B.TECH

(ENVIRONMENTAL ENGINEERING)

(Effective from the admitted batch of 2021-22)

Scheme and Syllabus

DEPARTMENT OF ENVIRONMENTAL SCIENCE, ENGINEERING AND MANAGEMENT

AU COLLEGE OF ENGINEERING

ANDHRA UNIVERSITY

VISAKHAPATNAM

ANDHRA UNIVERSITY
DEPARTMENT OF ENVIRONMENTAL SCIENCE, ENGINEERING AND MANAGEMENT

B.Tech. (Environmental Engineering)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The undergraduate program is intended to provide engineering and technical aptitude in Environmental Engineering field. It will enable them to utilize the knowledge to pursue a career and professional accomplishment in the field of environmental engineering. The objectives of the program are to

PEO1. Educate the students for successful careers in Environmental Engineering field that meets the needs of National and International organizations

PEO2. Impart the knowledge in mathematical, scientific and engineering fundamentals to identify, formulate and design engineered solutions to environmental issues and challenges in air, water, land and bio environment

PEO3. Provide basic principles of environment, concepts of environmental protection, and their significance in the socio-economic development

PEO4. Apply various aspects of sustainable development elements in the design and development of best management practices for environmental management

PEO5. Engross in life long process of learning to keep themselves abreast of current developments in the field of environmental engineering and management and promote skills to work in collaboration with others.

PROGRAMME OUTCOMES (POs)

On successful completion of the undergraduate programme, the candidate will have the ability to

PO1. Apply the mathematics, science and engineering principles to understand the environmental issues and challenges.

PO2. Understand, identify, formulate and solve various environmental engineering problems

PO3. Modelling environmental systems using modern tools and techniques

PO4. Use modern engineering tools, software and equipment to analyze problems.

PO5. Introduce the principles and concepts of various aspects of sustainable development elements in the design and development projects or activities

PO6. Pursue life-long learning as a means of enhancing the knowledge and skills in treatment technologies and management practices

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1. Design a system, component and/or process as per needs of the project with appropriate consideration for the environmental impact, public health and safety

PSO2. Understand and assess the impact of engineering projects and solutions on the environment and society assess the potential environmental impacts of development projects and design mitigation measures

SCHEME AND SYLLABI
(With effect from 2021-22 admitted batches)

B.Tech. I year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
EN 1101	BS	Mathematics – I	4	0	30	70	100	3
EN 1102	BS	Physics	4	0	30	70	100	3
EN 1103	ES	Engineering Graphics	2	3	30	70	100	3
EN 1104	ES	Civil and Environmental Engineering Materials	4	0	30	70	100	3
EN 1105	ES	Engineering Mechanics	4	0	30	70	100	3
EN 1106	ES	Workshop	0	3	50	50	100	1.5
EN 1107	BS	Physics Lab	0	3	50	50	100	1.5
EN 1108	ES	Engineering Geo lab	0	3	50	50	100	1.5
							Total Credits	**19.5**

B.Tech. I year - II Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
EN 1201	BS	Mathematics – II	4	0	30	70	100	3
EN 1202	BS	Green Chemistry	4	0	30	70	100	3
EN 1203	HSS	English	4	0	30	70	100	3
EN 1204	ES	Computer Programming & Numerical Methods	4	0	30	70	100	3
EN 1205	ES	Surveying and Geomatics	4	0	30	70	100	3
EN 1206	HSS	English Language Lab	0	3	50	50	100	1.5
EN 1207	BS	Chemistry Lab	0	3	50	50	100	1.5
EN 1208	ES	Computer Programming & Numerical Methods Lab	0	3	50	50	100	1.5
							Total Credits	**19.5**

B.Tech. II year - I Semester

Course code	Category	Course Title	Hours per Week	Internal Marks	External Marks	Total Marks	Credits

			L	P				
EN 2101	BS	Numerical Methods	4	0	30	70	100	3
EN 2102	PC	Mechanics of Solids	4	0	30	70	100	3
EN 2103	PC	Environmental Chemistry	4	0	30	70	100	3
EN 2104	PC	Fluid Mechanics	4	0	30	70	100	3
EN 2105	HSS	Managerial Economics	4	0	30	70	100	3
EN 2106	PC	Strength of Materials Laboratory	0	3	50	50	100	1.5
EN 2107	PC	Fluid Mechanics Laboratory	0	3	50	50	100	1.5
EN 2108	PC	Surveying Field Work	0	3	50	50	100	1.5
EN 2109	SC	Safety, Health and Environment	1	2	50	50	100	2
EN 2110	MC	Professional Ethics & Universal Human values	0	0	-	100	100	0
EN 2111	MC	NCC/NSS	0	2	-	-	-	0
							Total credits	**21.5**

B.Tech. II year - II Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
EN 2201	ES	Environmental Microbiology	4	0	30	70	100	3
EN 2202	PC	Structural Analysis	4	0	30	70	100	3
EN 2203	PC	Python Programming	4	0	30	70	100	3
EN 2204	PC	Ecology and Eco-system Engineering	4	0	30	70	100	3
EN 2205	PC	Water Supply Engineering	4	0	30	70	100	3
EN 2206	PC	Environmental Engineering lab	0	3	50	50	100	1.5
EN 2207	PC	Python Programming lab	0	3	50	50	100	1.5
EN 2208	SC	Environmental Instrumentation Analysis	1	2	50	50	100	2
EN 2209	MC	Environmental Science	0	0	-	100	100	0
							Total credits	**20**
Internship - I								

B.Tech. III Year - I Semester

Course code	Category	Course Title	Hours per week	Internal Marks	External Marks	Total Mark	Credits

			L	P			s	
EN 3101	PC	Hydraulics and Hydraulic Machinery	4	0	30	70	100	3
EN 3102	PC	Environmental Impact Assessment and Carrying Capacity	4	0	30	70	100	3
EN 3103	PC	Wastewater Collection and Treatment	4	0	30	70	100	3
EN 3104	PE	Professional Elective- I	4	0	30	70	100	3
EN 3105	OE	Open Elective	4	0	30	70	100	3
EN3106	PC	Geotechnical Engineering Lab	0	3	50	50	100	1.5
EN 3107	PC	Hydraulic Engineering Lab	0	3	50	50	100	1.5
EN 3108	SC	Environment and Pollution Control Facilities operator skills	1	2	50	50	100	2
EN 3109	INT	Internship - I			50	50	100	2
							Total Credits	**22**

B.Tech. III Year - II Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
EN 3201	PC	Air Pollution and Control	4	0	30	70	100	3
EN 3202	PC	Solid and Hazardous Waste Management	4	0	30	70	100	3
EN 3203	PC	Industrial Pollution Control and Management	4	0	30	70	100	3
EN 3204	PE	Professional Elective - II	4	0	30	70	100	3
EN 3205	OE	Open Elective - II	4	0	30	70	100	3
EN 3206	PC	Environmental Engineering Systems Design and Design Drawing	0	3	50	50	100	1.5
EN 3207	PC	Air and Noise Monitoring Laboratory	0	3	50	50	100	1.5
EN 3208	PC	Computer Applications in Environmental Engineering	0	3	50	50	100	1.5
EN 3209	SC	Soft Skills	1	2	50	50	100	2
							Total Credits	**21.5**
Internship - II								

B.Tech. IV Year - I Semester

Course code	Category	Course Title	Hours per week	Internal Marks	External Marks	Total Marks	Credits

			L	P				
EN 4101	PE	Professional Elective III	4	0	30	70	100	3
EN 4102	PE	Professional Elective IV	4	0	30	70	100	3
EN 4103	PE	Professional Elective V	4	0	30	70	100	3
EN 4104	OE	Open Elective III	4	0	30	70	100	3
EN 4105	OE	Open Elective IV	4	0	30	70	100	3
EN 4106	HSSE	HSS Elective	4	0	30	70	100	3
EN 4107	SC	Air Quality Monitoring	1	2	50	50	100	2
EN 4108	INT	Internship - II			50	50	100	2
							Total Credits	**22**

B.Tech. IV Year - II Semester

Course code	Category	Course Title	Internal Marks	External Marks	Total Marks	Credits
EN 4201	PROJ	Project work	100	100	200	14
					Total Credits	**14**

PROFESSIONAL ELECTIVES

1. Geotechnical Engineering
2. Elements of Coastal Engineering
3. Fundamentals of Chemical Reaction Engineering
4. Hydrology and Water Resources Engineering
5. Estimation, Specification and Contracts
6. Disaster management
7. Natural Resource Management and Accounting
8. Agricultural Pollution and Control
9. Circular Economy
10. Environmental Biotechnology and Bioremediation
11. Climate Change Impact Mitigation and Adaptation
12. Urban Storm Water Management
13. Fundamentals of Mass Transfer
14. Air and Water Quality Modelling
15. Integrated Water Resources Management
16. Reinforced Concrete Structures

OPEN ELECTIVES

1. Plumbing Services and Maintenance
2. Occupational Health and Industrial Hygiene
3. Sustainable Engineering
4. Environmental Law and Policy
5. Environmental Management System and Audit
6. Environmental and Sustainable Development
7. Wastewater Treatment Plant Operation and Maintenance
8. Water Shed and River Basin Management
9. Environmental Modelling and Simulation
10. Social and Ecological Impact Assessment
11. Environmental Economics
12. Green Technologies

HSS ELECTIVES

1. Organizational Behavior
2. Industrial Management and entrepreneurship
3. Operational Research

EN1101: MATHEMATICS-I

Course Objectives

- To transmit the knowledge of partial differentiation
- To know of getting maxima and minima of function of two variables and finding errors and approximations
- To evaluate double and triple integrals, volumes of solids and area of curved surfaces.
- To expand a periodical function as Fourier series and half-range Fourier series.

Course Outcomes

- Find the partial derivatives of functions of two or more variables.
- Evaluate maxima and minima, errors and approximations.
- Evaluate double and triple integrals, volumes of solids and area of curved surfaces.
- To expand a periodical function as Fourier series and half-range Fourier series.
- Have a fundamental understanding of Fourier series and be able to give Fourier expansions of a given function.

SYLLABUS

Partial Differentiation:
Introduction - Functions of two or more variables - Partial derivatives - Homogeneous functions – Euler's theorem - Total derivative - Change of variables – Jacobins. Mean value Theorems (without proofs)

Applications of Partial Differentiation:
Geometrical interpretation -Tangent plane and Normal to a surface -Taylor's theorem for functions of two variables - Errors and approximations -Total differential. Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers - Differentiation under the integral Sign - Leibnitz's rule.

Multiple Integrals:
Introduction - Double Integrals - Change of Order of Integration - Double Integrals in Polar Coordinates - Triple Integrals - Change of Variables.

Multiple Integrals-Applications:
Area enclosed by plane curves - Volumes of solids - Area of a curved surface - Calculation of Mass - Center of gravity - Moment of inertia - product of inertia – principal axes- Beta Function - Gamma Function - Relation between Beta and Gamma Functions. Error Function or Probability Integral.

Fourier Series:
Introduction - Euler's Formulae - Conditions for a Fourier Expansion - Functions having points of discontinuity - Change of Interval - Odd and Even Functions - Expansions of Odd or Even Periodic Functions, Half-Range Series - Parseval's Formula. Practical Harmonic analysis.

Text Book

1. Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43rd Edition, Khanna publishers.

Reference Books

1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K. International publishing house Pvt. Ltd.
2. Advanced Engineering Mathematics by Erwin Kreyszig.
3. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal, Lakshmi Publications.
4. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.
5. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.

*****

EN1102: PHYSICS

Course Objectives

- To impart knowledge in basic concept of physics of Thermodynamics relevant to engineering applications.
- To grasp the concepts of physics for electromagnetism and its application to engineering. Learn production of Ultra-sonics and their applications in engineering.
- To Develop understanding of interference, diffraction and polarization: connect it to a few engineering applications.
- To Learn basics of lasers and optical fibers and their use in some applications.
- To Understand concepts and principles in quantum mechanics and Nano-phase Materials. Relate them to some applications.

Course Outcomes:

- Understand the fundamentals of Thermodynamics and Laws of thermodynamics. Understand the working of Carnot cycle and concept of entropy.
- Gain Knowledge on the basic concepts of electric and magnetic fields. Understand the concept of the nature of magnetic materials. Gain knowledge on electromagnetic induction and its applications.
- Understand the Theory of Superposition of waves. Understand the formation of Newton's rings and the working of Michelson's interferometer. Remember the basics of diffraction, Evaluate the path difference. Analysis of Fraunhofer Diffraction due to a single slit
- Understand the interaction of matter with radiation, Characteristics of Lasers, Principle, working schemes of Laser and Principle of Optical Fiber. Realize their role in optical fiber communication.
- Understand the intuitive ideas of the Quantum physics and understand dual nature of matter. Compute Eigen values, Eigen functions, momentum of Atomic and subatomic particles using Time independent one-Dimensional Schrodinger's wave equation. Understand the fundamentals and synthesis processes of Nanophase materials.

SYLLABUS

THERMODYNAMICS

Introduction, Heat and Work, First law of thermodynamics and applications, Reversible and Irreversible process, Carnot cycle and Efficiency, Second law of thermodynamics, Carnot's Theorem, Entropy, Second law in terms of entropy, Entropy and disorder, Third law of thermodynamics (statement only).

ELECTROMAGNETISM

Concept of electric flux, Gauss's law - some applications, Magnetic field - Magnetic force on current, torque on current loop, The Biot-Savart's Law, B near a long wire, B for a circular Current loop, Ampere's law, B for a solenoid, Hall effect, Faraday's law of induction, Lenz's law, Induced magnetic fields, Displacement current, Maxwell's equations (no derivation), Magnetic materials: Classification of magnetic materials and properties.

Ultra-sonics: Introduction, Production of ultra-sonics – Piezoelectric and Magnetostriction methods, acoustic grating, applications of ultra-sonics.

OPTICS

Interference: Principles of superposition – Young's Experiment – Coherence - Interference in thin films (reflected light), Newton's Rings, Michelson Interferometer and its applications.

Diffraction: Introduction, Differences between interference and diffraction, Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at a single slit (Qualitative and quantitative treatment).

Polarization: Polarization by reflection, refraction and double refraction in uniaxial crystals, Nicol prism, Quarter and Half wave plate, circular and elliptical polarization.

LASERS and FIBRE OPTICS

Introduction, characteristics of a laser beam, spontaneous and stimulated emission of radiation, population inversion, Ruby laser, He-Ne laser, Semiconductor laser, applications of lasers

Introduction to optical fibers, principle of propagation of light in optical fibers, Acceptance Angle and cone of a fiber, Numerical aperture, Modes of propagations, classification of fibers, Fiber optics in communications, Application of optical fibers.

MODERN PHYSICS

Introduction, De Broglie concept of matter waves, Heisenberg uncertainty principle, Schrodinger time independent wave equation, application to a particle in a box. Free electron theory of metals, Kronig - Penney model (qualitative treatment), Origin of energy band formation in solids, Classification of materials into conductors, semi-conductors and insulators.

Nanophase Materials

Introduction, properties, Top-down and bottom up approaches, Synthesis - Ball milling, Chemical vapor deposition method, sol-gel methods, Applications of nano materials.

Text books

1. Physics by David Halliday and Robert Resnick – Part I and Part II - Wiley.
2. A textbook of Engineering Physics, Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S. Chand
3. Engineering Physics by R.K. Gaur and S.L. Gupta –Dhanpat Rai

Reference Books

1. Modern Engineering Physics by A.S. Vadudeva
2. University Physics by Young and Freedman.

*****

EN1103: ENGINEERING GRAPHICS

Course Objectives

- Understand the basics of Engineering Graphics and BIS conventions.
- Develop the graphical skills for communication of concepts, ideas and design of engineering products through technical drawings
- Demonstrate and practice the various profiles/curves used in engineering practice through standard procedures.
- Demonstrate and practice the orthographic projections of points, lines, planes, solids and section of solids
- Demonstrate and practice the development of surfaces of simple solids
- Familiarize the basic concept of isometric views clearly.

Course Outcomes

- Develop simple engineering drawings by considering BIS standards.
- Able to draw different engineering curves with standard Procedures
- Comprehend the basics of orthographic projections and deduce orthographic projections of points, lines, planes and solids at different orientations in real life environment.
- Visualize clearly the sections of solids.
- Apply the concepts of development of surfaces while designing/analyzing any product.
- Recognize the significance of isometric drawing to relate 2D environment with 3D environment.

SYLLABUS

Introduction:
Lines, Lettering and Dimensioning, Geometrical Constructions, and Scales.
Curves:
Conic sections: General construction of ellipse, parabola and hyperbola. Construction of involutes of circle and polygons only. Normal and tangent to curves.
Projections of Points:
Principal or Reference Planes, Projections of a point situated in any one of the four quadrants.
Projections of Straight Lines:
Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane.
Projections of Straight Line Inclined to Both the Reference Planes:
Projections of Planes: Projection of Perpendicular planes: Perpendicular to both reference planes, perpendicular to one reference plane and parallel to other reference plane and

perpendicular to one reference plane and inclined to other reference plane. Projection of Oblique planes. Introduction to Auxiliary Planes.

Projections of Solids:

Types of solids: Poly-hedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to other and axes inclined to both the reference planes.

Sections of Solids:

Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids (Prism, Pyramid, Cylinder and Cone) in simple position only.

Development of Surfaces:

Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

Isometric Views:

Isometric projection, Isometric scale and Isometric view. Isometric view of Prisms, Pyramids, cylinder, cone, and their combinations.

