Analytical Methods: Quantitative analysis. Precipitation, types of precipitates, impurities, co-precipitation , post-precipitation, conditions for participation, precipitation from homogeneous solution Gravimetric determination of Fe, Ni and Cu, calculations.

UNIT-II

Volumetric analysis: Acid base titrations: Indicators; Oxidation-reduction titrations; Complexation using ligands, complexometric titration with EDTA, metal ion indicators; simple calculations; analysis of Na_2CO_3, Fe_2O_3 , Brass, Solder etc.

UNIT – III

Molecular Spectrophotometry: Absorption spectra, Lamberts Law, Beer's Law - Combined law equation; Derivations from Beer's Law. Block diagram of a uv- visible spectrophotometer – quantitative analysis ; Direct method for the determination of metal ions; Chromium, Manganese, Iron etc in alloys.

UNIT – IV

Infrared Spectroscopy : Interaction of infra-red radiation with molecules, Sources of IR Radiation ; Spectral regions; Block diagram of IR Spectrometer , Function of each component; Sampling Techniques; Application of IR Spectroscopy to functional group analysis (-OH, $-NH_2$, -CHO, -CO-R, -CONH).

UNIT V:

Chromatographhy: Principles, planar chromatography, paper chromatography, RF value. Thinlayer chromatography, identification of spots by spraying and other methods.

UNIT –VI:

Gas Chromatography: Principles of Gas Chromatography, block diagram of gas chromatograph, Function of each component, Detectors (FID, ECD), stationary phase for column, mobile pahse, chromatogram, qualitative analysis, quantitative analysis, retention time, retention volume, capacity factor, area., normalization method.

UNIT VII:

HPCL: Principles of high performance liquid chromatography, Block diagram of HPCL, Systems, functions of each component, stationary phases, eluting solvents, pumps, detectors, quantitative applications of HPLC.

UNIT –VIII:

Analysis of water: Hardness, definition, Types of Hardness, estimation of hardness by EDTA method, Alkalinity, Acidity, Chlorides, Chlorine, dissolved oxygen, BOD, COD.

Text BOOK:
1. Quantitative analysis, R.A. Day & A.L.Underwood Printice-Hall of India, pvt. Ltd. 5th edition, 2000.
2. Vogels Text book of Quantitative chemical analysis, J.Mendham, R.C Denny, J.D. Barnes, M J.K.Thomas, pearson education, 6th edition, 2002.

REFERENCES:
1. Analytical Chemistry – Y.Anjaneylu, K. Chandrasekhar, V. Manickam- Pharma book syndicate, 2007.
2. Instrumental methods of analysis, Willand merrit and dean, caps publications & Distribution, 1999.
3. Instrumentaiotn methods of analysis, Chatwal & Anand, Himalaya Publ;ications, 2003.
4. Principles of Analytical Chemistry by Vacarcel, Springer Publications, 2005.

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CHEMICAL PROCESS CALCULATIONS

Unit-1:
Stoichiometric relation: basis of calculations, methods of expressing compositions of mixtures and solutions, density and specific gravity, Baume and API gravity scales.

Unit-2:
Behavior of Ideal gases: Kinetic theory of gases, application of ideal gas law, gaseous mixtures, gases in chemical reactions.

Unit-3:
Vapor pressure: Liquefaction and liquid state, vaporization, boiling point, effect of temperature on vapor pressure, Antoine equation, vapor pressure plots, estimation of critical properties, vapor pressure of immiscible liquids and ideal solutions, Roult's law. Non volatile solutes.

Unit-4:
Humidity and Saturation: Relative and percentage saturation or dew point, wet bulb and dry bulb temperature, use of humidity charts for engineering calculations.

Unit-5:
Material balances: Tie substance, Yield, conversion, processes involving chemical reactions.

Unit-6:
Material balance calculation involving drying, dissolution and crystallization. Processes involving recycle, bypass and purge.

