BACHELOR OF TECHNOLOGY (CHEMICAL ENGINEERING)
SCHEME OF STUDIES/EXAMINATIONS (KUK)

Semester-III (w.e.f. session 2016-2017)

SN	Course No.	Course Title	Teaching Schedule				Allotment of Marks				Dur of Exam (Hrs.)
			L	T	P	Hrs/ Wk	Theory	Sessional	Practical	Total	
1	AS-201N	Mathematics-III	3	1	0	4	75	25	0	100	3
2	CH-201N	Chemistry-II	3	1	0	4	75	25	0	100	3
3	CHE-201N	Chemical Engineering Process Calculations	4	1	0	5	75	25	0	100	3
4	CHE-203N	Fluid Flow	3	1	0	4	75	25	0	100	3
5	CHE-205N	Chemical Engineering Thermodynamics-I	3	1	0	4	75	25	0	100	3
6	CHE-207N	Material Technology	3	0	0	3	75	25	0	100	3
7	CHE-209N	Unit Process	3	0	0	3	75	25		100	3
8	CH-203N	Chemistry -II Lab	0	0	3	3	0	40	60	100	3
9	CHE-211N	Fluid Flow Lab	0	0	2	2	0	40	60	100	3
		Total	**22**	**5**	**5**	**32**	**525**	**255**	**120**	**900**	
10	MPC-201N	Environmental Studies*	3	0	0	3	75	25	0	100	3

*MPC-201N is a mandatory course and student has to get passing marks in order to qualify for the award of degree but its marks will not be added in the grand total.

Semester-IV (w.e.f. session 2016-2017)

SN	Course No.	Course Title	Teaching Schedule				Allotment of Marks				Dur of Exam (Hrs.)
			L	T	P	Hrs /Wk	Theory	Sessional	Practical	Total	
1	HS-201N	Fundamentals of Management	3	1	0	4	75	25	0	100	3
2	CHE-202N	Heat Transfer	4	1	0	5	75	25	0	100	3
3	CHE-204N	Chemical Technology-I	3	0	0	3	75	25	0	100	3
4	CHE-206N	Mechanical Operations	4	1	0	5	75	25	0	100	3
5	CHE-208N	Membrane Processes	3	0	0	3	75	25	0	100	3
6	CHE-210N	Process Instrumentation	3	0	0	3	75	25	0	100	3
7	CHE-212N	Nanotechnology	3	0	0	3	75	25	0	100	3
8	CHE-214N	Mechanical Operations Lab	0	0	3	3	0	40	60	100	3
9	CHE-216 N	Heat Transfer Lab	0	0	3	3	0	40	60	100	3
		Total	**23**	**3**	**6**	**32**	**525**	**255**	**120**	**900**	
10	MPC-202N	Energy Studies*	3	0	0	3	75	25	0	100	3

*MPC-202N is a mandatory course and student has to get passing marks in order to qualify for the award of degree but its marks will not be added in the grand total.

NOTE: All the students have to undergo six weeks industrial training after IV semester and it will be evaluated in V semester.

Syllabus for 2nd Year Bachelor Technology (Chemical Engineering)KUK

Objectives

In Chemical Engineering Bachelors' courses such as Transfer Operations, Thermodynamics, Reaction Engineering, Process Control, and Process Design etc. help to develop a modularized understanding of these independent fields, with the expectation that the whole process is the sum of these individual parts.

Programme Objectives

The Chemical Engineering graduates will be able to:

1. Exhibit knowledge of basic sciences, concepts and principles of Chemical Engineering.
2. Comprehend, analyze, design and implement engineering systems with a focus on research, innovation and sustainability.
3. Work in multidisciplinary team and cater to the needs of process industries with appropriate safety, health and environmental regulations.
4. Demonstrate effective communication skills, leadership qualities and develop into successful Entrepreneurs.

AS-201N MATHEMATICS-III

Lecture	Tutorial	Practical	Major Test	Minor Test	Total Time
3	1	-	75	25	3H

Purpose: To provide the conceptual knowledge of Engineering mathematics
Course Outcomes
CO 1 : To studyvarious fundamental concepts of Fourier series and Fourier Transformation.
CO 2 : To study and understand the functions of a complex variables.
CO 3 : To study the Probability Distributions.
CO 4 : To study the linear programming problem formulation.

UNIT – I

Fourier Series : Euler's Formulae, Conditions for Fourier expansions, Fourier expansion of functionshaving points of discontinuity, change of interval, Odd & even functions,Half-range series.

Fourier Transforms : Fourier integrals, Fourier transforms, Fourier cosine and sine transforms.

Properties of Fourier transforms, Convolution theorem, Perseval's identity, Relation between Fourierand Laplace transforms, Fourier transforms of the derivatives of a function, Application to boundaryvalue problems.

UNIT-II

Functions of a Complex Variables : Functions of a complex variable, Exponential function,Trigonometric, Hyperbolic and Logarithmic functions, limit and continuity of afunction, Differentiability and analyticity.

Cauchy-Riemann equations, Necessary and sufficient conditions for a function to be analytic, Polar form of the Cauchy-Riemann equations, Harmonic functions, Application toflow problems, Conformal transformation, Standard transformations (Translation, Magnification &rotation, inversion & reflection, Bilinear).

UNIT-III

Probability Distributions : Probability, Baye's theorem, Discrete & Continuous probabilitydistributions, Moment generating function, Probability generating function, Properties and applicationsof Binomial, Poisson and normal distributions.

UNIT-IV

Linear Programming : Linear programming problems formulation, Solution of Linear ProgrammingProblem using Graphical method, Simplex Method, Dual-Simplex Method.

Paper Setter's Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

Text Book

1. Higher Engg.Mathematics : B.S. Grewal
2. Advanced Engg.Mathematics : E. Kreyzig

Reference Book

1. Complex variables and Applications : R.V. Churchil; Mc. Graw Hill
2. Engg. Mathematics Vol. II: S.S. Sastry; Prentice Hall of India.
3. Operation Research : H.A. Taha.
4. Probability and Statistics for Engineer : Johnson. PHI.