Text Book

1. Elementary Engineering Drawing by N.D.Bhatt, Charotar Publishing House

Reference

1. Engineering Graphics by K.L. Narayana and P. Kannaiah, Tata Mc-Graw Hill

*****

EN 1104: CIVIL AND ENVIRONMENTAL ENGINEERING MATERIALS

Course Objectives

- Student can enlisting the various materials of different types of stones, cement, bricks, timber, lime products, tar, bitumen, metal, sand, paints, admixtures, etc...used in building construction
- Student will have the capability of understanding the different processes of brick and cement manufacturing, and their types and uses.
- Impart the knowledge on green building materials

Course Outcomes

After completion of the course, the student will have the

- Capability of testing of building construction materials like cement, bricks, aggregate, etc. to find various properties of them
- Capability of preservation of building construction materials like cement, bricks, aggregate, etc. from the external agencies, weather, etc.
- Understand the design concepts of different types of windows, Doors and staircases etc.
- Ability to introduce environmental friendly materials in the built environment

SYLLABUS

Masonry: Different Types of Stone Masonry – Plan, Elevation, Sections of Stone Masonry Works – Brick Masonry – Different Types of Bonds – Plan, Elevation and Section of Brick

Bonds up to Two-Brick Wall Thickness – Partition walls – Different Types of Block Masonry – Hollow Concrete Blocks – FAL-G Blocks, Hollow Clay Blocks.

Paints, Varnishes: Constituents and Characteristics of Paints, Types of Paint, their uses and preparation on Different Surfaces, Painting Defects, Causes and Remedies. Constituents of Varnishes, Uses of Varnishes, Different Kinds of Varnishes, Polishes. Painting of Interior Walls, Exterior Walls, Wooden Doors and Windows – Steel Windows – Various Types of Paints (Chemistry of Paints not included) Including Distempers; Emulsion Paints etc., Varnishes Wood Work Finishing Types.

Asbestos, Asphalt Bitumen and Tar: Availability and uses of Asbestos, Properties of Asbestos, Various Types of Asbestos, Difference Between Asphalt and Bitumen, Types, Uses and Properties of Asphalt and Bitumen, Composition of Coal Tar, Wood Tar, Mineral Tar and Naphtha.

Roofing: Mangalore Tiled Roof, RCC Roof, Madras Terrace, Hollow Tiled Roof, Asbestos Cement, Fibred Glass, Aluminum, G.I. Sheet Roofing's. Wooden and steel, King Post and Queen Post Trusses.

Wooden Doors and Windows: Parallel – Glazed – Flush Shutters, Plywood, Particle Board Shutters – Aluminum, PVC, Steel Doors, Windows and Ventilators, various types of Windows, Glazing – Different Varieties.

Green Materials: Bamboo, reclaimed wood, ferrock, recycled steel, low energy windows, Fiber Reinforced Polymer, cob (mix of subsoil, water, fibrous organic material), cork, recycled plastic, Ash Crete, Hempcrete, Mycelium is the vegetative part of a fungus fiber etc.

Text Books

1. Engineering Materials [Material Science] by Rangwala, Charotar Publications.
2. Building Construction by B.C. Punmia, Laxmi Publications.
3. Civil Engineering Construction Materials, S.K. Sharma, KBP House.

Reference Books

1. Concrete: Microstructure, Properties & Materials, PK Mehta, Tata McGra-Hill Publications.
2. Building Construction, Vol. II & III by W.B. Mckay, E.L.B.S. and Longman, UK.
3. Building Materials by S.K. Duggal, New Age International Publishers.

*****

EN1105: ENGINEERING MECHANICS

Course Objectives

- To provide students with practice in applying their knowledge of mathematics, science, and engineering, as well as to broaden this knowledge into the vast field of "rigid body Mechanics"
- To prepare students for advanced courses such as Mechanics of Solids and Structural Analysis

- To educate about distributed force systems, the centroid/center of gravity, how to locate centroids, moment of inertia, and how to find moment of inertia of composite figures and bodies
- To know frame types and analyze forces in truss members using the method of joints and the method of sections
- To understand the kinetics and kinematics of rigid bodies and use the work-energy technique to solve simple problems
- To discuss the implementation of work-energy and impulse-momentum to dynamic systems

Course Outcomes

- The student will be able to:
- Understand the Effect of forces and its components, the principle of Moments on wide variety of practical situations that are encountered by Engineers.
- Analyze forces in statically determinate structures using scalar and vector analytical techniques.
- Identify the significance of the centroid/center of gravity and locate the centroids of composite figures and bodies.
- Recognize the moment of inertia and the method for determining the moment of inertia of areas and bodies.
- Understand the dynamics of rigid bodies and how to solve simple problems using the work-energy approach and the virtual work method

SYLLABUS

Basic concepts:
Introduction to Engineering Mechanics – Scalar and Vector quantities – Forces – Characteristics of a force – Definitions and examples of various types of force systems – Definition of resultant – Composition and resolution of forces – Moment of a force – Principles of moments of force – Couples – characteristics of a couple – on Transformations of a couple – Resolution of a force into a force and couple. Resultants of Force Systems, Possible resultants of different types of force systems – Resultant of a concurrent, coplanar force system – Resultant of a non-concurrent coplanar force system – Resultant of a concurrent non-coplanar force system – Resultant of a parallel, non-coplanar force system – Resultant of a system of couples in space – Resultant of non-concurrent, non-coplanar, non-parallel force system – screw of Wrench.
Equilibrium: Free body diagrams – Equations of equilibrium for a concurrent coplanar force system – Equilibrium of Bodies acted on by two or three forces – Equilibrium of bodies acted on by non-concurrent coplanar force system – Equilibrium of bodies acted on by parallel, non-coplanar force system – Equilibrium of non-concurrent, non-coplanar non-parallel force system.
Draw a free body diagram (FBD) and evaluate the equilibrium of different force systems. Centroids and Centre of Gravity: Centre of gravity of parallel forces in a plane – Centre of gravity of parallel forces in space – centroids and Centre of gravity of composite bodies – Theorems of Pappus – Distributed Loads on Beams.
Moments of inertia: Definition – Parallel axis theorem for areas – Second moments of areas by integration – Radius of gyration of areas – Moments of inertia of composite areas – Parallel axis and parallel plane theorems for masses – Moments of inertia of masses by integration – Radius of gyration of mass – Moments of inertia of composite masses.

Friction: Nature of friction – Laws of friction – Coefficient of friction – Angle of friction – Cone of friction – Problems involving frictional forces – Frictional forces on flexible bands and belts – Rolling friction.
Method of Virtual Work: Principle of virtual work – Equilibrium of ideal system – Stability of equilibrium.
Kinematics : Absolute Motion : Introduction – Recapitulation of basic terminology of mechanics – Newton's Laws – Introduction to Kinematics of Absolute Motion – Rectilinear motion of a particle – Angular motion of a line – Curvilinear motion of a particle using rectangular components – Motion of projectiles – Curvilinear motion using Radial and Transverse Components – (Simple Problems only) – basics of simple harmonic motion (Simple problems) – Motion of rigid bodies.
Kinematics: Relative Motion: Introduction to kinematics of relative motion – Relative displacement – Relative velocity – Instantaneous Centre – Relative acceleration.
Kinetics: Introduction to Kinetics – Force, Mass and Acceleration approach – Newton's Laws of motion – Equation of motion for a particle. Motion of the mass Centre of a system of particles – D Alembert's principle – Rectilinear translation of a rigid body – Curvilinear translation of a rigid body – Rotation of a rigid body – Plane motion of a rigid body – Reserved effective forces and couples and their use in Dynamic Equilibrium method.
Kinetics: Work and Energy approach – Work done by a force – Work done by a couple – Work done by a force system – Energy: Potential energy – Kinetic energy of a particle – Kinetic energy of a rigid body – Principle of Work and kinetic energy – Conservation of energy – Power and efficiency.
Impulse – Momentum approach – Linear impulse – Linear momentum – Principle of linear impulse and linear momentum – Conservation of linear momentum – Elastic impact – Angular impulse – Angular momentum – Principles of angular impulse and angular momentum.

Text Books

1. Engineering Mechanics by Fredin and Leon Singer, B.S.Publications.
2. Applied Mechanics by I.B. Prasad, Khanna Publishers.

Reference Books

1. Engineering Mechanics by S.Timoshenko and D.H. Young, Tata McGraw-Hill Publishing Co. Ltd. India.
2. Engineering Mechanics Vol. I and Vol. II by J.L.Meriam and L.G.Kraige, Wiley Publications.
3. Mechanics for Engineers Statics and Dynamics by F.B. Beer and E.R. Johnston.
4. Engineering Mechanics by R.S.Kurmi, S.Chand Publishing.

*****

EN1106: WORKSHOP LAB

Course Objectives

- Get hands on experience with the working skills in Carpentry trade.
- Know how to work with Sheet Metal tools.
- Get familiar with the working skills of Metal Fitting operations.
- Get hands on experience with house hold electrical wiring.

Course Outcomes

- Can be able to work with Wood Materials in real time applications.
- Can be able to build various parts with Sheet Metal in day-to-day life.
- Can be able to apply Metal Fitting skills in various applications.
- Can be able to apply this knowledge to basic house electrical wiring and repairs.

SYLLABUS

Carpentry:
Any three jobs from – Half lap joint, Mortise and Tenon joint, Half – lap Dovetail joint, Corner Dovetail joint, Central Bridle joint.
Sheet Metal:
Any three jobs from – Square tray, Taper tray(sides), Funnel, Elbow pipe joint.
Fitting:
Any three jobs from – Square, Hexagon, Rectangular fit, Circular fit and Triangular fit.
House wiring:
Any three jobs from – Tube light wiring, Ceiling fan wiring, Stair-case wiring, Corridor wiring.

References

1. Elements of workshop technology, Vol.1 by S. K. and H. K. Choudary.
2. Work shop Manual / P.Kannaiah/ K.L.Narayana/ SciTech Publishers.
3. Engineering Practices Lab Manual, Jeyapoovan, Saravana Pandian, 4/e Vikas.

*****

EN1107: PHYSICS LAB

Course Objectives

- To enable the students to acquire skill, technique and utilization of the Instruments
- Draw the relevance between the theoretical knowledge and to imply it in a practical manner with respect to analyze various electronic circuits and its components.
- To impart the practical knowledge in basic concepts of Wave optics, Lasers and Fiber optics.
- To familiarize the handling of basic physical apparatus like Vernier caliper's, screw gauge, spectrometers, travelling microscope, laser device, optical fibre, etc.

Course Outcomes
- Ability to design and conduct experiments as well as to analyze and interpret
- Ability to apply experimental skills to determine the physical quantities related to Heat, Electromagnetism and Optics
- The student will learn to draw the relevance between theoretical knowledge and the means to imply it in a practical manner by performing various relative experiments.

SYLLABUS

1. Determination of Radius of Curvature of a given Convex Lens By forming Newton's Rings.
2. Determination of Wavelength of Spectral Lines in the Mercury Spectrum by Normal Incidence method.
3. Study the Intensity Variation of the Magnetic Field along axis of Current Carrying Circular Coil.

4. Determination of Cauchy's Constants of a Given Material of the Prism using Spectrometer.
5. Determination of Refractive Index of Ordinary ray ⌈o and Extraordinary ⌈e ray.
6. Determination of Thickness Given Paper Strip by Wedge Method.
7. Calibration of Low Range Voltmeter.
8. Calibration of Low Range Ammeter.
9. Determination of Magnetic Moment and Horizontal Component of Earth's Magnetic Field.
10. Lees Method - Coefficient of thermal Conductivity of a Bad Conductor.
11. Carey Foster's Bridge – Verification of laws of Resistance and Determination of Specific Resistance.
12. Melde's Apparatus – Frequency of electrically maintained Tuning Fork.
13. Photoelectric cell-Characteristics.
14. Planks Constants.
15. Laser- Diffraction.

*****

EN1108: ENGINEERING GEO LAB

Course Objectives

- To enable the students to know different types of soils
- To enable the students to know different properties of different soils
- To enable the students to know the application of Remote Sensing and Geo Physical Methods
- Understand weathering process and mass movement

Course Outcomes

- Students can identify different types of rocks and their mineral composition.
- Students will study the physical properties of minerals by conducting laboratory tests.
- Students can study the models of folds, faults, joints and tunnels.
- Students can study the satellite data and evaluate the terrain through integrated approach.

SYLLABUS

1. General study of topo sheet
2. Physical properties of minerals
3. Physical properties of 3 types of rocks
4. Study of folds, faults and joints (Models)
5. Study of tunnels (models)
6. General observation of satellite data for abstraction of data
7. Integrated approach of Terrain evaluation

Text Books

1. Principles of Engineering Geology by K.V.G.K.Gokhale. B.S. Publications-2005
2. Engineering Geology by N.Chennakesavalu, Mc-Millan, Indian Ltd-2005
3. A Text Book of Geology by P.K.Mukherjee, World Press
4. Engineering and General Geology by Parbin Singh, Katson Publishing House

5. Fundamentals of Remote Sensing by George Jospeh, University Press (India) Private Ltd.

*****

II SEMESTER

EN1201: MATHEMATICS – II

Course Objectives

- The way of obtaining rank, eigen values and eigen vectors of a matrix
- To know the importance of Cayley-Hamilton theorem and getting canonical form from a given quadratic form
- To solve the system of equations by using direct and indirect methods
- To solve first order and higher order differential equations by various methods
- To obtain the Laplace transforms and inverse Laplace transforms for a given functions and their applications

Course Outcomes

- Find rank, eigen values and eigen vectors of a matrix and understand the importance of Cayley-Hamilton theorem
- Reduce quadratic form to canonical forms and solving linear systems by direct and indirect methods
- Demonstrate solutions to first order differential equations by various methods and solve basic applications problems related to electrical circuits, orthogonal trajectories and Newton's law of cooling
- Discriminate between the structure and procedure of solving higher order differential equations with constant and variable coefficients.
- Understand Laplace transforms and its properties and finding the solution of ordinary differential equations.

SYLLABUS

Linear Algebra

Rank of a matrix- Echelon form, Normal Form - Solution of Linear System of Equations - Consistency of Linear System of Equations - Direct & Indirect Methods: Gauss elimination method, LU Factorization method, Gauss Seidel Method. Complex Matrices: Hermitian, Skew-Hermitian and Unitary Matrices and their Properties.

Eigen Values and Eigen Vectors

Eigen Values and Eigen Vectors of a Matrix - Cayley-Hamilton theorem - Inverse and Powers of a Matrix using Cayley-Hamilton's theorem and its applications. Diagonalization of a Matrix - Quadratic Forms - Reduction of Quadratic Form to Canonical Form - Nature of a Quadratic Form.

Ordinary Differential Equations of First Order and its Applications

Formation of ordinary differential equations (ODEs) - Solution of an ordinary differential equation - Equations of the first order and first degree - Linear differential equation - Bernoulli's equation - Exact differential equations - Equations reducible to exact equations - Orthogonal Trajectories - Simple Electric (LR & CR) Circuits - Newton's Law of Cooling - Law of Natural growth and decay.

Differential Equations of Higher Order
Solutions of Linear Ordinary Differential Equations with Constant Coefficients - Rules for finding the complimentary function - Rules for finding the particular integral - Method of variation of parameters - Cauchy's linear equation - Legendre's linear equation - Simultaneous linear differential equations.

Laplace Transforms
Introduction - Existence Conditions - Transforms of Elementary Functions - Properties of Laplace Transforms - Transforms of Derivatives - Transforms of Integrals - Multiplication by t^n - Division by t – Evaluation of integrals by Laplace Transforms - Inverse Laplace Transform - Applications of Laplace Transforms to Ordinary Differential Equations - Simultaneous Linear Differential Equations with Constant Coefficients - Second Shifting Theorem - Laplace Transforms of Unit Step Function, Unit Impulse Function and Laplace Transforms of Periodic Functions.

Text Book
1. Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, $43r^d$ edition, Khanna publishers.

Reference Books
1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K. International publishing house Pvt. Ltd.
1. Advanced Engineering Mathematics by Erwin Kreyszig.
2. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal. Lakshmi Publications.
3. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.
4. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.

*****

EN1202: CHEMISTRY

Course Objectives

- To apply the basic knowledge of Chemistry to the Engineering Discipline
- To develop knowledge about water and its treatment for industrial and potable purposes
- To develop understanding in the areas of Polymers, Mechanism of Corrosion of Metals and Corrosion Control Methods, Fuels, Lubricants and Nanomaterials for of conducting polymers, bio-degradable polymers and fiber reinforced plastics and apply the knowledge for solving existing challenges faced in various engineering and societal areas.

Course Outcome

- This course applies the basic concepts and principles studied in Chemistry to Engineering.
- It provides an application of chemistry to different branches of engineering

- The students will be able acquire knowledge in the areas of Water Chemistry, Polymers, Corrosion, Fuels and Lubricants and nonmaterial's and suggest innovative solutions for existing challenges in these areas.

SYLLABUS

Water Chemistry

Sources of Water – Impurities and their influence of living systems – WHO Limits – Hardness and its Determination – Boiler Troubles and their removal – Water Softening Methods – Lime-Soda, Zeolite and Ion Exchange - Municipal Water Treatment-Break Point Chlorination – Desalination of Sea Water – Reverse Osmosis Method, Electro-dialysis.

Polymers and Plastics

Polymers:

Definition – Types of Polymerization (Addition & Condensation) – Mechanisms of Addition Polymerization – Radical and Ionic – Thermodynamics of Polymerization Process.

Plastics:

Thermosetting and Thermoplastics – Effect of Polymer Structure on Properties of Cellulose Derivatives – Vinyl Resins – Nylon (6,6), Reinforced Plastics – Conducting Polymers.