Unit-7:
Thermophysics: Energy, energy balances, heat capacity of gases, liquid and mixture solutions. Kopp's rule, latent heats, heat of fusion and heat of vaporization, Trouton's rule, Kistyakowsky equation for non polar liquids enthalpy and its evaluation.

Unit-8:
Thermochemistry: Calculation and applications of heat of reaction, combustion, formation and neutralization, Kirchoff's equation, enthalpy concentration change, calculation of theoretical and actual flame temperatures.

TEXTBOOKS
1. Chemical process principles, Part -I, Material and Energy Balance by Hougen O A, Watson K.M. and Ragatz R.A. John Wiley and Sons, New York, 1963, 2nd Ed.
REFERENCES :
1. Basic principles and calculation in chemical engineering by D.H. Himmelblau, 5th Ed. PHI, 2001
2. Stoichiometry by B.I. Bhatt and S.M. Vora (3rd Ed.) Tata McGraw Hill publishing company, Ltd. New Delhi (1996)

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Momentum Transfer Lab

1. Identification of laminar and turbulent flows
   Major equipment - Reynolds apparatus

2. Measurement of point velocities
   Major equipment - Pitot tube setup

3. Verification of Bernoulli's equation
   Major equipment – Bernoulli's Apparatus

4. Calibration of Rotameter
   Major equipment – Rotameter Assembly

5. Variation of Orifice coefficient with Reynolds Number
   Major equipment - Orifice meter Assembly

6. Determination of Venturi coefficient
   Major equipment – Venturi meter Assembly

7. Friction losses in Fluid flow in pipes
   Major equipment - Pipe Assembly with provision for Pressure measurement

8. Pressure drop in a packed bed for different fluid velocities
   Major equipment - Packed bed with Pressure drop measurement

9. Pressure drop and void fraction in a fluidized bed
   Major equipment - Fluidized bed with Pressure drop measurement

10. Studying the coefficient of contraction for a given open orifice
    Major equipment - Open Orifice Assembly

11. Studying the coefficient of discharge in a V-notch
    Major equipment - V-notch Assembly

12. Studying the Characteristics of a centrifugal pump
    Major equipment - Centrifugal Pump

13. Viscosity determination using Stoke's law.
    Major equipment – Terminal Velocity determination column

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ANALYTICAL CHEMISTRY LAB

1. Estimation of ferrous iron (II) in solution using Potassium Dichromate.
2. Estimation of cooper (II) using standard sodium thiosulphate.
3. Estimation of total, permanent and temporary hardness of water by EDTA.
4. Estimation of Total alkalinity of water.
5. Estimation of Iron in cement using Spectrophotometer.
6. Estimation of Zinc using potassium ferrocyanide.
7. Percentage purity of lime stone.
8. Estimation of Chlorides in water.
9. Estimation of Dissolved oxygen in water.
10. Determination of stability constant by Job's method.
11. Determination of sulphates through turbidometry.
12. Assay of paracetamol/ Ibuprofen sample using spectrophotometer.

TEXT BOOKS:

1. Vogel's Text book of Quantitative Chemical Analysis, Sixth Edition – J. Mendham et al, Pearson Education.
2. Chemistry Practical – Lab Manual by Chandra Sekhar and Jayaveera.

APPARATUS AND EQUIPMENT REQUIRED

GLASSWARE:

Burettes, Pipettes (10ml, 20 ml, 25 ml), Conical Flasks (250 ml), Standard Flasks (25 ml, 50 ml, 100 ml, 250 ml, 500 ml, 1000 ml) Graduated Pipettes, Beakers (100 ml, 250 ml, 500 ml, 1000 ml) Reagent Bottels (100 ml, 250 ml, 500 ml,), Test Tubes, Test Tube Stands, Burette Stands, Porcelain Tiles, Brushes, Wash Bottles, Droppers, Conical Flaks (250 ml, 100 ml), Weighing Bottles.

EQUIPMENT :

Colorimeter, UV- Visible Spectrophotometer, Hot Water Bath, Hot Plates, Distilled Water, Plant/De - ionizer, Magnetic- Stirrer, Chemical Balances, Weighing Boxes and Electrical Balance.