CH-201N	CHEMISTRY – II					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessional**	**Total**	**Time**
3	**1**	**-**	**75**	**25**	**100**	**3**
Purpose	To familiarize with the basic knowledge of Organic reactions and mechanism, Chemistry of Hydrocarbons, Chromatographic analysis methods, Kinetic of a chemical reaction and chemical Equilibrium of the processes.					
Course Outcomes						
CO1	To understand the basic knowledge of organic reactions and mechanism, substitution and addition of electrophilic,nucleophillic, free radical and chemistry of hydrocarbons.					
CO2	To familiarize with the various Chromatographic analysis methods.					
CO3	To introduce the Kinetic of a chemical reaction.					
CO4	To give in-depth knowledge of chemical Equilibrium of the processes.					

Paper Setter's Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT I

Classification of Organic Reactions: Types of mechanism, types of reactions, Reaction intermediates, the mechanism of the following type of reactions. substitution - Electrophiilic, nucleophiilic, fee radical, Addition- Electrophilic, nucleophillic, free radical Elimination-Elimination (E_1 and E_2 type) Rearrangement, Migration with electron (electrophillic).

Chemistry of Hydrocarbons: Sources, preparation and uses of alkanes, alkenes, alkynes, cracking & reforming aromatic hydrocarbons, concept of aromaticity (Huckel rule, 4n+2) rule) and directive effect.

UNIT II

Chromatography: Introduction, classification, solid, Liquid chromatography (LSC, TLC, Liquid - Liquid Chromatography (LLC), Column, GPC, HPLC, Gas-Liquid Chromatography (GLC).

UNIT III

Chemical Kinetics: Rate expression of reactions of various orders, rate mechanism, kinetics of complex reactions, molecularity, order of reaction, concept of energy barrier and activation energy theories of reaction rates, Arhenius equation.

UNITIV

Chemical Equilibrium: Equilibrium constant, Factors affecting, Ka, Kp, Standard free energy and equilibrium constant, homogeneous and heterogeneous chemical equilibria, Lechtelier'sprinciple and its applications' Relation between Kp and Kc.

Books Recommended:

1. Advanced organic chemistry (Reaction Mechanism and structure) by JerryMarch (WilleYEasern 3rd edition)
2. Text Book of Organic Chemistry by R'K' Bansal' (T'M'H')
3. Organic Chemistry by Morrison, Bayd (P'H'L')
4. Chromatography by B'K' Sharma ((Goel Publishing' Merrut')
5. Organic Chemistry Vol' I By l'L' Finar (ELBS)'
6. Schaum's solved Problems series,Organic Chemistry(T'M'H')
7. Organic Reaction Mechanism,3rdedition(T.M.H')by R.K.Bansal.

CHE-201N	CHEMICAL ENGINEERING PROCESS CALCULATIONS					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessional**	**Total**	**Time**
4	**1**	**-**	**75**	**25**	**100**	**3**
Purpose	To familiarize with the concept of units, their dimensions and conversions, stoichiometric and composition relations, various Gas laws, Material balance and Energybalance.					
Course Outcomes						
CO1	To introduce the basic concept of units, their dimensions and conversions, stoichiometric and composition relations.					
CO2	To understand the various Gas laws and Henry's Law, Humidity and use of humidity charts for engineering calculations.					
CO3	To familiarize with the concept of Material balances for systems with and without chemical reactions, species and elemental balance.					
CO4	To familiarize with the concept of Steady state energy balance for systems with and without chemical reactions, Enthalpy-concentration charts; Degrees of freedom in steady state processes, Unsteady state material and energy balance.					

Paper Setter's Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

Unit I

Units and Dimensions: Introduction-Units, their dimensions and conversions, Dimensional consistency of equations, Dimensional and dimensionless constants, Mass and volume relations, Stoichiometric and composition relations, Excess reactants, Degree of completion, Conversion, Selectivity and Yield.

Unit II

Gas Law and Humidity: Gas laws-Ideal gas law, Dalton's Law, Amagat's Law, and Average molecular weight of gaseous mixtures. Vapour pressure-Effect of temperature on vapour pressure, Vapour pressure plot (Cox chart), Vapour pressures of miscible and immiscible liquids and solutions, Raoult's Law and Henry's Law. Relative Humidity and percent saturation; Dew point, Dry and Wet bulb temperatures; Use of humidity charts for engineering calculations

Unit III

Material Balance: Material balances for systems with and without chemical reactions, species and elemental balance. Analysis of systems with by-pass, recycle and purge. Heat capacity of gases, liquids and solutions, Heat of fusion and vaporization.

Unit IV

Energy Balance: Steady state energy balance for systems with and without chemical reactions; Calculations and application of heat of reaction, combustion, formation, neutralisation and solution; Enthalpy-concentration charts; Degrees of freedom in steady state processes, solution of simultaneous material and energy balance problems using flow sheeting codes; Unsteady state material and energy balance.

Books Recommended:

1. D.M.Himmelblau, Basic Principles and calculations in Chemical Engineering, Printice-Hall.
2. O.A. Hougen,K.M.Watson&R.A.Ragatz, Chemical process principles, John Willey & sons.
3. D. P. Tiwari, Chemical Calculation,Vrinda Publications (Zalgaon).
4. S. N. Saha, Chemical Engineering process calculation, DhanpatiRai publication.
5. Bhatt and Vora, Stoichiometry, Nirali Publications.