Corrosion:

Origin and Theory – Types of Corrosion: Chemical and Electrochemical; Pitting, Inter granular, Waterline, Stress – Galvanic Series – Factors Effecting Corrosion.

Corrosion Controlling Methods:

Protective Coatings: Metallic Coatings, Electroplating and Electroless Plating – Chemical conversion Coatings – Phosphate, Chromate, Anodized, Organic Coatings – Paints and Special Paints.

Fuels and Lubricants

Solid Fuels:

Wood and Coal, Ranking of Coal – Analysis (Proximate and Ultimate) Coke Manufacture – Otto Hoffmann's Process – Applications;

Liquid Fuels:

Petroleum Refining – Motor Fuels – Petrol and Diesel Oil – Knocking – Octane number – Cetane Number;

Gaseous Fuels:

Biogas, LPG and CNG – Characteristics – Applications;

Rocket Fuels:

Propellants – Classification – Characteristics

Lubricants:

Classification – Mechanism – Properties of Lubricating Oils – Selection of Lubricants for Engineering Applications.

Nanomaterials

Nanomaterials, Properties and application of fullerenes, fullerols, Carbon nanotubes and nanowires. Synthesis - Top-down and Bottom-up approaches - Nanocomposites - Nanoelectronics- Applications of nanomaterials in catalysis, telecommunication and medicine.

Text Books

1. Engineering Chemistry – PC Jain and M. Jain – Dhanpath Rai and Sons, New Delhi.
2. A Text book of Engineering Chemistry – S. S. Dara – S. Chand & co. New Delhi.

Reference Books

1. Engineering Chemistry – B. K. Sharma – Krishna Prakashan – Meerut.
2. Introduction to Nanoscience - S. M. Lindsay - Oxford University Press
3. Engineering Chemistry - B. L. Tembe, Kamaluddin and M. S. Krishnan, (NPTEL).

*****

EN1203: ENGLISH

Course Objectives

- To make students understand the explicit and implicit meanings of a text/topic;
- To give exposure to new words and phrases, and aid to use them in different contexts;
- To apply relevant writing formats to draft essays, letters, emails and presentations; and
- To adapt oneself to a given situation and develop a functional approach to finding solutions: adaptability and problem solving.

Course Outcomes

- Students will be able to analyze a given text and discover the various aspects related to language and literature;
- Learn the various language structures, parts of speech and figures of speech;
- Develop one's reading and writing abilities for enhanced communication; and
- Learn to apply the topics in real-life situations for creative and critical use.

SYLLABUS

On the conduct of life: William Hazlitt
Life skills: Values and Ethics
If: Rudyard Kipling

The Brook: Alfred Tennyson
Life skills: Self-Improvement
How I Became a Public Speaker: George Bernard Shaw

The Death Trap: Saki
Life skills: Time Management
On saving Time: Seneca

Chindu Yellama
Life skills: Innovation
Muhammad Yunus

Politics and the English Language: George Orwell

Life skills: Motivation

Dancer with a White Parasol: Ranjana Dave

Grammar:

Prepositions – Articles – Noun-Pronoun Agreement, Subject-Verb Agreement – Misplaced Modifiers – Clichés, Redundancies.

Vocabulary:

Introduction to Word Formation – Root Words from other Languages – Prefixes and Suffixes – Synonyms, Antonyms – Common Abbreviations

Writing:

Clauses and Sentences – Punctuation – Principals of Good Writing – Essay Writing – Writing a Summary

Writing: Essay Writing

Life skills: Innovation

Muhammad Yunus

Text Book

1. Language and Life: A Skills Approach Board of Editors, Orient Blackswan Publishers, India. 2018.

References Books

1. Practical English Usage, Michael Swan. OUP. 1995.
2. Remedial English Grammar, F.T. Wood. Macmillan.2007
3. On Writing Well, William Zinsser. Harper Resource Book. 2001
4. Study Writing, Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills, Sanjay Kumar and PushpLata. Oxford University Press. 2011.
6. Exercises in Spoken English, Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

*****

EN1204: CPNM

Course Objectives

- The course is designed to provide complete knowledge of C language.
- To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.
- To provide knowledge to the Students to develop logics this will help them to create programs, applications in C.
- This course aims to identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.
- This course provides the fundamental knowledge, which is useful in understanding the other programming languages.

Course Outcomes

- Identify basic elements of C programming structures as if data types, expressions, control statements, various simple functions and apply them in problem solving.
- Apply various operations on derived data types like arrays and strings in problem solving.

- Design and Implement of modular Programming and memory management using Functions, pointers.
- Apply Structure, Unions and File handling techniques to Design and Solve different engineering programs with minimal complexity.
- Apply Numerical methods to solve the complex Engineering problems.

SYLLABUS

1. Introduction to C:
Basic structure of C program, Constants, Variables and data types, Operators and Expressions, Arithmetic Precedence and associativity, Type Conversions. Managing Input and Output Operations Formatted Input, Formatted Output.

2. Decision Making, Branching, Looping, Arrays & Strings:
Decision making with if statement, Simple if statement, The if…else statement, Nesting of if…else statement, the else. If ladder, switch statement, the (?:) operator, the GOTO statement., The while statement, the do statement, the for statement, Jumps in Loops, One, Two-dimensional Arrays, Character Arrays. Declaration and initialization of Strings, reading and writing of strings, String handling functions, Table of strings.

3. Functions:
Definition of Functions, Return Values and their Types, Function Calls, Function Declaration, Category of Functions: No Arguments and no Return Values, Arguments but no Return Values, Arguments with Return Values, No Argument but Returns a Value, Functions that Return Multiple Values. Nesting of functions, recursion, passing arrays to functions, passing strings to functions, the scope, visibility and lifetime of variables.

4. Pointers:
Accessing the address of a variable, declaring pointer variables, initializing of pointer variables, accessing variables using pointers, chain of pointers, pointer expressions, pointers and arrays, pointers and character strings, array of pointes, pointers as function arguments, functions returning pointers, pointers to functions, pointers to structures-Program Applications

5. Structure and Unions:
Defining a structure, declaring structure variables, accessing structure members, structure initialization, copying and comparing structure variables, arrays of structures, arrays within structures, structures within structures, structures and functions and unions, size of structures and bit-fields- Program applications.

6. File handling:
Defining and opening a file, closing a file, Input/ Output operations on files, Error handling during I/O operations, random access to files and Command Line Arguments- Program Applications

7. Numerical Methods:
Solutions of Algebraic and Transcendental Equations, Bisection Method, Newton Raphson Method. Newton's forward and backward Interpolation, Lagrange's Interpolation in unequal intervals. Numerical Integration: Trapezoidal rule, Simpson's 1/3 rules. Solutions of Ordinary First Order Differential Equations: Euler's Method, Modified Euler's Method and Runge-Kutta Method.

Text Book

1. Programming in ANSI C, E Balagurusamy, 6th Edition. McGraw Hill Education (India) Private Limited.
2. Introduction to Numerical Methods, SS Sastry, Prentice Hall

Reference Books

1. Let Us C ,YashwantKanetkar, BPB Publications, 5th Edition.
2. Computer Science, A structured programming approach using C", B.A.Forouzan and R.F.Gilberg, " 3rd Edition, Thomson, 2007.
3. The C –Programming Language' B.W. Kernighan, Dennis M. Ritchie, PHI.
4. Scientific Programming: C-Language, Algorithms and Models in Science, Luciano M. Barone (Author), Enzo Marinari (Author), Giovanni Organtini, World Scientific.

*****

EN1205: SURVEYING AND GEOMATICS

Course Objectives

- To impart knowledge about the different methods of surveying to determine the position and elevation of inaccessible points.
- To familiarize the students with chain and compass surveying and train them to determine the bearing of any required station by different methods.
- To impart knowledge about the concept of levelling and reduced level of any station and teach them the procedure to establish bench marks.
- To familiarize the students with total station and explain the usage of Total Station with respect to all the areas of surveying.
- To explain the concept of Global Positioning System and its applications.

Course Outcomes

Students will be able to

- Determine the precise location of any required point with respect to horizontal and vertical control.
- Carry out different methods of levelling the profile levelling, reciprocal levelling etc. to determine the elevation of points with respect to benchmark.
- Understand the procedure to establish benchmarks with respect to mean sea level.
- Handle the instrument theodolite to measure the horizontal and vertical angles and analyze to determine the inaccessible distances.
- Understand the concept of global positioning system and its applications in surveying.

SYLLABUS

Introduction: Classification and Principles of Surveying, Triangulation and Trilateration – Earth as Spheroid, Datum, Geoid, Azimuth, Latitude, Longitude, Map Projections, Scales, Plans and Maps. Chain Surveying: Instrumentation for Chaining – Errors due to Incorrect Chain–Chaining on uneven and sloping Ground – Errors in Chaining –Tape Corrections – Problems: Base Line Measurement – Chain Triangulation – Check Lines, Tie Lines, Offsets. Basic Problems in Chaining – Obstacles in Chaining – Problems – Conventional Signs.

Compass Survey: (a) Introduction to Compass Survey Definitions of Bearing. True bearing, True meridian, Magnetic Meridian, Magnetic Bearing. Plane Table Surveying: Introduction – Advantages, Accessories. Theodolite – Types of Theodolites – Temporary Adjustments, Measurements of Horizontal Angle – Method of Repetition, Method of Reiteration – Uses of Theodolites. Curves – Sample Curves – Elements of Simple Curves – Methods of Setting Simple Curves – Rankine's Method – Two Theodolite Method.

Levelling: Definitions of Terms – Methods of Levelling – Uses and Adjustments of Dumpy Level – Temporary and Permanent Adjustments of Dumpy Level Levelling Staves – Differential Levelling, Profile Levelling – Cross Sections – Reciprocal levelling. Precise Levelling – Definition of BS, IS, FS, HI, TP – Booking and Reduction of Levels, H.I. Methods – Rise and Fall Method – Checks – Related Problems – Curvature and Refraction Related Problems –Correction – Reciprocal Levelling – Related Problems – L.S & C.S Leveling – Problems in Levelling – Errors in Levelling. Contouring: Definitions – Contour Intervals, Characteristics of Contours.

Total Station Surveying: Electronic Theodolite, Electronic Distance Measurements, Total Station, Errors in Measurements, Advantages, Disadvantages, Applications; Contour Mapping, Determination of Height of Remote Point, Position of Hidden Point, Free Station, Area Measurement, Volume Measurement.

Modern Surveying and Mapping: GPS Survey – Introduction, Errors in GPS, Positioning Methods, Classification of GPS Surveying, Applications, Advantages and Disadvantages, Photogrammetric Surveying; Sensors and Platforms, Aerial Photogrammetry, Satellite Images Resolution, Concept of Stereo Models, Photogrammetric Products, Rectified Images, Orthophotography, Topographic Map, Digital Maps, DEM, GIS, Advantages and Disadvantages of Photogrammetric Surveying.

Text Books

1. Surveying Vol. I, II and III by B.C.Punmia, Standard Book House.
2. Advanced Surveying by Satheesh Gopi, Sathikumar and Madhu, Pearson India.
3. Geomatics Engineering by M.K.Arora and R.C.Badjatia, Nemchand& Bros.

Reference Books

1. Surveying Vol. I and II by S.K. Duggal, Tata McGraw-Hill Publishing Co. Ltd.
2. Surveying: Theory & Practices by James M. Anderson and Edward M. Mikhail, Tata McGraw-Hill Publishing Co. Ltd.

*****

EN1206: ENGLISH LANGUAGE LAB

Course Objectives

- To make students recognize the sounds of English through Audio-Visual aids;
- To help students build their confidence and help them to overcome their inhibitions and self- consciousness while speaking in English;
- To familiarize the students with stress and intonation and enable them to speak English effectively; and
- To give learners exposure to and practice in speaking in both formal and informal contexts

Course Outcomes

- Students will be sensitized towards recognition of English sound patterns and the fluency in their speech will be enhanced;
- A study of the communicative items in the laboratory will help students become successful in the competitive world;

- Students will be able to participate in group activities like roleplays, group discussions and debates; and
- Students will be able to express themselves fluently and accurately in social as well professional context.

SYLLABUS

Introduction to Phonetics: The Sounds of English (Speech sound – vowels and consonants) - Stress and Intonation - Accent and Rhythm.

Listening Skills: Listening for gist and specific information - listening for Note taking, summarizing and for opinions - Listening to the speeches of eminent personalities.

Speaking Skills: Self-introduction - Conversation Skills (Introducing and taking leave) - Giving and asking for information - Role Play - Just A Minute (JAM) session - Telephone etiquette.

Reading and Writing skills: Reading Comprehension – Précis Writing - E-Mail writing - Punctuation.

Presentation skills: Verbal and non-verbal communication - Body Language - Making a Presentation.

Reference Books

1. Ashraf Rizvi. *Effective Technical Communication*. Tata McGraw Hill Education Private Limited, New Delhi.
2. *Speak Well*. Orient Blackswan Publishers, Hyderabad.
3. Allan Pease. *Body Language*. Manjul Publishing House, New Delhi.

*****

EN1207: CHEMISTRY LAB

Course Objectives

- To develop the fine skills of quantitative determination of various chemical components through titrimetric analysis
- To prepare and use ion-exchange/ zeolite columns for the removal of hardness of water
- To develop the skill of organic synthesis through the preparation of a polymer/ drug

Course Outcomes

- The course provides quantitative determine the amount of various chemical species in solutions by titrations and conduct the quantitative determinations with accuracy
- The course provides to develop novel materials to be used as zeolite and prepare columns for removal of hardness of water
- The course provides to synthesize a polymer or a drug

SYLLABUS

1. Determination of Sodium Hydroxide with HCl (Na_2CO_3 Primary Standard)
2. Determination of Alkalinity (Carbonate and Hydroxide) of water sample
3. Determination of Fe (II)/Mohr's Salt by Permanganometry
4. Determination of Oxalic Acid by Permanganometry
5. Determination of Chromium (VI) by Mohr's Salt Solution
6. Determination of Zinc by EDTA method
7. Determination of Hardness of Water sample by EDTA method
8. Determination of Chlorine in water by Iodometric Titration
9. Ion-exchange/ Zeolite column for removal of hardness of water
10. Synthesis of Polymer/ drug

Reference Books

1. Vogel's Quantitative Chemical Analysis – V – Edition – Longman.
2. Experiments in Applied Chemistry (For Engineering Students) – Sinita Rattan – S. K. Kataria& Sons, New Delhi

*****

EN1208: CPNM LAB

Course Objectives

- To impart writing skill of C programming to the students and solving problems.
- To write and execute programs in C to solve problems such as Modularize the problems into small modules and then convert them into programs.,
- To write and execute programs in C to solve problems such as arrays, files, strings, structures and different numerical methods.
- This reference has been prepared for the beginners to help them understand the basic to advanced concepts related to Objective-C Programming languages.

Course Outcomes

- Understand various computer components, Installation of software. C programming development environment, compiling, debugging, and linking and executing a program using the development environment.
- Analyzing the complexity of problems, Modularize the problems into small modules and then convert them into programs.
- Construct programs that demonstrate effective use of C features including arrays, strings, structures, pointers and files.
- Apply and practice logical ability to solve the real-world problems.
- Apply Numerical methods to Solve the complex Engineering problems.

SYLLABUS

1. Write a program to read x, y coordinates of 3 points and then calculate the area of a triangle formed by them and print the coordinates of the three points and the area of the triangle. What will be the output from your program if the three given points are in a straight line?
2. Write a program, which generates 100 random integers in the range of 1 to 100. Store them in an array and then print the arrays. Write 3 versions of the program using different loop constructs. (e.g. for, while, and do while).

3. Write a set of string manipulation functions e.g. for getting a sub-string from a given position, copying one string to another, reversing a string, adding one string to another.
4. Write a program which determines the largest and the smallest number that can be stored in different data types like short, int, long, float, and double. What happens when you add 1 to the largest possible integer number that can be stored?
5. Write a program, which generates 100 random real numbers in the range of 10.0 to 20.0, and sort them in descending order.
6. Write a function for transposing a square matrix in place (in place means that you are not allowed to have full temporary matrix).
7. First, use an editor to create a file with some integer numbers. Now write a program, which reads these numbers and determines their mean and standard deviation.
8. Given two points on the surface of the sphere, write a program to determine the smallest arc length between them.
9. Implement bisection method to find the square root of a given number to a given accuracy.
10. Implement Newton Raphson method to det. a root of polynomial equation.
11. Given table of x and corresponding f(x) values, write a program which will determine f(x) value at an intermediate x value by using Lagrange's interpolation/
12. Write a function, which will invert a matrix.
13. Implement Simpson's rule for numerical integration.
14. Write a program to solve a set of linear algebraic equations.

*****

EN2101: NUMERICAL METHODS

Course Objectives

1. To understand the use of numerical methods in modern scientific computing and familiar about the concepts like error estimation in scientific computing which is helpful in various fields of engineering.

2. To demonstrate the use appropriate methods for interpolation and approximation of functions

3. To elaborate the concepts of numerical differentiation and integration and their applications engineering

4. To understand the processes of numerical simulation, modeling, identification, and finding solution of complex engineering systems

5. To understand the appropriate numerical methods to solve initial and boundary value problems

Course Outcomes: Student will be able to

1. An ability to identify, formulate and the use the numerical techniques, skills, and modern engineering tools to solve engineering problems
2. Familiar with the knowledge of modern scientific computing and interpretation of errors in numerical methods
3. Familiar with numerical interpolation and construct approximation of functions

4. Familiar with the concepts of numerical integration and differentiation with engineering applications
5. familiar with numerical solution of ordinary differential equations and Partial Differential Equations

SYLLABUS

Numerical Approximation: errors and their computations: Absolute, relative and percentage errors-Errors propagation -A general Error Formula-Error in a series approximation.

Numerical solution of linear equations: Gauss Jacobi; Gauss Seidel iterative methods-method of least square for curve fitting. Eigen value problems

Interpolation Methods: Errors in polynomial Interpolation-Finite differences: Forward, Backward, Central Differences-Interpolation Formulae: Newton Forward formula, Newton Backward formula, Gauss, Stirling's, Bessel's, Everett's Formulae-Interpolation with unequal spaced points: Lagrange's interpolation, Newton's divided Difference-Inverse interpolation.

Numerical Calculus: Numerical Differentiation (first & second order)-Errors in Numerical Differentiation-Maximum and Minimum values of a Function-Numerical Integration: Trapezoidal rule, Simpson's rule, Weddle's Rule-Numerical Double integration using trapezoidal and Simpson's rule.

Numerical Solutions of Ordinary Differential Equations: Introduction to Initial and Boundary Value Problems-Numerical solutions of Ordinary Differential Equations: Taylor's series, Pi-cards method of successive approximations, Euler's method, Modified Euler's method, Runge-Kutta methods (second and fourth orders). Boundary Value Problems: Finite Difference Method (FDM).

Numerical Solutions of Partial Differential Equations: Classification of Second Order Equations-Finite difference approximation to Derivatives-Elliptic equations -Solution of Laplace's equation: Liebman's iteration Process-Solution to Poisson's Equation-Parabolic Equations-Solution of one-dimensional heat equation: Bender-Schmidt method. Crank Nicholson difference Method-Solution of two-dimensional heat equation: ADE method-Hyperbolic Equations-Solution of one dimensional (I-D) wave equation.

Text Books

1. Introductory Methods of Numerical Analysis by S.S. Sastry, 4th Edition, PHI Learning Private Limited
2. Numerical Methods in Engineering and Science by B.S. Grewal, 5th Edition, Khanna Publishers.

Reference Books

1. Numerical Methods for Engineers by Steven C. Chapra and Raymond P. Canale, 6th Edition, McGraw Hill Publications
2. Numerical Methods by M.K. Jain, S.R.K. lyengar, R.K. Jain, Revised 2nd Edition, New Age International (P) Ltd.

*****

EN2102: MECHANICS OF SOLIDS

Course objectives

- The student can understand the concepts of stress and strain by analysis of solids.
- The student can understand the engineering properties of materials, force-deformation, and stress-strain relationships.
- The student can understand the determinate and indeterminate members, and beams, torque, shear forces, and bending moments.
- The student can understand the combined bending and direct stresses on column and strut members, axial load on open and closed coiled helical spring subjected to axial load.

Course Outcomes

- The student will be able to:
- Understand the basic concepts of stress and strain along with their relations.
- Determine the shear force and bending moments of the simply supported, cantilever and over hanging beams under various loads.
- Assess the flexural normal and shear stresses of various cross sections.
- Analyze the stresses on oblique plane and torsional shear stress distribution of solid and hollow circular sections.
- Analyze the stresses on columns and struts using various theories.
- Analyze open and closed coiled helical springs subjected to axial load.

SYLLABUS

Duties/Obligations Accountability of Structural Engineer for the Design of a Structure: a) Economy b) Safety: (i) Strength Consideration (ii) Stiffness Consideration. Need for Assessment of Strength of a Material – Analysis for Strength Requirement for Design Purposes – Review of IS Code Provisions.

Effects of Force: Tension, Compression and Shear. Stress as Internally Elastic Resistance of a Material – Strain – Property of Elasticity – Hooke's Law – Stress-Strain Diagrams. Characteristic Strengths, Factors of Safety and Working Stresses for Materials and Various Types of Application of Load. Elastic Strain – Energy, Stress due to Gradually Applied Load, Sudden Load, Impact Load and Shock Load. Lateral Strain, Poisson's Ratio. Complementary Shear Stress, Shear Strain, Shear Modulus. Relation between Modulus of Elasticity, Modulus of Rigidity and Bulk Modulus. Stresses in Composite Assemblies due to Axial Load and Temperature Change.

Effect of Transverse Force, Shear Force, Bending Moment and Axial Thrust Diagrams for A) Cantilever B) Simply Supported and C) Over Hanging Beams for various patterns of Loading. Relation between (i) Intensity of Loading (ii) Shear Force and (iii) Bending Moment at a Section. Theory of Simple Bending: Flexural Normal Stress Distribution; Flexural Shear Stress Distribution for Various Shapes of Cross Section.

Stresses on Oblique Plane – Resultant Stress – Principal Stress and Maximum Shear Stress and Location of their Planes. Mohr's Circle for Various Cases of Stresses; Theory of Pure Torsion for Solid and Hollow Circular Sections – Torsional Shear Stress Distribution, Effect of Combined Torsion, Bending and Axial Thrust – Equivalent B.M and T.M.

Longitudinal and Hoop stresses in Thin Cylinders subjected to Internal Pressure. Wire Wound Thin Cylinders. Thick Cylinders – Lamme's Theory, Compound Tubes – Theory of Failure (i) Principal Stress Theory, (ii) Principal Strain Theory, (iii) Maximum Shear Stress Theory and (iv) Maximum Strain Energy Theory.

Columns and Struts: Combined Bending and Direct Stresses – Kern of a Section – Euler's Theory – End Conditions. Rankine-Gordon Formula – Eccentrically Loaded Columns. Open and Closed Coiled Helical Springs subjected to Axial Load.

Text Books

1. Strength of materials by S.Ramamrutham and R.Narayanan, Dhanpat Rai Publishing Company, New Delhi.
2. Mechanics of Materials by B.C.Punmia, Ashok Kumar Jain, Arun Kumar Jain, Lakshmi Publications.
3. Analysis of Structures, Vol. I, 1993 edition, by V.N.Vazirani and M.M.Ratwani, Khanna Publishers Books.

Reference Books

1. Strength of Materials (Elementary Theory and Problems) by S.Timoshenko and D.H.Young, CBS Publishers & Distributors Pvt. Ltd.
2. Introduction to Mechanics of Solids by Popov, Prentice-Hall.
3. Strength of Materials by Hyder, Universities Press.
4. Elementary Mechanics of Solids by P.N. Singer and P.K.Jha, New Age International Publishers.

*****

EN2103: ENVIRONMENTAL CHEMISTRY

Course Objectives

- Demonstrate a foundation of the subject relates to environmental chemistry;
- Impart the knowledge of the analysis and laboratory procedures for analytical chemistry related to environmental research and applications;
- Explain basic concepts of water chemistry and water pollution
- Provide an understanding of organic chemistry and interactions with the environmental media
- Study the basics of chemical reactions involved in biochemistry and nuclear chemistry

Course Outcomes

At the conclusion of the course, students will be able to:

- Identify and evaluate the relative importance of various reactions, physical processes and transport mechanisms affecting different chemicals in the environment and Know the principles of green chemistry
- Apply the analytical skills in the estimation of various chemical parameters and their analysis.
- Assess the importance of organic functional groups and significance of organic molecules in the contamination and pollution
- Make out the nature of nuclear structure, nature of radiation, nuclear fission and fusion to apply these in understanding the radioactive pollution
- Specify the factors influencing the function of proteins, carbohydrates and fats in the waste management as part of the biochemistry.

SYLLABUS

Quantitative, Qualitative and physical chemistry: Basic concepts of physical chemistry, Gas laws, Laws of Mass action, Common Ion Effect, Solutions, Vapor pressures of liquids, Binary Mixtures, Solutions of solids in Liquids, Oxidation – Reduction potentials, Ionization, Solubility products, Basics of colloidal chemistry- adsorption and absorption.

Analytical and Equilibrium chemistry: Important techniques in analytical chemistry; data collection – units and quantities, data quality, and data interpretation- Equilibrium constants and Calculations, Le-Chatelier Principle, Transport and transformation of chemicals – Photo catalysis - Soil chemistry - acid-base and ion-exchange reactions in soil - salt affected soil and its remediation

Chemistry of water: Physical and chemical properties of water; water and the environment; behavior of water in the environment; water as a solvent for gases and solids; water as a reaction medium; water as a transport medium.

Organic and Bio Chemistry: Properties of Organic Compounds, Sources of Organic Compounds, Isomerism, Types of Organic Compounds, Aliphatic, Aromatic and Heterocyclic. – Principles of green chemistry - Significance of organic molecules and their interaction with environmental media; importance of functional groups in contamination and pollution - Enzymes, factors affecting the action of Enzymes, (co-enzymes or cofactors, Temperature, pH, Micro and Macro mutants), Proteins, carbohydrates and fats. Functional groups, bonding and reactions of molecules of importance in living organisms.

Nuclear Chemistry: Atomic Structure, Electron orbits, Neutron, Proton, Nuclear structure, Nomenclature of Isotopes, stable and radioactive nucleoids, Nature of Radiation, Energy of Radiation, Units of Radioactivity, half-life, α, γ and neutron induced reaction, nuclear fission and fusion.

Text Books

1. Chemistry for Environmental Engineering and Science, C.N. Sawyer, P.L. McCarty and G.F. Parkin, Tata McGraw-Hill publication.
2. Environmental Chemistry by AK De, Wiley Publications

Reference Books

1. Chemistry for Environmental Engineering and Science, C.N. Sawyer, P.L. McCarty and G.F. Parkin, Tata McGraw-Hill publication.
2. Environmental Chemistry by AK De, Wiley Publications

*****

EN2104: FLUID MECHANICS

Course Objectives

- To familiarize students with the fundamentals and basic concepts of fluid mechanics.
- To impart knowledge to the students about fluid statics and kinematics which are prerequisite to comprehend fluid dynamics and other more advanced aspects.
- To enable students to understand one-dimensional applications of energy equation and to impart the concepts of flow measuring devices.
- To develop insight in the application of momentum principle to closed conduits.
- To impart knowledge on fluid flow through pipes and pipe network analysis.

Course Outcomes

Students will be able to

- Understand the significant properties of fluids and pressure measurement, and analyze hydrostatic forces on plane and curved surfaces.
- Comprehend kinematics of fluid flow and further derive and apply continuity equation, which is useful in analyzing more complex field problems such as seepage analysis.
- Understand the theory of flow measuring devices in pipes and open channel flows using Bernoulli's equation.
- Compute forces on pipe bends using linear impulse momentum application and understand the basics of angular momentum principle which is essential to understand the concepts of hydraulic turbines.
- Perform analysis of pipes and hydraulic design of pipe networks.

SYLLABUS

Fluid Properties: Introduction & Physical Properties of Fluids –Newton's Law of Viscosity. **Fluid Statics:** Forces acting on a fluid element – Pascal's law; Variation of Pressure in Static Fluid; Absolute, Gauge and Total Pressure; Pressure Measurement, Forces on Immersed Bodies in Static Fluids – Force on a Plane Surface and curved surfaces.

Fluid Kinematics: Types of Flow, Streamline, Path line, Streak line; Stream Tube, Translation, Deformation and Rotation of a Fluid Element in Motion; Local, Convective and Total Accelerations; One, Two- and Three-Dimensional Analysis of Flows. Ideal Fluid Flow – Stream Function, Velocity Potential; Rotational & Irrotational Flows–Vorticity and Circulation; Laplace Equation in terms of Stream Function and Velocity Potential; Flow Nets. Principle of Conservation of Mass – Concepts of System and Control Volume; Continuity Equation in three dimensional Cartesian coordinates; Continuity Equation for flow through a Stream tube.

Fluid Dynamics: Principle of Conservation of Energy – Equation of Motion for Ideal Fluids, Euler's Equation in Streamline Coordinates, Derivation of Energy Equation through integration of Euler's Equation, Bernoulli's Equation, Energy Correction Factor. Flow measuring devices – Flow Measurement in Pipes – Measurement of Static, Stagnation and Dynamic Pressures and Velocity – Pitot Tube, Prandtl Pitot Tube; Measurement of Discharge through a Pipe using Flow Meters – Venturi meter, Flow Nozzle meter and Orifice meter.

Flow through Tanks and Reservoirs – Measurement of Discharge from Tanks and Reservoirs – Steady and Unsteady Flow through Orifices and Mouthpieces – Small & Large Orifices – Different types of Mouthpieces; Discharge from tanks through Drowned Orifices, Time of Emptying Tanks, Discharge from a Tank with Inflow. Flow Measurement in

Channels – Flow Measurement in Open Channels, Flow Past Weirs and Notches, Sharp Crested and Broad Crested Weirs, Weirs with and without end contractions, Ventilation of Weirs, Triangular Notches, Cipolletti Weir.

Principle of Conservation of Momentum – Momentum of Fluids in Motion, Impulse Momentum Equation, Momentum Correction Factor, Application of Momentum Principle – Forces on Pipe Bends and Reducers, Flow through a Nozzle; Angular Momentum of Fluid Flow – Sprinkler Problems.

Flow through Pipes: Introduction to Pipe Flow and Laws of Friction – Reynolds Experiment; Steady Turbulent Flow through Pipes; Laws of Friction; Darcy-Weisbach Equation; Total Energy and Hydraulic Gradient – Energy and Hydraulic Gradient Lines; Minor Losses in Pipes; Pipes in Series and Parallel – Equivalent Length of Pipe; Flow Between Two Reservoirs; Siphon; Pipe Network Analysis by Hardy–Cross Method; Hydraulic Power Transmission through Pipes and Nozzles, Water Hammer (Only Concept).

Text Books

1. Fluid Mechanics and Hydraulic Machinery by P.N.Modi and S.M. Seth, Standard Book House.
2. Fluid Mechanics by A.K.Jain, Khanna Publishers.

Reference Books

1. Engineering Fluid Mechanics by K.L.Kumar, S. Chand & Co.Ltd.
2. Engineering Hydraulics, H.Rouse, John Wiley & Sons Inc.
3. Mechanics of Fluids, I.H.Shames,McGraw-Hill Professional.
4. Fluid Mechanics and Its Applications, Vijay Gupta and Santosh K Gupta, New Academic Science Ltd.

*****

EN2105: MANAGERIAL ECONOMICS

Course Objectives:

- To introduce micro as well as macro, financial concepts that can be used in business decision making
- To analyze various business situations with the help of different economic concepts.
- To assist in a better understanding of the application of modern principles and methods of microeconomics to real-world business issues in different contexts.
- To master the basic tools of microeconomics: supply and demand analysis; firms' production and pricing decisions, market equilibrium, and market structure analysis.
- To enable the students to understand how organizations make important investment and financing decisions

Course Outcomes

The student will be able to

- Understand the concepts of cost, nature of production, and its relationship to Business operations.
- Apply marginal analysis to the "firm" under different market conditions.
- Use the tools of marginal analysis to explain the optimal allocation of resources within the firm.
- Analyze the causes and consequences of different market conditions.

- Integrate the concept of price and output decisions of firms under the various market structure

SYLLABUS

Significance of Economics and Managerial Economics: Economics: Definitions of Economics- Wealth, Welfare and Scarcity definitions Classification of Economics- Micro and Macro Economics.

Managerial Economics: Definition, Nature and Scope of Managerial Economics, Differences between Economics and Managerial Economics, Main areas of Managerial Economics, Managerial Economics with other disciplines.

Demand and Utility Analysis: Demand - Definition, Meaning, Nature and types of demand, Demand function, Law of demand - Assumptions and limitations. Exceptional demand curve.

Elasticity of demand - Definition, Measurement of elasticity, Types of Elasticity (Price, Income, Cross and Advertisement), Practical importance of Price elasticity of demand, Role of income elasticity in business decisions, Factors governing Price Elasticity of demand. Utility Analysis: Utility- Meaning, Types of Economic Utilities, Cardinal and Ordinal Utility, Total Utility, Marginal Utility, the law of Diminishing Marginal Utility and its Limitations.

Theory of Production and Cost analysis: Production - Meaning, Production function and its assumptions, use of production function in decision making; Cost analysis - Nature of cost, Classification of costs - Fixed vs. Variable costs, Marginal cost, Controllable vs. Non - Controllable costs, Opportunity cost, Incremental vs. Sunk costs, Explicit vs. Implicit costs, Replacement costs, Historical costs, Urgent vs. Postponable costs, Escapable vs. Unavoidable costs, Economies and Diseconomies of scale.
Market Structures: Definition of Market, Classification of markets; Salient features or conditions of different markets - Perfect Competition, Monopoly, Duopoly, Oligopoly, Importance of kinked demand curve; Monopolistic Competition. Pricing and Business Cycles:

Pricing Analysis : Pricing – Significance; Different Pricing methods- Cost plus pricing, Target pricing, Marginal cost pricing, Going -rate pricing, Average cost pricing, Peak load pricing , Pricing of joint Products, Pricing over the life cycle of a Product, Skimming pricing Penetration pricing, Mark- up and Mark- down pricing of retailers.

Business cycles - Definition, Characteristics, Phases, Causes and Consequences; Measures to solve problems arising from Business cycles.

Text Books

1. Sankaran,S., Managerial Economics, Marghan Publications, 2015, Chennai.
2. Aryasri, A.R., Managerial Economics and Financial Analysis, MC Graw Hill Education, New Delhi,2015.

Reference Books

1. Dwivedi, D.N., Managerial Economics, Vikhas Publishing House Pvt. Ltd. 6th Edition, New Delhi,2004.

2. Dewett, K.K., Modern Economic Theory, S.Chand & Company Ltd., New Delhi, 2005.

*****

EN2106: STRENGTH OF MATERIALS LABORATORY

Course Objectives:

- To impart knowledge about behavior of materials under the action of loads.
- To explain about various kinds of loads that are going to act on materials.
- To understand about various kinds of stress and strain measuring machinery that is used in laboratory.
- To familiarize he students with various physical, mechanical properties of various engineering materials.
- To explain about various deformations of materials under the action of loads.