CHE-203N	FLUID FLOW					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessional**	**Total**	**Time**
3	**1**	**-**	**75**	**25**	**100**	**3**
Purpose	To understand the concept and application of fluid, fluid forces, pressure measurement in fluid, energy losses, friction factor and various flow measuring devices.					
Course Outcomes						
CO1	To understand the fundamental concepts of fluids, Classification of fluid-forces, Pressure measurement by manometers, Types of flow, velocity distribution for laminar flow in conduits, Reynold's number and its significance.					
CO2	To understand the concept of Conservation of mass, momentum and energy, Euler's equation. Energy losses.					
CO3	To familiarize with thebasic equations of fluid flow and flow measuring devices.					
CO4	To familiarize with the flow of incompressible fluids in conduits .					
CO5	To familiarize the concept of hydrodynamic boundary layer and dimensional analysis by Rayleigh's and Buckingham's method.					
CO6	To familiarize with the flow past immersed bodies and transportation of fluids.					

Paper Setter's Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT I

Introduction: Fluid, Properties of fluid, Classification of fluids, Newton's law of viscosity, Rheological classification of fluids, Pressure and temperature dependence, Types of flow, Lines to describe the flow, Application of fluid flow in Chemical Engineering.

Fluid Statistics and Its Applications: Hydrostatic equilibrium, parametric equation, Hydrostatic equilibrium in centrifugal field; Concept of atmospheric, gauge and absolute pressure, manometers, pressure measurement by simple and differential manometer.

UNIT II

Basic Equations of Fluid Flow and Flow Measuring Devices: Basic equations of fluid flow: Continuity equation, equation of motion, Flow measurement using Venturimeter, Orificemeter, Rotameter&Pitot Tube.

Flow of Incompressible Fluids in Conduits: Shear stress distribution, Relation between skin friction and wall shear, The friction factor; Laminar flow through circular pipe, on inclined plane, through annular space; Relation between average and maximum velocity, Major and Minor Loses, Darcy Weisbach equation, Friction factor chart.

UNIT III

Boundary Layer and Dimensional Analysis: Concept of hydrodynamic boundary layer, Growth over a flat plate, Different thickness of boundary layer, Fundamental dimensions of quantities, Dimensional homogeneity, Dimensional analysis by Rayleigh's method and Buckingham's method, Dimensionless numbers.

UNIT IV

Flow Past Immersed Bodies And Transportation Of Fluids: Drag and drag coefficient, Flow through beds of solids, Motion of particles through fluids, Introduction to fluidization, Pipes and tubing's, Joints and fitting Major and minor losses, Different types of valves, Pumps: Centrifugal pump, Performance of centrifugal pumps.

Books Recommended:

1. J.M. Coulson and J.F. Richardson, Chemical Engineering, Vol-1, Pergamon.
2. W.L. McCabe and J.C. Smith, Unit Operations of Chemical Engineering, McGraw Hill.
3. A.K. Jain, Fluid Mechanics,Khanna publishers, New Delhi.
4. JagdishLal, Hydraulics & Fluid Mechanics, Metro-polliton Books Co. Pvt. Ltd. Delhi
5. D. S. Kumar, Fluid Mechanics, S. K. Kataria& Sons.
6.

CHE-205N	CHEMICAL ENGINEERING THERMODYNAMICS-I					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessional**	**Total**	**Time**
3	**1**	**-**	**75**	**25**	**100**	**3**
Purpose	To understand the basics of thermodynamics and P-V-T behavior, Laws of Thermodynamcs, Thermodynamics relations, concept of Power and Refrigeration cycle.					
Course Outcomes						
CO1	To Introduce with the basics of thermodynamics and P-V-T behavior.					
CO2	To familiarize with the Laws of Thermodynamics.					
CO3	To familiarize with the concept of Thermodynamics relations.					
CO4	To familiarize with the concept ofPower and Refrigeration cycle.					

Paper Setter's Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

Unit I

Introduction and P-V-T behavior: Concept of Work and heat, Cp, C_V, open system and closed system, extensive and intensive properties, Internal Energy, enthalpy, entropy, P-V-T behavior of Pure Fluids- Virial equations, cubic equations, generalized correlations, Throttling process, Joules Thompson coefficient.

Unit II

Laws of thermodynamics: Laws of thermodynamics Energy equations for close system and steady flow processes, Limitations of first law, carnot cycles, concept of available energy and dead state availability and irreversibility.

Unit III

Thermodynamics relations: Maxwell relations, Helmholtz and Gibbs function, Tds equations, clausiusclapeyron equation.

Unit IV

Power and Refrigeration cycle: Rankine cycle, Air standard cycles, vapour compression cycle, otto cycle, Brayton cycle, refrigerant and their properties, Liquifaction of gases, generation of power from heat.

Books Recommended:

1. Y.V.C. Rao, Chemical Engineering Thermodynamics, University Press.
2. Smith & van Ness, Introduction to Chemical Engineering Thermodynamics, McGraw Hill.
3. B. Bhattacharyya and S. C. Bera, Engineering Thermodynamics and Fluid Mechanics, New Age International Publishers.
4. Radha Krishnan, Fundamentals of Engineering Thermodynamics, PHI Publishers.
5. P.K. Nag, Engineering Thermodynamics, Tata McGrew Hill.

CHE-207N	MATERIAL TECHNOLOGY					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessional**	**Total**	**Time**
3	**0**	**-**	**75**	**25**	**100**	**3**
Purpose	To understand the concept and applications of material science, Crystal Geometry, Isothermal transformations, Heat Treatment, Corrosion and its Prevention, various polymers.					
Course Outcomes						
CO1	To Introduce the material science, classification of engineering materials.					
CO2	To understand the concept ofIsothermal transformations (TTT Curves); Heat Treatment methods.					
CO3	To familiarize with the Corrosion and its Prevention.					
CO4	To familiarize with the typical engineering materials.					

Paper Setter's Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

Unit I

Introduction: Introduction to material science, classification of engineering materials, Crystal Geometry And Structure Determination, Crystal Imperfections: Point imperfections, Line imperfections-edge and screw dislocations, Surface imperfections.