Course Outcomes:

The student will be able to:

- Understand strength and quality of materials through laboratory tests.
- Understand about properties of elastic materials.
- Find deformation of materials after the respective experiment.
- Apply the knowledge of mathematics to find the properties of materials.

SYLLABUS

1. Tension test on Mild/HYSD bars
2. Compression test on wood (parallel and perpendicular to grains)
3. Tests on springs for the determination of rigidity modulus and spring constant
4. Brinell's and Rockwell hardness tests.
5. Charpy and Izod impact tests.
6. Double shear test on mild steel specimen.
7. Bending test.: Load deflection test for the determination of young's modulus on simply supported and cantilever beam for wood and steel.
8. Buckling of Wooden column

*****

EN2107: FLUID MECHANICS LABORATORY

Course Objectives

- To impart knowledge in measuring pressure, discharge and velocity of fluid flow.
- To understand the flow measurement in tanks
- To determine the metacentric height of a floating body.
- To determine the flow measurement in pipe flow.
- To measure the discharge in a open channel flow.
- To learn and practice writing technical reports

Course Outcomes

The student will be able to:

- Conduct experiments (in teams) in pipe flows and open-channel flows and interpreting data from model studies to prototype cases, as well as documenting them in engineering reports.
- Analyze a variety of practical fluid-flow devices and utilize fluid mechanics principles in design.
- Provide exposure to modern computational techniques in fluid mechanics.

SYLLABUS

1. Study of Small orifice, by constant head method and Time of emptying a tank through a small orifice.
2. Study of Cylindrical mouthpiece by constant head method and Time of emptying a tank through a cylindrical mouthpiece.
3. Study of floating body and determination of Metacentric Height.
4. Study of surface profiles in Free and Forced Vortex motions.
5. Study of Venturi meter.
6. Study of Orifice meter.
7. Study of Flow nozzle meter.
8. Study of Sharp – crested full width and contracted weirs.
9. Study of V-notch and Trapezoidal notch.
10. Study of Broad-crested weir.

*****

EN 2108: SURVEYING FIELD WORK

Course Objectives:

- To impart knowledge about the art of determining the relative positions of points on, above or beneath the surface of the earth.
- To impart knowledge of the measurement of angles and distances and keeping of a record in field book.
- To familiarize the students with instruments like chain, compass, dumpy level, plane table and some special instruments.
- To impart knowledge about advanced instruments of surveying like total station and GPS.
- To familiarize about the theodolite and electronic theodolites that can read angles directly.

Course Outcomes:

At the end of the course, the student will be able to:

- Determine the inaccessible horizontal and vertical distances from the observed bearings and calculated angles between the survey lines.
- Determine the relative positions of points on, above or beneath the surface of the earth by direct or indirect measurements of distance, direction and elevation.
- Find out the elevations of points with respect to a given datum and also to establish points at a given elevation.
- Handle the advanced survey instruments like total station and global positioning system.
- Use the theodolite as a tacheometer to determine the elevations and reduced levels of points.

LIST OF EXPERIMENTS

1. Chain traversing: Plotting a chain traverse for a building.
2. Compass traversing: Measurement of bearings and determination of inaccessible distance using a compass.
3. Levelling: Determination of reduced levels of different points by Height of Instrument method and Rise & Fall method.
4. Theodolite traversing: Measurement of horizontal angles by Reiteration method and repetition method, Determination of inaccessible distance using a theodolite, Heights and Distances using vertical and horizontal angles.

5. Point positioning using GPS
6. Total station exercises:

i. Contour mapping using total station.

ii. Height of remote point using total station.

iii. Position of hidden point using total station.

iv. Area& volume measurement using total station.

Text Books

1. Surveying Vol. I, II and III by B.C.Punmia, Standard Book House.
2. Advanced Surveying by Satheesh Gopi, Sathikumar and Madhu, Pearson India.
3. Geomatics Engineering by M.K.Arora and R.C.Badjatia, Nemchand & Bros.

*****

EN 2109: SAFETY, HEALTH AND ENVIRONEMT

Course Objectives

- Teach the need for developing Environment, Health and Safety systems in work places
- Impart the fundamental knowledge on the occupational health and industrial hygiene and the Environmental Safety Management Principles & practices
- Get acquainted with the principles of ergonomics.
- Make the students understand the Workplace Safety and Safety Systems
- Familiarize the quality management systems in health and safety management and need for education and training

Course Outcomes

After completion of the course, the student will be able to

- Understand the concept of EHS and their importance in the work place environment
- Gain a fundamental understanding of the workplace safety and safety systems and knowledge of the safety technologies
- Identify the hierarchy of control measures for occupational health risks and the role of personal protective equipment and the selection criteria
- Understand the Workplace Safety and Safety Systems along with the features of the satisfactory design of work premises HVAC systems
- Comprehend the information from the quality manuals, safety policies & written risk assessments and health and safety records and other documentation in an organization.

SYLLABUS

Introduction to Occupational Health and Hygiene: Definition of Occupational Health and hygiene - Environmental Safety Management - Principles practices- Need for developing Environment, Health and Safety systems in work places. Regulations and Codes of Practice. Role of trade union safety representatives - International initiatives. Ergonomics and work place. Medical surveillance for control of occupational diseases and health records.

Industrial Hygiene: Definition of Industrial Hygiene - Categories of health hazards - Exposure pathways and human responses to hazardous and toxic substances; Advantages and limitations of environmental monitoring and occupational exposure limits. Control Measures - Hierarchy of control measures for occupational health risks- Evaluation and control of basic hazards; Role of personal protective equipment and the selection criteria. Concept of

threshold, limit values. Effects on humans, control methods and reduction strategies for noise, radiation and excessive stress.

Workplace Safety and Safety Systems: Features of the satisfactory design of work premises HVAC, ventilation. Safe installation and use of electrical supplies. Fire safety and first aid provision. Significance of human factors in the establishment and effectiveness of safe systems. Safe systems of work for manual handling operations. Control methods to eliminate or reduce the risks arising from the use of work equipment. Requirements for the safe use of display screen equipment. Procedures and precautionary measures necessary when handling hazardous substances. Contingency arrangements for events of serious and imminent danger.

Techniques of Environmental Safety: Methods of effective implementation and review of health & safety policies. Functions and techniques of risk assessment, inspections and audits. Investigation of accidents- Principles of quality management systems in health and safety management. Industry specific EHS issues.

Education and Training: Relationship between quality manuals, safety policies and written risk assessments. Records and other documentation required by an organization for health and safety. Requirements for and benefits of the provision of information, instruction, training and supervision. Factors to be considered in the development of effective training programmes. Principles and methods of effective training. Feedback and evaluation mechanism.

Text Books

1. R. K. Jain and Sunil S. Rao, Industrial Safety, Health and Environment Management Systems, Khanna publishers, New Delhi (2006)
2. Environmental and Health and Safety Management by Nicholas P. Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995
3. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007.
4. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services 2005

Reference Books

1. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services 2005
2. Slote. L, Handbook of Occupational Safety and Health, JohnWilleyand Sons, NewYork.
3. Heinrich H.W, Industrial Accident Prevention, McGrawHill Company, NewYork,1980

*****

EN-2110: PROFESSIONAL ETHICS AND UNIVERSAL HUMAN VALUES

Course Objectives

- Develop a holistic perspective based on self-exploration about themselves (human beings), family, society, and nature/existence.
- Illuminate the concepts of laws and their applicability to engineers Understanding (or developing clarity) of the harmony in the human being, family, society, and nature/existence
- Strengthen self-reflection, development of commitment, and courage to act.

- Imbibe and internalize the Values and Ethical Behavior in the personal and professional lives
- Imbibe the Values and Ethical Behavior in the personal and professional lives

Course Outcomes

- The student will be able to
- Understand the meaning of the concept - get an overview of the laws relating to law and engineers and also understand the importance of being a person who respects the law and they will have a better critical capacity.
- Self-explore by using different methods to live in harmony at different levels
- Evaluate themselves and understand their position in relation to morality and ethics successful and satisfying work-life requires character
- Awareness about themselves and their surroundings (family, society, nature) and becoming more responsible in life and in solving sustainable problems
- Give solutions with a focus on human relationships and human nature.

SYLLABUS

Need, Basic Guidelines, Content and Process for Value Education, Self-Exploration–what is it? – Its content and process; 'Natural Acceptance' and Experiential Validation - as the process for self-exploration, Continuous Happiness and Prosperity - A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility - the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking, Include practice sessions and case studies.

Understanding Harmony in the Human Being - Harmony in Myself!
Understanding human being as: a co-existence of the sentient 'I' and the material 'Body', the needs of Self ('I') and 'Body' - happiness and physical facility, the Body as an instrument of 'I' (I being the doer, seer and enjoyer), the characteristics and activities of 'I' and harmony in 'I', the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, P to ensure Sanyam and Health, Include practice sessions and case studies.

Understanding Harmony in the Family and Society - Harmony in Human – Human Relationship
Understanding values in human-human relationship: meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, the meaning of Trust; Difference between intention and competence, the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, the harmony in the society (society being an extension of family), Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order from family to world family, Include practice sessions and case studies.
Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all – pervasive space, Holistic perception of harmony at all levels of existence, Include practice sessions and case studies.

Concept of Law and Law of Torts
Understanding Essentials of a Valid Contract and the basics of contract law protecting rights and obligations, Introduction to the Law of Torts and the basics to protect oneself and the company Law affecting the Workplace Employers Responsibilities/Duties Hiring Practices, Introduction to Intellectual Property Law, Professional Code of Conduct for Engineers, Relationship between Law and Ethics, Include practice sessions and case studies.
Implications of the above Holistic Understanding of Harmony on Professional Ethics
Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: a. Ability to utilize 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, Case studies of typical holistic technologies, management models and production systems, 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, Include practice sessions and case studies.

Text Books

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

3. R. Subramanian, "Professional Ethics", Oxford University Press.

4. S.B. Srivasthva, "Professional Ethics & Human Values", SciTech Publications (India) Pvt.Ltd. New Delhi.

5. D.R. Kiran, "Professional Ethics & Human Values", TATA Mc Graw Hill Education. Saroj Kumar, "Business Law" and Avtar Singh, "Law of Contract"

Reference Books

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan VidyaPrakashan, Amar kantak, 1999.
2. A. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.

3. The Story of Stuff (Book), Mohandas Karam chand Gandhi "The Story of My Experiments with Truth", E. FSchumacher.

"Small is Beautiful", Slow is Beautiful –Cecile Andrews, J C

5. Kumarappa "Economy of Permanence", Pandit Sunderlal "Bharat Mein Angreji Raj" and

6. Dharampal, "Rediscovering India

7. G K Kapoor, "Business Law" and Sen &Mitra, "Business & Commercial Laws" and Calvin

8. Frank Allen, “Business law for Engineers” Hilgard, E. R.; Atkinson, R. C. & Atkinson, R.L. (1975). Introduction to Psychology. 6th

9. Edition. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd. Govindarajan, M; Natarajan, G. M. &Senthilkumar, V.S. (2013). Professional Ethics & Human Values. Prentice Hall: New Delhi

10. Gogate, S. B. (2011). Human Values & Professional Ethics. Vikas Publishing: New Delhi.

11. Charles E Harris Jr., Michael S Pritchard, Michael J Rabins, “Engineering Ethics, Concepts Cases: 4e, Cengage learning, 2015.

12. Caroline Whitbec, “ Ethics in Engineering Practice & Research: 2e, Cambridge University Press 2015.

*****

II / IV B.Tech. (Environmental Engineering)
Scheme of Instruction and Examination
(with effect from 2021-22 Admitted Batch)
II Semester

EN2201: ENVIRONMENTAL MICROBIOLOGY

Course objectives:

- Impart fundamentals of environmental microbiology involved in water, soil and air.
- Introduce the knowledge on different microorganisms and their metabolisms in the environment
- Provide the knowledge of the microbiology of fresh and polluted water and wastewater along with some of the microbiological examinations;
- Present the knowledge on the microbiology of biological treatment processes
- Introduce the students to aquatic microbiology

Course Outcomes

At the conclusion of the course, students will be able to:

- Understand the fundamentals and importance of microbiology in the environment management applications particularly water and wastewater management
- Aware of the basics of metabolism, including heterotrophic metabolism and phototrophic metabolism
- Realize the basics of respiration and electron flow in an organism, including concepts from aerobic respiration and anaerobic respiration
- Able to comprehend the fundamental kinetic expressions of enzyme activity, microbial growth, and substrate utilization
- Apply the principles of microbiology and microbial remediation in the environment and particularly with reference to the capable of applying to wastewater management

Introduction: Microorganisms - classification, prokaryotic and eukaryotic cells, structure, characteristics, nucleic acids, DNA and RNA, replication. Recombinant DNA - Genetic Engineering.

Metabolism of Microorganisms: Environmental factors, nutrition and metabolism, growth phases, enzymes, carbohydrate, protein, lipids metabolism, respiration, fermentation, Glycolysis, Kreb's cycle, Hexose monophosphate pathway, significance of energetic

Microbiology of Drinking Water: Distribution of microorganisms, indicator organisms, coliforms - fecal coliforms - E. coli, Streptococcus faecalis and Clostridium welchii, differentiation of coliforms - significance - MPN index, M.F. technique, standards. Virus-concentration techniques. Algae in water supplies - problems and control.

Microbiology of Wastewater Treatment: Biodegradation of toxic pollutants - alpha oxidation, beta-oxidation, electron transport system and oxidative phosphorylation mechanism, Microbiology of biological treatment process

Aquatic Microbiology: Ecotoxicology - toxicants and toxicity - factors influencing toxicity, effects, acute, chronic, concentration response relationships, test organisms, toxicity testing bioconcentration - bioaccumulation - bio-magnification - bioassay - biomonitoring.

Text Books

1. Microbiology for sanitary engineers by Mckinney
2. Microbiology for Scientists and Engineers by Grady & Grady.

Reference Books

1. Microbiology by Pelzer, Ecschan & N R Kreig. Tata McGraw Hill Publishing Company Limited.
2. Municipal and Rural sanitation by Victor Ehalers and Earnest W Steel

*****

EN2202: STRUCTURAL ANALYSIS

Course Objectives:

- Familiarize students to the various methods of determining deflections of beams.
- Improve student's ability in understanding strain – energy due to Axial load, Shear force, Bending Moment and Torque.
- Impart skills of analyzing the fixed beams, three span continuous beams subjected to different types of loads.
- Enable students understand the concept of moving loads and draw maximum Shear force and Bending moment diagrams for different types of loads
- Expose students to understand Lamme's theory in analyzing thick cylinders and know the concept of theories of failure.

Course Outcomes:

The student will be able to:

- Understand behavior of beams and determine slope and deflections of a beams, trusses (having 9 members or less) using various methods.
- Differentiate determinate and indeterminate structures and determine deflections of statically determinate structures.
- Apply strain energy principle to determine the deflections of beams using various methods.
- Understand the concept of moving loads and draw the maximum Shear force and bending moment diagrams for different types of moving loads.

- Gain knowledge on thick cylinders and compound cylinders. Learns basic concepts of theories of failure

SYLLABUS

Deflections of Beams: (i) Cantilever (ii) Simply Supported and (iii) Over Hanging Beams, using (a) Double Integration and (b) Macaulay's Method.

Deflections of Beams Using (i) Moment Area Method, (ii) Conjugate Beam Method, (iii) Unit Load Method (iv) Castigliano's Theorem – 1.

Strain – Energy due to (i) Axial Load, (ii) Shear Force, (iii) Bending Moment and (iv) Torque;

Deflections of Statically Determinate Structures: (A) Single Storey, Single Bay Rectangular Portal Frames using (i) Unit Load Method, (ii) Castigliano's Theorem –1. (B) Trusses (Having 9 Members or less) using (i) Unit Load Method and (ii) Castigliano's Theorem-1.
Analysis of (A) Fixed Beams, (B) Three Span Continuous Beams using (i) Theorem of Three Moments, (ii) Slope Deflection Method and (iii) Moment Distribution Method

Moving Loads: Maximum Shear Force and Bending Moment Diagrams for Different types of Loads. Maximum Bending Moment at a Section under a Wheel Load and Absolute Maximum Bending Moment in the case of several Wheel Loads. Equivalent Uniformly Distributed Live Load for Shear Force and Bending Moment. Reversal of Nature of Shear Force, Focal Length, Counter Bracing for Truss Panels, Influence Lines for (i) Beams and (ii) Members of Warren and Pratt Trusses.

Text Books

1. Theory of Structures, Vol- I, by G.S.Pundit, S.P.Gupta and R.Gupta, McGraw-Hill Education India.
2. Mechanics of structures Vol- I by H.J.Shah and S.B.Junnarkar, Charotar Publishing House.
3. Strength of Materials by S.Ramamrutham and R.Narayanan, Dhanpat Rai Publishing House.

Reference Books

1. Elementary Strength of Materials by S. Timoshenko and D. H. Young, Affiliated East-West Press.
2. Analysis and Design of Structures Vol-I by V. N. Vazirani and M. M. Ratwani, Khanna Publishers.
3. Intermediate Structural Analysis by C. K. Wang, McGraw-Hill.
4. Strength of Materials by B. C. Punmia, Laxmi Publications.