Unit II

Isothermal transformations (TTT Curves); Heat Treatment methods: Isothermal transformations (TTT Curves); Heat Treatment: Annealing Normalizing, Hardening, Martempering ,Austempering, Hardenability, Quenching, Tempering, Carburising , Cyaniding, Nitriding, Flame hardening.

Unit III

Corrosion and its Prevention: Corrosion and its Prevention: Direct corrosion, Electro-chemical corrosion, Galvanic cells,High temperature corrosion, Passivity, Factor influencing corrosion rate, Control and preventionof corrosion-modification of corrosive environment, Inhibitors, Cathodic protection, Protectivecoatings, glass lining, lead lining, FRP lining.

Unit IV

Engineering Materials: Typical Engineering Materials: Ferrous metals, Non ferrous metals and alloys – Aluminumand its alloys, Copper and its alloys, Alloy steels Alloys for high temperature service, Ceramic materials – Structure of ceramics, Polymorphism, Speciality glasses and refractories, properties and applications. Polymers: Classifications, comparison and properties, of various polymers and their relationship with chain structure. Grey and white cast iron- properties, applications,Uses.

Books Recommended:

1. V. Raghawan, Material Science & Engineering, Prentice Hall.
2. O.P. Khanna, Material Science,DhanpatRai Publications, New Delhi.
3. S. K. HajraChoudhury, Material Science and Processes**,** 2nd Edition, Indian BookDistributing Co.,1982.
4. R. L. Timings, Kemal Ahmet, EngineeringMaterial,Vol. I&II., Longman Publisher.
5. V.L. Van Vlack, Material of Engineering: Concepts and Application,Addison Wesley.

CHE-209N	UNIT PROCESS					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessional**	**Total**	**Time**
3	**-**	**-**	**75**	**25**	**100**	**3**
Purpose	To make student able to understand about various unit operations.					
Course Outcomes						
CO1	To familiarize with the Alkylation process.					
CO2	To understand the concept of hydrogenation.					
CO3	To familiarize with the Sulfonation.					
CO4	To familiarize with the halogenations and nitration.					

Paper Setter's Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT-I

ALKYLATION : Products derived from alkylation, types of alkylation, factors controlling alkylation, flow street for alkylarylsulfonates, sulfuric acid alkylation for petroleum industry equipment for alkylation-kellogg cascade alkylater.

UNIT - II

HYDROGENATION : Products derived from hydrogenation, types of hydrogenation, factors controlling hydrogenation, equipment for hydrogenation, apparatus and rnaterial of construction, high pressure autoclave, shaking autoclave, flow sheet for synthesis of methanol from carbon rnonoxide and hydrogen, Hydrogenation of oil.

UNIT - III

SULFONATION: Sulfonation and sulfonating agents, physical and chemical factors in sulfonation, mechanism of desulfonation, Industrial equipment and techniques, batch surfonation kettle, ball mill sulfonator, flowsheet for manufacture of anthraquinonesulphonate ethanol from methylene.

UNIT-IV

HALOGENATION: Products derived by halogenation, types of halogenation, mechanism of dehalogenation, Design and construction of equipment for halogenations, flow sheets for manufacture of chroroacetic acid, monochroroacetic acid & chloral.

NITRATION: Products derived from nitration, types of nitration, process equipment for nitration, batch nitration, continuous nitration, schmidt nitration of propane.

BOOKS RECOMMENDED:

1. Unit Processes in Organic synthesis by P.H. Groggins (MGH)
2. Chemical Technology by Merk and Hahn (MGH)
3. Chemical Egg. Dev., NT, Madras (Organic)-ll Centre.

CH-203N	CHEMISTRY- II LAB					
Lecture	**Tutorial**	**Practical**	**Practical**	**Sessional**	**Total**	**Time**
-	**-**	**3**	**60**	**40**	**100**	**3**
Purpose	To make student able to identify and quantify organic compounds.					
Course Outcomes						
CO1	Students will be able to perform preliminary tests to identify organic compounds.					
CO2	Students will be able to analyze functional groups of organic compounds and prepare derivatives.					
CO3	Students will be able to determine kinetics of reaction by method of half life period.					
CO4	Students will be able to determine the activation energy for reaction by integral and differential method.					

Identification of organic compounds :

1. Preliminary tests (elemental analysis, Ignition, colour, odour and determination of physical constants)
2. Functional group analysis.
3. Preparation of derivatives, Organic Acids, Aldehydes, Ketones, Amides, .Phenols,amines,Carbohydrates, Hydrocarbons.
4. Preparation of aspirin, 2,4, 6- tribromoaniline, picric acid from phenol, iodoform, Sbenzylisothiourounimchloride.

Quantitative organic analysis:

1. Estimation of phenol, aniline, formaldehyde.
2. To determine kinetics of reaction between ethyl acetate and sodium hydroxide at room temp. by method of half life period.
3. To determine the activation energy for reaction between ethyl acetate and sodium hydroxide by integral and differential method.

Books Recommended:

1. A. I. Vogel, Qualitative Organic analysis (ELBS) Longman.
2. Satish Aggarwal & R.C. Aggarwal, Advanced organic analysis, PargatiPrakashan.
3. G. Mann, Practical Organic Chemistry, Longman

CHE-211N	FLUID FLOW LAB					
Lecture	**Tutorial**	**Practical**	**Practical**	**Sessional**	**Total**	**Time**
-	**-**	**2**	**60**	**40**	**100**	**3**
Purpose	To provide practical knowledge for the application of flow measurement devices, calibration of flow measurement device, pressure drop in pipe flow, determination of equivalent length of various fittings in pipe line.					
Course Outcomes						
CO1	Students will be able to use various flow measurement devices to measure flow rates.					
CO2	Students will be able to calibrate flow measurement device.					
CO3	Students will be able to determine pressure drops in pipe flow.					
CO4	Students will be able to determine equivalent length of various fittings in pipe line.					