*****

EN2203: REINFORCED CONCRETE STRUCTURES

Course Objective

- Establish the basic principles of reinforced concrete structural member and system behavior.
- Explain the basic design philosophy behind the working stress method and Limit State Method of design.
- Introduce the basic principles of the analytical methods and design procedures.
- Impart knowledge of basic structural elements such as slabs, beams, columns, staircases, and isolated footings in the design process.
- Understand the concepts of designing reinforced concrete structures for limit state of collapse.

Course Outcomes

- After completion of this course, students will be able.
- To understand the IS code of practice for the design of reinforced concrete structural elements.
- To understand the various design philosophies and their differences.
- To understand behavior of RCC members under flexural and shear.
- Define design stages of reinforced concrete structures.
- To analyze and design basic structural elements like slabs, beams, columns, staircases & isolated footings.

SYLLABUS

General:
Loading standards as per IS 875, Grades of steel and cement, Stress-Strain characteristics of concrete and steel, Introduction to working stress method and Limit State Method (L.S.D.) of design.

Limit State of Collapse of in Flexure: Central Value measures, Measures of distribution, Normal distribution curve. Introduction and Principles of L.S.D., Characteristic load and strengths, Design values, Partial safety factors, Factored loads.

Limit State of Collapse: Flexure of R.C.C. beams of rectangular section. Under reinforced, Balanced and over reinforced sections. Compression stress block, Estimation of ultimate moment by strain compatibility. Guide lines for choosing width, depth and percentage of reinforcements in beams.

Analysis and design of singly reinforced rectangular beams and doubly reinforced beams, design by using SP 16 (Sessional Work Only).

Design of flanged beams (T and L), Effective flange width, Basis of analysis and design, Minimum and Maximum steel in flanged beams, SP 24 in design of beams.

Design of one-way and two-way slab: Simply supported slabs on all four sides, Moment in two-way slabs with corners held down. Choosing slab thickness. Design of restrained slabs (with torsion at corners) I.S. code provisions. Detailing of reinforcement. Load from slabs on supporting beams. Different kinds of loads on slabs including partition walls, Shear in slabs.

Shear, Torsion and Bond:
Limit state of collapse in shear, types of shear failures. Truss analogy, shear span / depth ratio. Calculation of shear stress, types of shear reinforcement. General procedure for design

of beams for shear. Enhanced shear near supports. Shear in slabs, steel detailing. Analysis for torsional moment in a member. Torsional shear stress in rectangular and flanged sections. Reinforcement for torsion in RC beams. Principles of design for combined bending shear and torsion. Detailing of torsion reinforcement – Concept of bond, development length, anchorage, bond, flexural bond.

Columns:
Short and Long columns, Minimum eccentricity, short column under axial compression, column with helical and tie reinforcement. Short columns subjected to uniaxial and biaxial moments.
Footings: Analysis and design of isolated Square and rectangular footings.
Design of stair case.

Text books

1. Limit State of Design of Reinforced Concrete – P. C. Vergheese
2. Reinforced Concrete Limit State Design – A.K. Jain.
3. R.C.C Design – Unnikrishna Pillai and Vasudeva Menon.

Reference Books

1. Reinforced Concrete Limit State Design, P. Dayaratnam
2. Reinfoeced Concrete Structures by R Park and Paulay

*****

EN2204: ECOLOGY AND ECOSYSTEM ENGINEERING

Course Objectives

- Describe the fundamentals of ecology and ecosystems along with the ecological engineering
- Impart the knowledge on the functional interaction of the environmental systems, which helps in realizing the importance of the ecosystems integrity
- Provide knowledge on the ecological models and eco technology
- Understand and apply concepts involved in designing and achieving sustainable uses of ecosystems
- Identify and describe the impact that designing ecosystems to solve engineering problems has in the context of societal and global issues

Course Outcomes

The Student should be able to

- Describe the ecosystems and its structure along with the key functions /services of the ecosystems
- Realize the importance of ecological engineering in addressing the issues and challenges in environmental management
- Apply technology to manage ecosystems efficiently by understanding the essential workings of natural ecological systems
- Understand and develop the mathematical concepts and models to use for the environmental systems such as wetlands, lakes, reservoirs etc.
- Develop detritus-based treatment for waste and analyze some of the case studies in the ecosystem engineering

SYLLABUS

Development and evolution of ecosystems – Principles and concepts – Energy flow and material cycling – productivity – Classification of ecotechnology – ecological engineering.

Classification of systems – Structural and functional interactions of environmental systems – Mechanisms of steady-state maintenance in open and closed systems

Classification of ecotechnology - Principles and components of Systems and Modeling- Modeling and ecotechnology – Classification of ecological models – Applications- Ecological economics- Self-organizing design and processes – Multi seeded microcosms.

Self-organizing processes - Multiple seeded microcosms- Interface coupling in ecological systems - Concept of energy - Adapting ecological engineering systems to potentially catastrophic events – Agro ecosystems - Determination of sustainable loading of ecosystems.

Eco-sanitation – soil infiltration systems–Wetlands and ponds–Source separation systems– Aqua cultural systems – Agro ecosystems – Detritus based treatment for solid wastes –marine systems- Case studies.

Text Books

1. Kangas, P.C. and Kangas, P., *Ecological Engineering: Principles and Practice*, Lewis Publishers,
2. Concepts of Ecology by Kormondy, PHI Publications

Reference Books

1. Etnier, C. and Guterstam, B., Ecological Engineering for Wastewater Treatment, Lewis Publishers.

*****

EN2205: WATER SUPPLY ENGINEERING

Course Objectives

The course will address the following:

- Outline planning and the design of water supply systems for a community/town/city
- Provide knowledge of water quality requirement for domestic usage
- Impart understanding of importance of protection of water source quality and enlightens the efforts involved in converting raw water into clean potable water.
- Selection of valves and fixture in water distribution systems
- Impart knowledge on design of water distribution network

Course Outcomes

Upon the successful completion of this course, the students will be able to:

- Plan and design the water and distribution networks and sewerage systems
- Identify the water source and select proper intake structure
- Characterization of water
- Select the appropriate appurtenances in the water supply
- Selection of suitable treatment flow for raw water treatments

SYLLABUS

Water Demand and Quantity studies: Estimation of water demand for a town or city, Types of water demands, Per capita Demand, Factors affecting the Per Capita Demand, Variations in the Demand, Design Period, Factors affecting the Design period, Population Studies, Population Forecasting Studies.

Hydrological Concepts: Hydrological Cycle, Types of Precipitation, Measurement of Rainfall. Surface sources of water: Lakes, Rivers, Impounding Reservoirs, Capacity of storage reservoirs, Mass curve analysis. Groundwater sources of water: Types of water bearing formations, springs, Wells and Infiltration galleries, Yields from wells and infiltration galleries.

Collection of Water: Factors governing the selection of the intake structure, Types of Intakes. Conveyance of Water: Gravity and Pressure conduits, Types of Pipes, Pipe Materials, Pipe joints, Design aspects of pipelines, laying of pipe lines.

Quality and Analysis of Water: Characteristics of water – Physical, Chemical and Biological. Analysis of Water – Physical, Chemical and Biological. Impurities in water, Water borne diseases. Drinking water quality standards.

Treatment of Water: Flowchart of water treatment plant, Treatment methods (Theory and Design) - Sedimentation, Coagulation, Sedimentation with Coagulation, Filtration, Chlorination and other Disinfection methods, Softening of Water, De-fluoridation, Removal of Odours.

Distribution of Water: Methods of Distribution system, Components of Distribution system, Layouts of Distribution networks, Pressures in the distribution layouts, Analysis of Distribution networks, Water connection to the houses.

Text Books

1. Environmental Engineering – Howard S. Peavy, Donald R. Rowe, Teorge George Tchobanoglus – Mc-Graw-Hill Book Company, New Delhi, 1985.
2. Elements of Environmental Engineering – K.N. Duggal, S. Chand & Company Ltd., New Delhi, 2012.

Reference Books:

1. Water Supply Engineering – Dr. P.N.Modi
2. Water Supply Engineering – B.C. Punmia
3. Water Supply and Sanitary Engineering – G.S.Birdie and J.S.Birdie
4. Environmental Engineering by D. Srinivasan, PHI Learning Private Limited, New Delhi, 2011.

*****

ENVE 2206 ENVIRONMENTAL ENGINEERING LABORATORY-1

Course Objectives

The course will address the following:

1. Estimation some important characteristics of water and wastewater in the laboratory
2. It also gives the significance of the characteristics of the water and wastewater

Course Outcomes

Upon the successful completion of this course, the students will be able to:

a. Estimation some important characteristics of water and wastewater in the laboratory
b. Draw some conclusion and decide whether the water is potable or not.
c. Decide whether the water body is polluted or not with reference to the state parameters in the list of experiments
d. Estimation of the strength of the sewage in terms of BOD and COD

SYLLABUS

List of Experiments

1. Determination of pH and Electrical Conductivity (Salinity) of Water and Soil.
2. Determination and estimation of Total Hardness–Calcium & Magnesium.
3. Determination of Alkalinity/Acidity
4. Determination of Chlorides in water and soil
5. Determination and Estimation of total solids, organic solids and inorganic solids and settleable solids by Imhoff Cone.
6. Determination of Iron.
7. Determination of Dissolved Oxygen with D.O. Meter & Winkler's Method and B.O.D.
8. Determination of N, P, K values in solid waste
9. Physical parameters – Temperature, Color, Odour, Turbidity, Taste.
10. Determination of C.O.D.
11. Determination of Optimum coagulant dose.
12. Determination of Chlorine demand.
13. Presumptive Coliform test.

NOTE: At least 10 of the above experiments are to be conducted.

Text Books

1. Standard Methods for Analysis of Water and Waste Water – APHA
2. Chemical Analysis of Water and Soil by KVSG Murali Krishna, Reem Publications, New Delhi

Reference

1. Relevant IS Codes.
2. Chemistry for Environmental Engineering by Sawyer and Mc. Carty.

*****

EN-2207: ENERGY RESOURCES LAB

Course Objectives

- Provide knowledge about various renewable energy technologies
- Impart knowledge about various possible hybrid energy systems
- Gain knowledge about application of various renewable energy technologies
- Provide hands on experience in the alternate energy systems functioning

Course Outcomes

Upon the successful completion of this course, the students will be able to:

• Understand and analyze the biogas generation systems.
• Comprehend the Renewable Energy Sources and technologies.
• Simulate the various Renewable energy sources such as solar, wind, tidal and Fuel cells.
• recognize current and possible future role of Renewable energy sources.

List of Experiments

I. Biogas Generation
1. Bio gas Generation
2. Study of various rural Biogas generation plant

II. Solar Energy

1. Solar Radiation Measurement
2. Solar Distillation
3. Solar Pumping
4. Solar Heater (Thermosiphon and Forced Circulation)
5. Solar Lanterns and Street light

III. Wind Energy

1. Study of Wind Mill
2. Experiment using Wind Energy Generator
3. Experiment on Performance assessment of micro Wind Energy Generator.
4. Simulation study on Hybrid (Solar-Wind) Power System.

IV. Small Hydel plants

1. Study on Hydel Power systems

V. MFCs and CFCs
1. Experimental study on MFCs and CFCs

VI. Tidal Energy
1. Experimental study on MFCs and CFCs

VII. Electro Chemical systems
1. Experimental study on Electro-chemical systems

Text Books

1. Steven Cortesa Adam Morin Jack Tyson (2014) Experiment Design for an Undergraduate Energy Laboratory Course. A Major Qualifying Project Submitted to the Faculty Of the Worcester Polytechnic Institute.

Reference Books

1. Joshua Earnest, Tore Wizeliu, 'Wind Power Plants and Project Development', PHI Learning Pvt.Ltd, New Delhi, 2011.
2. D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, New Delhi, 2013.
3. Scott Grinnell, "Renewable Energy & Sustainable Design", CENGAGE Learning, USA, 2016.
4. P.M.V. Subba Rao Course material of "Energy systems and Technologies" Department of Mechanical Engineering Indian Institute of Technology New Delhi

*****

EN2208: ENVIRONMENTAL INSTRUMENTATION ANALYSIS

Course Objectives

- Understand the fundamentals of functional elements of measuring system, classification and Calibration process.
- Acquire the knowledge on the estimation of errors in measurement and minimization, measurement of pressure, temperature and flow etc.
- Introduce the Spectro-analytical Methods, Electro Analytical Methods and continuous measurement methods for the environmental quality monitoring.
- Study the theoretical aspects of Chromatographic Methods for the environmental quality monitoring
- Understand the concepts of pollution monitoring, to enable select, design and configure pollution monitoring instruments

Course Outcomes

After completion of the course, the student will be able to

- Describe the functions, strengths, and limitations of various analytical instruments
- Differentiate the various types of errors in the management of data in quantitative analysis
- Use various instruments such as Colorimetry, Spectrophotometer, Fluorometry, Nephelometry for the estimation of parameters

- Understand the Chromatography Method and its application in the environmental quality monitoring
- Comprehend the Electro Analytical Methods and Continuous Monitoring Methods
- Explain the function and importance of analyzer sample systems

SYLLABUS

Fundamentals: Functional Elements of Generalized Measuring Systems - Management of Data in quantitative analysis: Accuracy, precision, types of errors, Minimization of error, statistical analysis and curve fittings - Classification of Measuring Instruments, Introduction of Microprocessors based instrumentation. Standards of Measurement and classification - Calibration of instruments and its importance - Transducers, measurement of non-electrical quantities like pressure, temperature, flow and level etc.

Instrumental Methods: pH meter – Colorimetry, Spectrophotometer: Flame Emission Spectrometry- Absorption spectrometry - Nephelometry - Atomic Absorption Spectrometry - Total Organic carbon analyzer – Mercury Analyzer polar graph for metal estimation and organic compounds - Ion selective Electrode - Instrument components and its working principle

Chromatography Method: Classification, Principal and application of Chromatography – Gas chromatography, GC-MS, HPLC, Ion Chromatography, Paper chromatography and thin layer
Chromatography

Electro Analytical Method: Conductometry Potentiometry, Coulometry and Polarography. Continuous environmental quality Monitoring instruments and their principals: NDIR for CO, Chemiluminescence analysis for NOX and fluorescence analysis for SO2

Air Pollution Control Equipment's: Working principles of electrostatic precipitator – cyclone separators – settling chamber – operation and Maintenance. Machinery for solid waste collection and disposal incineration – compactors – magnetic separators- incinerators

Text Books

1. Instrumentation and Mechanical Measurement by Prof. A. K. Tayal
2. Hand Book of Analytical Instrumentation by R. S. Khandpur
3. Instrumentation Measurement and Analyst by B. C. Nakra and K K Chaudhry

Reference Books

1. Standards Methods for the Examination of Water and Waste Water, 20th Edition, WPCF, APHA and AWWA, USA
2. Trivedy R. K. & Goel P.K., Chemical and Biological methods for water pollution studies, Environmental publication, Karat, 1986.
3. Cox C.R., Operation and Control of Water Treatment Processes, World Health Organisation, Geneva, 1964.

*****

EN 2209: ENVIRONMENTAL SCIENCE

Course Objectives

The objectives of the Environmental Science course are to

- Familiarize the fundamental aspects of environment and the environmental management'
- Provide information of some of the important international conventions, which will be useful during the future endeavors after graduation.
- Make realize the importance of natural resources management for the sustenance of the life and the society.
- Apprise the impact of pollution getting generated through the anthropogenic activities on the environment
- Provide the concept of Sustainable Development, energy and environmental management
- Impart knowledge on the new generation waste like e-waste and plastic waste.

Course Outcomes

After completion of the course the students will have

- Knowledge on the fundamental aspects of environment and the environmental management
- The knowledge on the salient features of the important international conventions
- Understanding of the importance of natural resources management for the sustenance of the life and the society
- Familiarity on various forms of pollution and its impact on the environment
- Understand the elements of Sustainable Development, energy and environmental management
- Knowledge on the new generation waste like e-waste and plastic waste

Introduction: Structure and functions of Ecosystems-Ecosystems and its Dynamics-Value of Biodiversity-impact of loss of biodiversity, Conservation of bio-diversity. Environmental indicators-Global environmental issues and their impact on the ecosystems.

Salient features of International conventions on Environment: Montreal Protocol, Kyoto protocol, Ramsar Convention on Wetlands, Stockholm Convention on Persistent Organic Pollutants, United Nations Framework Convention on Climate Change (UNFCCC),

Natural Resources Management: Importance of natural resources management-Land as resource, Land degradation, Soil erosion and desertification, Effects of usage of fertilizer, herbicides and pesticide- watershed management.

Forest resources: Use and over-exploitation, Mining and dams – their effects on forest ecosystems and the living beings

Water resources: Exploitation of surface and groundwater, Floods, droughts, Dams: benefits and costs.

Mineral Resources: Impact of mining on the environment and possible environmental management options in mining and processing of the minerals

Sustainable resource management (land, water, and energy), and resilient design under the changing environment

Environmental Pollution: Local and Global Issues. Causes, effects and control measures. Engineering aspects of environmental pollution control systems.

Air pollution: impacts of ambient and indoor air pollution on human health; Noise pollution; Water pollution: impacts water pollution on human health and loss of fresh water resources.

Soil pollution and its impact on environment. Marine pollution and its impact on blue economy.
Solid waste management: Important elements in solid waste management- Waste to energy concepts.
Air (prevention and control of pollution) Act, Water (prevention and control of pollution) Act and their amendments. Salient features of Environmental protection Act, 1986.