List of Experiments:

1. Flow measurement by Venturimeter.
2. Flow measurement by Orifice meter.
3. Calibration of Rotameter.
4. Flow measurement by V-notch.
5. Pressure drop in pipe flow.
6. Verification of Bernoulli's Theorem.
7. Determine friction factor in pipes of different material.
8. Flow measurement by Pitot tube.
9. To obtain the equivalent length of various fittings.

MPC- 201N ENVIRONMENTAL STUDIES

L	T	P	Sessional	Exam	Time
3	-	-	25	75	3H

UNIT I

The multidisciplinary nature of environmental studies.Definition, Scope and Importance. Need for public awareness. Natural Resources: Renewable and Non-Renewable Resources: Natural resources and associated problems.

(a) Forest Resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

(b) Water Resources- Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

(c) Mineral Resources- Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

(d) Food Resources- World Food Problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

(e) Energy Resources- Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies.

(f) 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 lifestyle.

UNIT II

Ecosystem- 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, esturaries

Field Work: Visit to a local area to document Environment assets-river/forest/grassland/ hill/ mountain. Visit to a local polluted site-Urban /Rural/Industrial/Agricultural. Study of common plants, insects and birds.Study of simple ecosystems-pond, river, hill, slopes etc. (Field work equals to 5 lecture hours).

UNIT III

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

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- cause, 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 IV

Social Issues and the Environment, From unsustainable to sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, 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, 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.

Suggested Text Books & References:

1. Environmental Studies- Deswal and Deswal. DhanpatRai& Co.
2. Environmental Science & Engineering Anandan, P. and Kumaravelan, R. 2009. Scitech Publications (India) Pvt. Ltd., India
3. Environmental Studies. Daniels Ranjit R. J. and Krishnaswamy. 2013. Wiley India.
4. Environmental Science- Botkin and Keller. 2012. Wiley, India.

HS-201N Fundamentals of Management

Lecture	Tutorial	Practical	Major Test	Minor Test	Total Time
3	1		75	25	3H

Purpose To make the students conversant with the basics concepts in management thereby leading to nurturing their managerial skills
COURSE OUTCOMES
CO1 An overview about management as a discipline and its evolution
CO2 Understand the concept and importance of planning and organizing in an organization
CO3 Enabling the students to know about the importance of hiring and guiding the workforce by understanding the concept of leadership and communication in detail
CO4 To understand the concept and techniques of controlling and new trends in management

UNIT-1

Introduction to Management: Meaning, Definition, nature, importance & Functions, Management as Art, Science & Profession-Management as social System, Concepts of management-Administration

Evolution of Management Thought: Development of Management Thought-Scientific management, Administrative Theory of Management, Bureaucratic Organization, Behavioral approach (Neo Classical Theory): Human Relations Movement; Behavioral Science approach; Modern approach to management –Systems approach and contingency approach.

UNIT-II

Planning: nature, purpose and functions, types of plans, planning process, Strategies and Policies:Concept of Corporate Strategy, formulation of strategy, Types of strategies, Management by objectives (MBO), SWOT analysis, Types of policies, principles of formulation of policies

Organizing: nature, importance, process, organization structure: Line and Staff organization, Delegation of Authority and responsibility, Centralization and Decentralization, Decision Making Process , Decision Making Models, Departmentalization: Concept and Types (Project and Matrix),formal & informal organizations

UNIT-III

Staffing: concept, process, features; manpower planning; Job Analysis: concept and process; Recruitment and selection: concept, process, sources of recruitment; performance appraisal, training and development Directing: Communication-nature, process, formal and informal, barriers to Effective Communication, Theories of motivation-Maslow, Herzberg, McGregor ; Leadership–concept and theories, Managerial Grid, Situational Leadership. Transactional and Transformational Leadership

UNIT-IV

Controlling: concept, process, types, barriers to controlling, controlling Techniques: budgetary control, Return on investment, Management information system-MIS , TQM-Total Quality Management, Network Analysis-PERT and CPM. Recent Trends in Management:-Social Responsibility of Corporate Social Responsibility (CSR) and business ethics. Functional aspects of business: Conceptual framework of functional areas of management-Finance; Marketing and Human Resources

Text books

1.Management Concepts -Robbins, S.P; Pearson Education India
2.Principles of Management -Koontz &O'Donnel; (McGraw Hill)

Recommended books

1.Business Organization and Management –Basu ; Tata McGraw Hill
2.Management and OB--Mullins; Pearson Education
3.Essentials of Management –Koontz, Tata McGraw-Hill
4.Management Theory and Practice –Gupta, C.B; Sultan Chand and Sons, new Delhi
5.Prasad, Lallan and S.S. Gulshan. Management Principles and Practices. S. Chand & Co. Ltd., New Delhi.
6.Chhabra, T.N. Principles and Practice of Management. DhanpatRai& Co., Delhi.
7.Organizational behavior –Robins Stephen P; PHI.

NOTE: Eight questions are to be set in all by the examiner taking two questions from each unit. Students will be required to attempt five questions in all, selecting at least one question from each unit.

CHE - 202N	HEAT TRANSFER					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessional**	**Total**	**Time**
4	**1**	**-**	**75**	**25**	**100**	**3**
Purpose	To understand the basic concept and applications of various modes of heat transfer, boiling & condensation, Evaporation and types of Heat exchangers.					
Course Outcomes						
CO1	To understand the concept of basic equations of steady state condition in slab, cylinder and sphere, Critical thickness of insulation, Use of transient temperature charts and lumped system analysis.					
CO2	To understand the basic concept of convection, boiling & condensation					
CO3	To familiarize with the concept of various types of Heat exchangers.					
CO4	To familiarize with the concept of Radiation and Evaporations.					

Paper Setter's Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT I

Introduction: Basis equation - one dimensional, two dimensional and three dimensional, Steady state condition in slab, cylinder and sphere, Critical thickness of insulation. Finned surfaces, Transient conduction Analytical solution for slabes, Use of transient temperature charts for slabs, cylinders and sphere and lumped system analysis.