Sustainable Development: Fundamentals of Sustainable Development– Sustainability Strategies and Barriers– Industrialization and sustainable development. Circular economy concepts in waste (solid and fluid) management.
Energy and Environment: Environmental Benefits and challenges, Availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability. Solar Energy: process of photovoltaic energy conversion, solar energy conversion technologies and devices, their principles, working and applications, disposal of solar panel after their usage. Biomass energy: Concept of biomass energy utilization, types of biomass energy, conversion processes, Wind Energy, energy conversion technologies, their principles, equipment and suitability in context of India.

Management of plastic waste and E-waste: Sources, generation and characteristics of various e- and plastic wastes generated from various industrial and commercial activities; Waste management practices including onsite handling, storage, collection and transfer. E-waste and plastic waste processing alternatives. E-Waste management rules and Plastic waste management rules, 2016 and their subsequent amendments.

Text Books:

1. Bharucha,Erach (2004). Textbook for Environmental Studies for Undergraduate Courses of all Branches of Higher Education, University Grants Commission, New Delhi
2. Basu, M., Xavier, S. (2016). Fundamentals of Environmental Studies, Cambridge University Press, India
3. Masters, G. M., &Ela, W. P. (1991). Introduction to environmental engineering and science. Englewood Cliffs, NJ: Prentice Hall.
4. Sharma, P. D., & Sharma, P. D. (2005). Ecology and Environment. Rastogi Publications
5. Enger, E. and Smith, B., Environmental Science: A Study of Interrelationships, Publisher: McGraw-Hill Higher Education; 12th edition, 2010.

Reference Books:

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.

2. Clark R.S. (2001). Marine Pollution, Clanderson Press Oxford (TB)

3. Jadhav, H &Bhosale, V.M. (1995). Environmental Protection and Laws. Himalaya Pub. House, Delhi.

4. MoEF&CC, Govt. of India, CPCB: E-waste Management Rules, 2016 and its amendments 2018.
5. MoEF&CC, Govt. of India, CPCB: Plastic Waste Management Rules, 2016.

*****

III/IV B.Tech. (Environmental Engineering)
1st Semester

EN3101 HYDRAULICS AND HYDRAULIC MACHINERY

Course Objectives

- To classify the types of flows in open channel and design most economical open channel sections and learns about critical flows.
- To study about non-uniform flows in open channels and to learn about the characteristics of hydraulic jump in rectangular channels
- To impart knowledge on impact of jets, working principle, selection and designing of impulse and reaction turbines.
- To explain governing of turbines and performance characteristics of pumps and turbines working under different conditions
- To explain various components and working principles of centrifugal pump and reciprocating pumps. Also, to teach the criteria of selection of the pumps

Course Outcomes

Students will be able to

- To calculate discharge carrying capacity of open channel sections and design of most economical channel sections.
- To calculate water surface profiles in open channels, hydraulic jump analysis.
- Select appropriate hydraulic turbines for given conditions and study their performance characteristics.
- Understand the operation of pumps and study their characteristics.

SYLLABUS

Open Channel Flows and Uniform Flow Computation: Basic Concepts – Introduction, Classification of Open Channels – Classification of Flow; Geometric Elements of a Channel Section; Velocity Distribution in a Channel Section; Wide Open Channel; Measurement of Velocity; Velocity Distribution Coefficients; Pressure Distribution in a Channel Section – Effect of Slope on Pressure Distribution; Basic Equations – Chezy's Equation, Manning's Equation.
Most Economical Channel Sections – Rectangular, Trapezoidal, Circular and Triangular Channel Sections; Critical Flow – Computation of Critical Flow, Section Factor for Critical Flow.

Application of Energy Principle in Open channels – Definition of Specific Energy, Specific Energy Diagram, Critical depth, Critical Velocity, Conjugate or Alternate Depths, Sub-critical, Critical and Super-critical Flows, Froude Number, Relationship between Critical depth and Specific Energy for Rectangular, Trapezoidal Sections; Application of Momentum Principle in Open channels – Specific Force; Canal Transitions – Change of Depth in Channels with Change in Cross-section and Hump in the Bed; Control Sections; Venturi Flume and Parshall Flume

Varied Flow in Open Channels: Analysis &Computation of G.V.F: Definition of G.V.F. and Derivation of Governing Equation – Mild, Steep, Critical, Horizontal and Adverse Slopes –

Backwater and Drawdown Curves –Computation of G.V.F. Profiles in rectangular channels using Direct and Single Step methods (Simple Slope cases only).
Rapidly Varied Flow – Hydraulic Jump, Types of Jumps, Hydraulic Jump in Horizontal Rectangular Channels.
Impact of Jets: Force Exerted by Fluid Jet on Stationary and Moving Flat and Curved Vanes, Torque and Work Done by Series of Moving Vanes.
Hydraulic Machines-Turbines: Introduction and Classification of Turbines –Working of Impulse Turbines and Design Principles – Components and Working Principles of Pelton Turbine – Work Done; Hydraulic and overall Efficiencies; Design of Pelton Turbine – Working Proportions.

Working of Reaction Turbines and Design Principles – Components and Working Principles of a Francis Turbine – Work Done; Hydraulic and overall Efficiencies; Design of Francis Turbine – Working Proportions; Draft Tube Theory; Kaplan Turbine and Working Proportions of Kaplan Turbine.
Performance and Characteristics of Turbines: Unit Quantities, Specific Speed and its Importance; Model Relationships; Operating Characteristic Curves; Cavitation Problem in Turbines.

Hydraulic Machines – Centrifugal Pumps; Functions of a Pump– Selection Criterion – Rotodynamic and Positive Displacement Pumps – Comparison between Centrifugal & Reciprocating Pumps; Components & Working principles of Centrifugal Pumps; Classification of Centrifugal Pumps; Working Head and Number of Stages, Single & Double Suction. Work done by Centrifugal Pumps – Pressure Change in a Pump, Manometric and Static Head – Velocity triangles– Minimum Starting Speed of pump – Multistage Pumps; Pumps in Parallel and Series; Cavitation – Limitation of Suction Lift, NPSH and its importance in Selection of Pumps. Performance Characteristics of Pumps – Similarity Relations and Specific speed of Pumps – Dimensionless characteristics – Constant Efficiency Curves of Centrifugal Pumps.
Hydraulic Machines – Reciprocating Pump: Reciprocating Pumps – Fundamental concepts, Component Parts and Working principle of Single Acting and Double Acting Reciprocating Pumps – Discharge Coefficient, Volumetric Efficiency and Slip; Work done by Reciprocating pumps.

Text Books

1. Fluid Mechanics and Hydraulic Machinery, Modi, P.N. and S.M. Seth, Standard Book House.
2. Fluid Mechanics, Jain, A.K., Khanna Publishers.
3. Flow in Open Channels, Subramanya, K., Tata McGraw-Hill Publishing Co. Ltd.

Reference Books

1. Engineering Fluid Mechanics, Kumar, K.L., S. Chand &Co. Ltd.
2. Flow through Open Channels, Ranga Raju, K.G., Tata McGraw-Hill Publishing Co. Ltd.
3. Open Channel Hydraulics, Chow, V.T., McGraw-Hill Ltd.

EN3102: ENVIRONMENTAL IMPACT ASSESSMENT AND CARRYING CAPACITY

Course Objectives

- To familiarize with EIA methodologies
- To impart knowledge on EIA case studies
- To input skills on prediction and assessment of air and noise environment
- To input skills for prediction and assessment of water and soil environment
- To familiarize with cultural and socio-economic environment
- Impart knowledge on the carrying capacity of the environment

Course Outcomes

The student will be able to

- Understand the concept and methodologies of EIA
- Understand the procedure for environmental clearance
- Discuss the basic information on environmental attributes like air, water and noise
- Discuss the standards, impact assessment and mitigation
- Understand the concepts of carrying capacity of environment
- Discuss the socio-economic attribute, resettlement and rehabilitation issues

SYLLABUS

Introduction to EIA: Definition, Concepts, Types, Limitations, components of EIA process, settings – public participation, public hearing. Methodologies**:** background information, interaction matrix methodologies, network methodologies etc., environmental setting- various factors, documentation and selection process, environmental indices and indicators for describing affected environment.

EIA notification by Ministry of Environment and Forest (Govt. of India): Provisions in the EIA notification, Categorization of Industries for seeking environmental clearance from concerned authorities, procedure for environmental clearance, procedure for conducting environmental impact assessment report, Rapid and Comprehensive EIA, general structure of EIA document, Environmental management plan, post environmental monitoring. Case studies in EIA.

Prediction and assessment of impact for air and noise environment: Basic information of air quality, identification of type and quantity of air pollutant, existing air quality and air quality standards, impact prediction and assessment, mitigation. Basic information of noise, existing noise levels and standards, prediction of noise levels and assessment of impact, mitigations.

Prediction and assessment of impact for water and soil environment: Basic information of water quality (Surface water and groundwater), water quality standards, identification of impact, prediction of impact and assessment, mitigations. Background information of soil environment, soil and groundwater standards, prediction and assessment of impact for groundwater and soil, mitigations.

Prediction and assessment of impact on cultural and socioeconomic environment: Basic information on cultural resources, rules and regulations for cultural resources like archaeological, historical structures, Cultural system, prediction and assessment of impact, mitigations. Basic information of socio-economic environment, description of existing socio-

economic environment, prediction and assessment of impact, mitigation, resettlement and rehabilitation.

Carrying Capacity and the Environment: Definition of Carrying capacity -' Concept of carrying capacity –carrying capacity of the supporting ecosystem and assimilative carrying capacity - Fundamentals of assessment of carrying capacity – case studies.

Text Books

1. Environmental Impact Assessment, Canter R.L., Mc Graw Hill International Edition,1997.
2. Environmental Impact Assessment Methodologies by Y Anjaneyulu, and Valli Manikkam, BSP Books PVT Ltd.
3. India Institute of Technology Guwahati 2011 Urban Carrying capacity: Concept and Calculation (Guwahati: Department of Civil Engineering)

References Books

1. Environmental Impact Analysis Handbook, John G. Rau and David C. Wooten (Ed), McGraw Hill Book.
2. MoEF & CC, Govt. of India: EIA notification and subsequent amendments
3. Environmental Efficiency and Carrying Capacity Indicators by Mathew May. LAP Lambert Academic Publishing (20 February 2013)
4. Carrying Capacity based regional planning. IHS, Rotterdam. National Institute of Urban Affairs, New Delhi.

EN3103: WASTEWATER COLLECTION AND TREATMENT

Course Objectives

The objective of this course is:

1. Outline planning and the design of wastewater collection, conveyance and treatment systems for a community/town/city
2. Provide knowledge of characterization of wastewater generated in a community
3. Impart understanding of treatment of sewage and the need for its treatment.
4. Summarize the appurtenance in sewerage systems and their necessity
5. Teach planning, and design of septic tank and Imhoff tank and the disposal of the effluent from these low-cost treatment systems
6. Effluent disposal method and realize the importance of regulations in the disposal of effluents in rivers

Course Outcomes

By the end of successful completion of this course, the students will be able to:

a. Plan and design the sewerage systems
b. Characterization of Sewage
c. Select the appropriate appurtenances in the sewerage systems
d. Selection of suitable treatment flow for sewage treatment
e. Identify the critical point of pollution in a river for a specific amount of pollutant disposal into the river

SYLLABUS

Introduction to sanitation – Systems of sanitation – relative merits & demerits – collection and conveyance of waste water – sewerage – classification of sewerage systems- Estimation of sewage flow and storm water drainage and fluctuations – types of sewers – design of sewers – appurtenances in sewerage system– cleaning and ventilation of sewers.

Pumping of wastewater: Pumping stations – location – components– suitability of pumps for pumping of wastewaters.
House Plumbing: Systems of plumbing-sanitary fittings and other accessories–one pipe and two pipe systems – Design of building drainage.
Sewage characteristics – Sampling and analysis of wastewater - Physical, Chemical and Biological Examination-Measurement of BOD and COD - BOD equations

Treatment of sewage: Primary treatment -Screens-grit chambers-grease traps–floatation–design of preliminary and primary treatment units - Aerobic and anaerobic treatment process - Suspended growth process: Activated Sludge Process, principles, designs, and operational problems, modifications of Activated Sludge Processes, Oxidation ponds, Aerated Lagoons.
Attached Growth Process**:** Trickling Filters – mechanism of impurities removal-classification–design-operation and maintenance problems. RBCs, Fluidized bed reactors

Sewage Treatment Methods: Nitrification and Denitrification – Removal of Phosphates – UASB – Membrane reactors. Anaerobic Processes: Septic Tanks and Imhoff tanks- working Principles and Design – disposal of septic tank effluent. Fundamentals of UASB.

Bio-solids (Sludge) management: Characteristics- handling and treatment of sludge - anaerobic digestion of sludge.
Disposal of sewage: Methods of disposal – disposal into water bodies - disposal on land – sewage sickness – reuse of the digested sludge.

Text Books

Wastewater Engineering Treatment and Reuse by Metcalf & Eddy, Tata McGraw-Hill edition.
Elements of Environmental Engineering by K.N. Duggal, S. Chand & Company Ltd. New Delhi, 2012.
Environmental Engineering by Howard S. Peavy, Donald R. Rowe, Teorge George Tchobanoglus – Mc-Graw-Hill Book Company, New Delhi, 1985

Reference Books

1. Environmental Engineering –II: Sewage disposal and Air Pollution Engineering, by Garg, S.K.; Khanna Publishers
2. Sewage treatment and disposal by Dr. P.N. Modi & Sethi.
3. Environmental Engineering by D. Srinivasan, PHI Learning Private Limited, New Delhi, 2011.

EN3106 GEOTECHNICAL ENGINEERING LAB

Course Objectives
The course is intended to

- Develop skills to identify and classify different types of soils
- Impart knowledge about different methods of determination of insitu density of soils
- Study the necessity of sedimentation analysis for classifying fine-grained soils
- Assess the drainage capacity of different soils
- Understand laboratory methods used for determining density of soil.

Course Outcomes

- The student will be able to
- Perform suitable tests for assessing grain size distribution and classify the soil accordingly Select appropriate method for determining field density of soil for a given soil
- Determine specific gravity of coarse and fine grained soils3
- Evaluate Permeability of given soil
- Estimate compaction characteristics of soil

LIST OF EXPERIMENTS

1. Atterberg limits
2. Field density by Core Cutter and Sand replacement method
3. Grain size analysis
4. Hydrometer/pipette analysis
5. Specific gravity by pycnometer/density bottle method
6. Permeability of soil – Constant and variable head tests
7. IS light compaction

DEMONSTRATION EXPERIMENTS:
1. Consolidation test.
2. Quicksand model and others if any.

EN 3107 Hydraulic Engineering Laboratory

Course Objectives
- To provide practical knowledge in verification of principles of fluid flow
- To conduct a test on hydraulic jump and measurement of rugosity coefficients in open channels.
- To understand major losses in pipe flows.
- To understand drag characteristics of cylinder in a wind tunnel e.
- To conduct experiments on impact of jets on vanes.
- To gain knowledge in performance testing of hydraulic turbine and hydraulic pumps at constant speed and head.
- To learn and practice writing technical reports.

Course Outcomes

- On completion of this course, the student will be able to
- Demonstrate practical understanding in formation of hydraulic jump and measurement of Rugosity coefficients.
- Demonstrate practical understanding of friction losses in pipe flows
- Demonstrate practical understanding of boundary layer, separation and drag
- Provide the student knowledge in calculating performance analysis in turbine and pumps.
- Demonstrate the ability to write clear lab records.

LIST OF EXPERIMENTS

1. Study of Characteristics of a hydraulic jump – To measure and draw (E1-E2)/E1 vs F1 and Lj / y2 vs F1, and compare with theoretical results wherever possible.

2. Study of Rugosity coefficients in an open channel flow.

3. Study of major losses in pipes – Pipe friction – To compute Darcy- Weisbach friction factor.

4. Study of impact of a jet on flat and curved vanes.

5. Study of performance characteristics of a centrifugal pump – To measure the discharge, head developed, and power input at various discharges for centrifugal pump and draw the performance characteristics.

6. Study of performance characteristics of a reciprocating pump – To measure the discharge, head developed, and power input at various discharges for reciprocating pump and calculate percentage slip and efficiency.

7. Study of performance characteristics of a Pelton turbine – To measure the discharge, head difference across the turbine, the brake load, speed of turbine for various discharges and draw the performance characteristics.

8. Study of performance characteristics of a Francis turbine – To measure the discharge, head difference across the turbine, the brake load, speed of turbine for various discharges and draw the performance characteristics.

EN3108: ENVIRONMENT AND POLLUTION CONTROL FACILITIES OPERATOR SKILLS

EN3109: INTERNSHIP

III/IV B.Tech. (Environmental Engineering)
2nd Semester

EN 3201 AIR POLLUTION AND CONTROL

Course Objectives

- To provide a general understanding of air quality and its impact on humans, materials, properties, and the local and global effects of air pollution on plants.
- To study the function and transport of air pollutants and their measurement methods
- Study of sampling types and methods for ambient air and stack.
- Study of macro and micrometeorology for understanding the dispersion of pollutants
- To discuss different types of air pollution control devices and their design principles and limitation.

Course Outcomes

At the end of the course student will be able to

- Classify and identify the sources of air pollutants
- Assess the effects of air pollutant on human health and environment.
- Apply and illustrate the importance of various air pollution dispersion models.
- Evaluate the air quality and relate it with air pollution regulation
- Compute the ground level concentration of a pollutant with the help of Gaussian model
- Understanding the design concepts of various air pollution control equipment and evaluate its use.

SYLLABUS

Air Pollution and its definition – Factors influencing air pollution – Classification of pollutants particulates – Gases-Sources of pollution – Air qualities standards – effects – Location of Industries.