UNIT II

Convection: Concept of free and forced convection. Dimensional Analysis.Empirical correlations for free and forced convection for various shapes.

Boiling & Condensation: Filmwise and dropwise condensation, Laminar film condensation on a vertical plate, Film condensation on tubes, Boiling regimes, Bubble growth and nucleate boiling.

UNIT III

Heat Exchangers: Basic types of heat exchanges, Overall heat transfer coefficient, log mean temperature difference, Effectiveness and NTU methods for heat exchanger analysis.

UNIT IV

Radiation: Black body radiation, radiation properties, concept of shape factor, Radiation exchange in enclosure with black surface.

Evaporators: Types of evaporators, Single & Multiple effect evaporators, calculationsfor surface area requirement. Methods of feeding.

Books Recommended:

1. W. L. McCabe & J. C. Smith, Unit operations of chemical engineering, McGraw Hill Book Company, New Delhi
2. J. P. Holman, Heat Transfer, McGraw Hill Book Company, New Delhi.
3. M. L. Oziski, Heat Transfer, McGraw Hill International Editions.
4. A. J. Chapman, Heat, Macmillan Indian, Delhi.
5. D. S. Kumar, Heat and Mass Transfer, S.K. Kataria and Sons, Delhi. .
6. Kirk, D. Hegen, Heat Transfer with Applications, Prentice Hall International. Inc., New Jercy.

CHE-204N	CHEMICAL TECHNOLOGY-I					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessional**	**Total**	**Time**
3	**0**	**-**	**75**	**25**	**100**	**3**
Purpose	To provide the knowledge and information about the chemical industries involving process technology, availability of raw materials, preparation of flow sheet and material of construction.					
Course Outcomes						
CO1	To familiarize about the Industrial and Fuel Gases, possible impurities, and water treatment methods.					
CO2	To familiarize about the manufacturing of various fertilizers.					
CO3	To understand the various manufacturing processes of Chlor alkali and Chlor alkali industry.					
CO4	To familiarize with the manufacturing of Sulphur and Ceramics.					

Paper Setter's Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT I

Industrial and Fuel Gases: Oxygen, nitrogen, hydrogen, natural gas, water gas, coal gas, carburetted Water gas: Sources and constraints, dissolved impurities, suspended impurities, colloidal impurities, hardness of water, water softening, ion exchange, Zeolite-processes.

UNIT II

Fertilizer industry: Ammonia, nitric acid, ammonium sulfate, ammonium nitrate, urea, NPK, phosphorus, phosphoric acid, phosphatic fertilizers, diammoniumphosphate.

UNIT III

Chlor-alkali industry: Solvey and modified solvey process, Brine Electrolysis manufacture of caustic soda and chlorine, diaphragm cells, membrane cells, mercury cell, hydrochloric acid.

UNIT IV

SulphurandCeramics: Sulphur dioxide, sulphuric acid, oleum, cement, glassand refractories.

Books Recommended:

1. C.E. Dryden, Outline of Chemical Technology: East- West Press Pvt Ltd., New Delhi.
2. G. T. Austin, Shreve's Chemical Process Industries, McGraw Hill Book Company, New Delhi.
3. Chemical Engineering Education Development centre- "Chemical Technology I, II, III, IV, Mannual of Chemical Technology, Indian Institute of Technology, Madras".
4. S. D. Shukla and G. N. Pandey, A text book of Chemical Technology Vol I, Vikas Publishing House Pvt.Ltd., New Delhi.
5. S. D. Shukla and G. N. Pandey, A text book of Chemical Technology Vol. II, Vikas Publishing House Pvt.Ltd., New Delhi.

CHE - 206N	MECHANICAL OPERATIONS					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessional**	**Total**	**Time**
4	**1**	**-**	**75**	**25**	**100**	**3**
Purpose	To understand the concept of unit operation and their role in chemical engineering industries, Types of mechanical operations, various size reduction techniques.					
Course Outcomes						
CO1	To Introduce the concept of unit operation and their role in chemical engineering industries, Types of mechanical operations, Particle size and shape, Measurement and analysis, various size reduction techniques.					
CO2	To familiarize with the concept of various methods of mixing of solids, Size enlargement: scope and applications and techniques, Filtration.					
CO3	To understand the concept of Drag force, Settling velocity of a particle in a fluid, Stoke's law, Elutriation, Classifiers, Thickeners, Gravity separation, concept of relative velocity.					
CO4	To familiarize with the concept of Storage of Solids, Flow of solids by gravity, Transport of solids, particle collection systems.					

Paper Setter's Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT I

Introduction to Unit operations: Introduction to unit operation and their role in chemical engineering industries, Types of mechanical operation, Particle size and shape, Particulate mass, Size and shape distributions, Measurement and analysis, Concept of average diameter, Screening, types of screens, effectiveness of screens, particle separation efficiency.Mixing of solids, blending, kneading, etc., Filtration: classification of filters, theory of filtration, cake resistance.

UNITII

Size Reduction and Size Enlargement of Solids: Size reduction, Crushing, Grinding and ultrafine grinding and selection of equipment, Laws of grinding. Construction and working principle of mostly used equipments, viz., Jaw crushers, gyratory crushers, hammer mill, crushing rolls, ball mills, and fluid energy mills. Size enlargement: scope and applications, size enlargement techniques, Agglomeration and compaction.

UNITIII

Drag force and Separation of solid particles: Flow around' single particle, Drag force & drag coefficient, Settling velocity of a particle in a fluid, Stoke's law, Elutriation, Classifiers, Hindered & free settling of particles, Thickeners, Gravity separation, concept of relative velocity.

UNIT IV

Storage, Handling & Transport of Solids: Storage of Solids, Flow of solids by gravity, Transport of solids by screw/ belt conveyors, pneumatic conveyors, cyclones, Bag filters, Electrostatic precipitators; particle collection systems.

Books Recommended:

1. J. M. Coulson & J. F. Richardson, Chemical Engineering, Vol. II, Pergamon press.
2. G. G. Brown, Unit Operations, Asia publishing House.
3. A. S. Foustetal, Principle of Unit Operations, John Wiley.
4. W. L. McCabe & J. C. Smith, Unit Operations of Chemical Engineering,McGraw Hill.
5. B. C. Bhattacharya & C. M. Narayanan, Mechanical Operations for Chemical Engineers,Khanna publishers.

CHE - 208N	MEMBRANE PROCESSES					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessional**	**Total**	**Time**
3	**0**	**-**	**75**	**25**	**100**	**3**
Purpose	To understand basics of various unit processes such as Alkylation, Hydrogenation, Sulfonation, Halogenation and Nitration processes.					
Course Outcomes						
CO1	To understand the membrane transport mechanisms.					
CO2	To familiarize with the physical and chemical properties of membranes.					
CO3	To familiarize with the various membrane formation techniques.					
CO4	To familiarize with thevarious separation processes.					

Paper Setter's Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT- I

Mechanisms of Membrane Transport: Fundamental, mechanisms of membrane transport. Gaseous diffusion. Membrane, osmosis and reverse osmosis, porosity, permeability, salt rejection, different membrane processes.

UNIT- II

Properties of Membrane: Physical and chemical properties of membranes, cellulosic and non-cellulosic membrane.

UNIT- III

Membrane Formation Techniques: Techniques of membrane formation, membrane characteristics, type of membrane modules, liquid membranes.

UNIT- IV

Separation Processes: Design, operation, maintenance and industrial applications of different membrane separation processes such as Reverse Osmosis, Ultra filtration, Electro Dialysis, nanofiltrationpervaporation dialysis.

Books Recommended:

1. S. Souriranjan, Reverse osmosis and synthetic Membranes - Technology and Engineering, National Research Council, Canada (1977).
2. S. Soururajan and Matusuura, Reverse Osmosis/ Ultra filtration Process Principles, National Research Council of Canada (1985)
3. B. Halley Baum, Membrane Separation Processes. Elsevier Scientific and White. R. A. publications.
4. Wilson and Sirkar, Membrane Handbook, Mc Grew Hill, London(2001).
5. Nune and Peinemann, Membrane Technology in Chemical Industries, Wiley, New York (2000).

CHE - 210N	PROCESS INSTRUMENTATION					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessional**	**Total**	**Time**
3	**0**	**-**	**75**	**25**	**100**	**3**
Purpose	To provide knowledge about fundamental principles of process instruments for various parameters.					
Course Outcomes						
CO1	To understand the general principles of measurement, static and dynamic characteristics of instruments, sensors and transducers.					
CO2	To understand the fundamentals of temperature measurement and liquid level measurement					
CO3	To familiarize with the concept of flow measurements, pressure measurement					
CO4	To familiarize with the basic principles of composition measurement, measurement of viscosity, conductivity, humidity, pH and nuclear radiations, Gas chromatography, mass spectroscopy.					

Paper Setter's Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT I

Introduction: General principles of measurement, static and dynamic characteristics of instruments, sensors and transducers.

Process Instruments

Recording instruments, indicator and signaling instruments, transmission of instrument reading control centre, instrumentation diagram, on line instrumentation in modern plants.

UNIT II

Temperature Measurement: Thermocouple resistance thermometers, bimetallic thermistors, optical and radiation pyrometer.

Liquid Level Measurement: Direct and differential method for the measurement in open pressure vessels.

UNIT III

Flow Measurements: Use of obstruction type meters, variable area pressure probe, positive displacement type meters, electromagnetic flowmeters and mass flow meters.

Pressure Measurement: Use of manometer, bourdon and bellow, type gauge, measurement of vacuum, pressure transducers.

UNIT IV

Miscellaneous Measurements: Composition measurement, measurement of viscosity, conductivity, humidity, pH and nuclear radiations. Instruments for gas analysis.Gas chromatography, mass spectroscopy.

Books Recommended:

1. D. P. Eckman, Industrial Instrumentation, Wiley Eastern Ltd, 1975.
2. W.G. Andrew, Applied Instrumentation in process Industries Vol. I &II, Gulf K Pub. Co., 1947.
3. F.W. Kerk, Instrumentation, Wiley Eastern Ltd., Rimbai&Tarapore D.B., 1983.
4. D. N. Considine, Process Instruments and controls handbook, MGH.

CHE-212-N	NANOTECHNOLOGY					
Lecture	**Tutorial**	**Practical**	**Theory**	**Sessional**	**Total**	**Time**
3	**0**	**-**	**75**	**25**	**100**	**3**
Purpose	To provide knowledge about the nanoscience and nanotechnology and its applications.					
Course Outcomes						
CO1	To understand the about the physical state, structure and bonding of nanoscience and nanotechnology.					
CO2	To understand the synthesis of nanomaterials.					
CO3	To familiarize with the characterization techniques of nanomaterials.					
CO4	To familiarize with the applications of the nanotechnology.					

Paper Setter's Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

Unit-I

Introduction: the physics of solid state; Structure & Bonding, Elements of nanoscience& nanotechnology.

Unit-II

Synthesis of nanomaterials: General approaches, Physical Methods, Chemical Methods & Biological Methods; Properties of nanomaterials: Mechanical, Structural, Thermal, Electrical & Optical properties.

Unit-III

Characterization techniques of nanomaterials: Microscopy; Spectroscopy; & Diffraction techniques; Some special nanomaterials: Carbon nanotubes, Porous silicon, Zeolites, Aerogels, Core-shell nanoparticles.

Unit-IV

Application: Nanolithography, Nanocomposites, Nanoparticles as catalyst, conducting polymers; nanotechnology: DNA Nanowires, Nanomedicines.

Books Recommended:

1. Nanotechnology: Principles & Practices; Sulabh K. Kulkarni, Capital Publishing Company, Kolkata References.
2. Principles of nanotechnology: N. Phanikumar; Scitech, Kolkata.
3. Introduction to nanotechnology: Charles P. Poole & Frank Li Owens, Wiley India (p) Ltd, New Delhi.

CHE- 214N	MECHANICAL OPERATIONS LAB					
Lecture	**Tutorial**	**Practical**	**Practical**	**Sessional**	**Total**	**Time**
-	**-**	**3**	**60**	**40**	**100**	**3**
Purpose	To provide the practical knowledge for the application of theories of Drag coefficient, Sedimentation, size reduction, grinding, screen analysis, separation of particles from air, filtration of slurry, Elutriation and the pressure drop in packed bed.					
Course Outcomes						
CO1	Students will be able to know the concept of Drag coefficient, Sedimentation, Size reduction.					
CO2	Students will be able to know the principle and working of grinding in a ball mill, separation of dust particles from air and filtration of slurry.					
CO3	Students will be able to know the solid separation techniques and size distribution of particles					
CO4	Students will be able to determine the pressure drop in a packed bed.					

LIST OF EXPERIMENTS:

1. Drag coefficient:Determination of drag coefficient from the plot of drag coefficient Vs modified Reynolds No. and verify Stroke's law.
2. To carry out Batch Sedimentation.
3. Size reduction: To determine the efficiency of the roll crusher for crushing a material of known working index.
4. Grinding in a Ball Mill:
   (a) To determine the critical speed, work index, Bond's law,Rittenger's law, Kick's law.
   (b) To determine the surface area generation for the given amount of feed.
5. Screen Analysis: To analyze sample for size distribution using sieve shaker.
6. Separation of dust particles from air:
   (a) To study the performance of given cylinder (efficiency vs. dp).
   (b) To study the effect of inlet gas velocity on overall efficiency.
   (c) To study the effect of solid concentration or dp or Drop.
7. Packed bed: Determination of pressure drop packed bed
8. Filtration of slurry: To calculation specific cake resistance and medium resistance in plate and frame filter press.
9. Elutriation: To analyze given sample of sand using Elutriator.

CHE- 216N	HEAT TRANSFER LAB					
Lecture	**Tutorial**	**Practical**	**Practical**	**Sessional**	**Total**	**Time**
-	**-**	**3**	**60**	**40**	**100**	**3**
Purpose	To provide practical knowledge of the application of different modes of heat transfer theory, heat transfer through composite walls, pipe and rod.					
Course Outcomes						
CO1	Student will be able to determine heat transfer coefficient.					
CO2	Student will be able to determine Filmwise and Dropwise condensation.					
CO3	Student will be able to determine LMTD, Thermal conductivity, Emissivity.					
CO4	Student will be able to determine Stefan Boltzman constant.					

LIST OF EXPERIMENTS:

1. To determine total thermal resistance and total thermal conductivity of composite wall.
2. To determine the thermal conductivity of insulating powder.
3. To find out heat transfer coefficient of vertical cylinder in natural convection.
4. (a) To study the unsteady state heat transfer and compare theoretical vs. practical value of response
   (b) To determine the convective heat transfer coefficient.
5. (a) To determine the heat flow rate through the lagged pipe for known value of thermal conductivity of lagging material.
   (b) To plot the temperature distribution across the lagging material.
6. To calculate LMTD for parallel and counter flow in double pipe heat exchanger.
7. To find average heat transfer coefficient for dropwise and filmwise condensation and find the overall heat transfer coefficient.
8. To study the temperature distribution along the length of a pin fin under natural convection heat transfer.
9. To study the temperature distribution along the length of a pin fin under forced convection heat transfer.
10. To find the emissivity of the test plate surface at various temperature and compare with the actual reported value.
11. To determine the thermal conductivity of metal rod.
12. (i) To demonstrate super thermal conductivity heat pipe and to compare its working with that of best conductor
    (ii) To plot temperature vs. time response of three pipes
    (iii) Temperature distribution along length of three members at different time intervals can be plotted and nearly isothermal temperature distribution in case of heat pipe
13. To find out the Stefan Boltzmann constant
14. To find heat transfer coefficient for heated pipe and air is forced to flow through it for different air flow

MPC-202N ENERGY STUDIES

L	T	P
3	-	-

Sessional: 25 Marks
Exam: 75 Marks
Total: 100 Marks
Time: 3 hrs

UNIT-I

Introduction: Types of energy, Conversion of various forms of energy, Conventional and Nonconventional sources, Need for Non-Conventional Energy based power generation.
Energy Management: General Principles of Energy Management, Energy Management Strategy.
Energy Audit & Tariffs: Need, Types, Methodology and Approach.

UNIT-II

Conventional Energy sources: Selection of site**,** working of Thermal, Hydro, Nuclear and Diesel power plants and their schematic diagrams & their comparative advantages- disadvantages.

UNIT-III

Non Conventional Energy sources: Basicprinciple, site selection and power plant layout of Solar energy, photovoltaic technologies, PV Systems and their components, power plant layout of Wind energy, layout of Bio energy plants ,Geothermal energy plants and tidal energy plants.

UNIT-IV

Energy Scenario: Lay out of power system, Role of Energy in Economic development, energy demand, availability and consumption, Commercial and Non-commercial energy, Indian energy scenario, long term energy scenario, energy pricing, energy sector reforms in India, energy strategy for the future.

Paper Setter's Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

Suggested Text Books & References:

1. Energy Studies-Wiley and Dream tech India
2. Soni, Gupta, Bhatnagar: Electrical Power Systems – DhanpatRai& Sons
3. NEDCAP: Non Conventional Energy Guide Lines
4. G.D. Roy: Non conventional energy sources
5. B H Khan: Non Conventional energy resources - - McGraw Hill
6. Meinel A B and Meinal M P,Addison :Applied Solar Energy- Wesley Publications
7. George Sutton: Direct Energy Conversion - McGraw Hill