Meteorology and Air Pollution dispersion – Wind roses – lapses rates – mixing depth atmospheric dispersion – plume behavior, accumulation, estimation of pollutants – Effective stack height.

Impact of Air Pollution: effects on human beings, animals, plants and materials – Air Pollution Episodes in India and abroad.

Air Quality Monitoring and Modelling: Ambient air quality monitoring and stack monitoring – Gaussian dispersion modeling and assessment of ground level concentration.

Control of air pollution – Removal of pollutants – particulate and gaseous – Air pollution control equipments (units) such as settling chamber, cyclones, wet scrubbers/collectors, scrubbers, centrifugal scrubbers spray towers, packed beds, electrostatic precipitators, after burners-absorption – adsorption – Diffusion.

Text Books

1. Air Pollution Control Technology by T. Painter.
2. Air Pollution by M.N.Rao & H.V.N.Rao

3. Air Pollution and Control Engineering by by Rajni Kant and Keshav Kant, Khanna Book Publishing

Reference Books

1. Fundamentals of Air Pollution Engineering by Richard C. Flagan John H. Seinfeld California Institute of Technology, PRENTICE HALL Englewood Cliffs, New Jersey
2. Elements of Air Pollution Control by K V S G Murali krishna

EN3202: SOLID AND HAZARDOUS WASTE MANAGEMENT

Course Objectives

- To familiarize the student on the sources and types of solid wastes
- To impart knowledge of solid waste management principles
- To input knowledge on waste segregation methods
- To develop skills of composting and familiarize with incineration methods
- To impart knowledge of waste disposal by sanitary landfill
- Impart knowledge on the hazardous waste characteristics and its handling

Course Outcomes

Upon successful completion of this course, students will be able to:

- Gains the knowledge about the sources and types of solid wastes.
- Evaluate the characteristics of municipal solid waste.
- Analyze the problems due to improper disposal of solid waste and understand the integrated solid waste management options.
- Explain the merits and demerits of composing and incineration.
- Perform the analysis and design of sanitary landfill.
- Understand the hazardous waste management which will be useful in using the method for waste management

SYLLABUS

Introduction: Definition of solid waste – waste generation, sources and types of solid waste – sampling and characterization – Determination of composition of Municipal Solid Waste – Onsite storage and handling of solid waste.

C**ollection and Transport of Solid Waste:** Type and methods of waste collection systems, analysis of collection system Optimization of collection routes – alternative techniques for collection system. Transfer and Transport**:** Need for transfer operation, transport means and methods, transfer station types and design requirements. Separation and Processing and Transformation of Solid Waste- Waste as a Resource Economics, Disposable Materials, Recycling Collection, Processing, Potential for Reuse

Processing and disposal: Unit operations used for separation and processing, Materials Recovery facilities, Source reduction and waste minimization, Metal Separation & Recovery Waste transformation through combustion and composting, anaerobic methods for materials recovery and treatment – Energy recovery – biogas generation and cleaning– Incinerators.

Landfills**:** Site selection, design and operation, drainage and leachate collection systems – designated waste landfill remediation.

Hazardous Waste Management: Definition and identification of hazardous wastes-sources and characteristics – hazardous wastes in Municipal Waste – Hazardous waste regulations – minimization of Hazardous Waste-compatibility, handling and storage of hazardous waste-collection and transport, e-waste - sources, collection, treatment and reuse.

Hazardous Waste Treatment Technologies - Design and operation of facilities for physical, chemical and thermal treatment of hazardous waste – Solidification, chemical fixation and encapsulation, incineration. Hazardous waste landfills: Site selection, design and operation – remediation of hazardous waste disposal sites.

Text Books

1. Integrated Solid Waste Management, George Techobanoglous and Frank Kreith, McGraw Hill Publication
2. Hazardous Waste Management, Charles A. Wentz; McGraw Hill Publication
3. Solid Waste Management, by K. Sasi Kumar and S. Gopi Krishna, PHI Learning

Reference Books

1. Solid and Hazardous Waste Management by MN Rao, Razia Sultana, BSP Books
2. Municipal Solid Waste Management by P Jayaramireddy, BSP Books PVT Ltd.
3. CPCB's Hazardous waste management rules (management and Handling) by CPCB. Govt. of India.

EN3203: INDUSTRIAL POLLUTION CONTROL AND MANAGEMENT

Course Objectives

- Acquire knowledge on characteristics of wastewater from various sources and its primary treatment.
- Impart knowledge about principles of biological waste treatment.
- Design the processes of different biological treatment units.
- Familiarize with the various principles in industrial waste treatment.
- Understand the manufacturing processes, treatment of wastes and disposal methods of various industries.

Course Outcomes

At the end of the course student will be able to

- Understand characteristics of wastewater and primary treatment process of waste water.
- Discuss the different principles of biological waste treatment.
- Understand the design processes of different biological treatment units.
- Understand the various principles involved in treatment of industrial wastes.
- Summarize the manufacturing processes, treatment of wastes and disposal methods of various industries.

SYLLABUS

Characteristics of wastewater of specific industries, characteristics of treatment plant effluents, Effect of wastewater on self-purification capacity of streams, Primary treatment of waste water.

Principles of biological waste treatment; Microbiological growth rate kinetic equations, sludge production, oxygen requirements, continuous flow treatment models. Aerobic treatment systems in continuous and semi-continuous reactors. Anaerobic treatment processes and systems, Nitrogen and Phosphorus removal.

Biological treatment facilities: Process designs of the following units w.r.t. Industrial Wastes; Activated sludge process; trickling filter; sludge digestion units; Aerated lagoons; Stabilization ponds (oxidation ponds); oxidation ditches (Pasveer ditches); Rotating Biological contactor; Anaerobic filter.

Principles of Industrial waste Treatment: Waste reduction, pretreatment of wastes, collection and segregation of wastes, reduction in volume and strength neutralization; equalization; proportioning.

Manufacturing processes, **flow sheets**; Characteristics and treatment of wastes and disposal methods of the following industries – Sugar, Dairy, Distillery, Paper, Tannery, Textile, Sheet, Fertilizer, Oil refinery and Petrochemicals.

Text Books

1. Wastewater Treatment by M.N. Rao and A. K. Datta. Oxford & IBH Publishing Co. New Delhi.
2. Industrial Water Pollution Control by W. Wesley Eckenfelder, Jr.; McGrawhill Publishing co., New Delhi

Reference Books

1. Industrial Wastewater Treatment by Patwardhan, A.D. PHI Learning Pvt. Ltd.
2. A Comprehensive Book on Industrial Waste and Management by Dr. H.S. Bhatia. Misha Books
3. Industrial Waste Treatment Handbook by Frank Woodard. Butterworth–Heinemann.

EN3206: ENVIRONMENTAL ENGINEERING SYSTEMS DESIGN AND DESIGN DRAWING

Course Objectives

To train the students on

- Preparing layout of water and wastewater treatment plants
- Design procedure and components of the water treatment units
- Design procedure and elements of various wastewater treatment units
- Impart knowledge of septic tank and Imhoff tank

Course Outcomes

The students completing the course will have

- Ability to prepare the treatment flow of water and wastewater treatment plants
- Understanding and designs of various treatment units in a treatment plant

- Identify the components or elements of the water and wastewater treatment units
- Design the septic tank and Imhoff tank

LIST OF EXPERIMENTS

1. Layout of Water treatment plant
2. Design and drawing of sedimentation tank, slow and rapid sand filters
3. Design and drawing of secondary settling tanks, trickling filter, activated sludge process
4. Design and drawing of RBCs
5. Design and drawing of Sludge digestion tank
6. Design and drawing of Septic tank with dispersion trench and soak pit.

Text Books

1. Metcalf and Eddy, "Wastewater Engineering – Treatment and Reuse", Tata McGraw-Hill, New Delhi, 2003.
2. Wastewater Treatment Plants: Planning, Design, and Operation, Second Edition by Syed R. Qasim. CRC press
3. Water Works Engineering: Planning, Design and Operation by Syed R. Qasim, Edward Motley, Guang Zhu. Prentice Hall India Learning Private Limited
4. Wastewater Treatment Plant Design Handbook by Water Environment Federation 601 Wythe Street Alexandria, VA 22314-1994 USA

Reference Books

1. Rangwala.S.C, "Fundamentals of water supply and sewerage engineering", Charotar Publishing, 2000.
2. Mannual on wastewater and treatment CPHEECO, Ministry of Urban Affairs and Eemployment, Govt. of India, New Delhi, 1990.
3. Shah.C. S., "Water supply and Sanitation", Galgotia publishing company, New Delhi, 1994.

EN3207: AIR AND NOISE MONITORING LABORATORY

Course Objectives

To train the students on
- The assessment of ambient air and noise quality measuring systems
- The measurement of meteorological parameters
- Practical issues that need to address while monitoring the air and noise quality parameters
- The calibration process of the equipment before taking up the measurements

Course Outcomes

The students completing the course will have
- Ability to design the sampling protocols to ambient air and noise quality assessment
- Learn the analysis techniques for the estimation of various quality parameters of air and noise
- Knowledge of the significance of each of the parameter estimated during the practical course

- The exposure on how the air sampling equipment works during the monitoring process

LIST OF EXPERIMENTS

1. Particulate Sampling – Dust Fall, Pollution Suspended Particulates and Total Particulate Matters using High Volume Sampler / Respirable Dust Sampler.
2. Experiment on Respirable Dust – Estimating RPM.
3. Estimating Sulphur Dioxide, NOx in Ambient Air Using High Volume Air Sampler.
4. Stack Sampling Techniques and Demonstration of Stack Monitoring.
5. Exercises on Ambient Gas Monitoring including CO & VOC.
6. Demonstration / Exercises on Air Pollution Control Devices – Bag Filter, Scrubber, Cyclone and ESP.
7. Exercises on Auto Exhaust Analyzer for Petrol Vehicle and Diesel Vehicle Smoke test for Diesel Vehicle.
8. Exercises on Noise Measuring Instruments.
9. Exercises on Luxmeter (Light Intensity measuring Instrument)
10. Demonstration on Wind Monitoring and Analysis of Data for Wind rose Diagrams.
11. Demonstration of Rain Gauges.

Text Books

1. Henry C Perkins "Air pollution and Control", Mc Graw Hill Pvt Ltd, New Delhi, 1974.
2. Stern A. C., “Air Pollution” (vol. I), “Air Pollution and its effects” (vol. II), “Analysis, Monitoring and Surveying” (vol. III), “Sources of Air Pollution and their control”, Academic press, New York, 1968.

Reference Books

1. Guidelines for measurement of Ambient air Pollutants, Volume 1, CPCB 2011.
2. IS 5182 (Part 14): Methods for Measurement of Air Pollution, Part 14: Guidelines for Planning the Sampling of Atmosphere (Second Revision) by Bureau of Indian Standards (BIS).

EN3208: COMPUTER APPLICATIONS IN ENVIRONMENTAL ENGINEERING

Course Objectives

To train the students on
- The application of computing systems in the environmental engineering field
- Usage of the available software in the field of environmental engineering
- Development of spread sheets for the design of various treatment units

Course Outcomes

The students completing the course will have the
- Capability in selecting an appropriate software to the simulations
- Ability to use the existing modeling software such as AERMOD, WASP etc.,
- Understanding of the data requirements for the usage of a given model

SYLLABUS

1. Introduction to the use of computer-based applications in environmental engineering

2. Overview of available environmental engineering software tools

3. Training and Hands on experience on using Environmental Engineering software
    i) Subsurface flow and ground water contaminant transport modeling
    ii) Air Quality Modelling: AERMOD– Air pollution modeling
    iii) EPA NET-Distribution network modeling
    iv) ALOHA model
4. Water or Wastewater Designs and development of design spread sheets

5. Solute Transport Modelling and Water Quality Analysis Simulation Program

EN3209: SOFT SKILLS

Course Objectives

- To develop skills to communicate clearly
- To aid students in building interpersonal skills
- To enhance team building and time management skills
- To inculcate active listening and responding skills

Course Outcomes

- Make use of techniques for self-awareness and self-development.
- Apply the conceptual understanding of communication into everyday practice.
- Understand the importance of teamwork and group discussions skills.
- Develop time management and stress management.

SYLLABUS

Introduction to Soft Skills: Communication – Verbal and Non-Verbal Communication - Personal grooming (Etiquette, Attitude, Body Language), Posture, Gestures, Facial Expressions, Eye Contact, Space Distancing, Presentation Skills, Public Speaking, Just a Minute (JAM) sessions, Adaptability.

Goal Setting and Time Management: Immediate, Short term, Long term, Smart Goals, Strategies to Achieve goals, Types of Time, Identifying Time Wasters, Time Management Skills, Stress Busters.

Leadership and Team Management: Qualities of a Good Leader, Team Dynamics, Leadership Styles, Decision Making, Problem Solving, Negotiation Skills.

Group Discussions: Purpose (Intellectual ability, Creativity, Approach to a problem, Tolerance), Group Behavior, Analyzing Performance.

Job Interviews: Identifying job openings, Covering Letter and CVs / Resumes, Interview (Opening, Body-Answer Q, and Close-Ask Q), Telephone Interviews, Types of Questions.

Text Books

1. Effective Technical Communications' by Rizvi M. Ashraf, McGraw–Hill Publication

2. 'Developing Communication Skills' by Mohan Krishna & Meera Banerji, Macmillan

Reference Books

1. 'Creative English for Communication' by N.Krishnaswami & T.Sriraman, Macmillan

2. 'Professional Communication Skills' by Jain Alok, Pravin S.R. Bhatia & A.M. Sheikh, S.Chand & Co

3. Krannich, Caryl, and Krannich, Ronald L. Nail the Resume! Great Tips for Creating Dynamite Resumes. United States, Impact Publications, 2005.

4. Hasson, Gill. Brilliant Communication Skills. Great Britain: Pearson Education, 2012

4. Prasad, H. M. How to Prepare for Group Discussion and Interview. New Delhi: Tata McGraw-Hill Education, 2001.

5. Pease, Allan. Body Language. Delhi: Sudha Publications, 1998.

6. Rizvi, Ashraf M. Effective Technical Communication: India, McGraw-Hill Education. 2010

7. Thorpe, Edgar &Showick Thorpe. Winning at Interviews. 2nd Edition. Delhi: Dorling Kindersley, 2006.

PROFESSIONAL ELECTIVES

1.GEOTECHNICAL ENGINEERING

Course Objectives

- To impart knowledge in analyzing the composition of the soil matrix and proportioning in developing fundamental relations
- To understand concepts like plasticity, compressibility, Shear strength, compaction, settlement, etc.
- To identify and classify soils based on their properties
- To develop skills in the identification of soil characterization when it interacts with water
- To estimate the magnitude and time rate of settlement due to consolidation

Course Outcomes

The student will be able to

- Analyze soil and identify its nomenclature, which helps in deriving its behavior at various in situ conditions.
- Apply basic concepts of soil to compute settlements and the bearing capacity of soils.
- Prediction of seepage characterization under various hydraulic structures
- Apply the knowledge of compaction during the construction of roads, embankments, canals etc., on weak soils.
- Solve practical problems related to consolidation settlement and the time rate of settlement.

SYLLABUS

Introduction: Soil Formation, Minerals in Clays and Sand, Soil Structure, Physical properties of Soil: Void Ratio, Porosity, Degree of Saturation, Water Content, Unit Weights, Specific Gravity, Weight - Volume Relationships, Relative Density, Consistency Limits and Consistency Indices, Activity.
Mechanical Analysis and Soil Classification**:** Sieve Analysis, Stokes' Law, Hydrometer and Pipette Analysis, Textural Classification, Classification based on size, Unified Soil Classification and Indian Standard Soil classification systems, Field Identification of Soils.

Soil Hydraulics: Types of Soil Water, Capillary Rise and Surface Tension, Darcy's Law and its Limitations, Constant Head and Variable Head Permeability Tests, Factors effecting coefficient of permeability, Permeability of Stratified Soils. Total, Neutral and Effective Stresses, Effective stress principle, Upward flow conditions, Quick Sand Conditions, Critical Hydraulic Gradient.
Stress Distribution in Soils: Boussinesq's Theory for Determination of vertical stress, Assumptions and validity, Extension to line, strip, Rectangular and Circular loaded areas, Pressure Bulb and Influence Diagrams, Newmark's Influence Chart- Construction and Use, Westergaards's Theory, 2:1 Load Dispersion Method, Contact Pressure Distribution beneath Footings.
Compaction and Consolidation: Mechanism of Compaction, Factors Effecting Compaction, Laboratory Compaction Tests, Effect of Compaction on Soil Properties, Field Compaction: Compaction Equipment and Evaluation of Field Compaction.
: Basic Definitions: Compression Index, Coefficient of Compressibility and Coefficient of volume decrease: Spring Analogy for Primary Consolidation: Initial compression, Primary compression and secondary compression, Generation of Effective Stress- Void Ratio relationship from consolidation test: Height of Solids Method and change in Void Ratio method: Determination of Pre consolidation Pressure, Normally consolidated, Over consolidated and under consolidated clays, Terzaghi's One Dimensional Consolidation Theory - Assumptions, Derivation of differential equation and Solution, Laboratory Determination of coefficient of consolidation by time fitting methods.

Shear Strength of Soils: Stress at Point, Mohr circle of stress, Mohr-Coulomb Failure Theory, Shear Parameters, Laboratory Shear Tests- Shear Box, Triaxial and Unconfined Compression Tests, Laboratory and Field Vane Shear Tests, Sensitivity of Clays, Types of Shear Tests based on Drainage Conditions, Total stress analysis and effective stress analysis, Shear Strength of Sands, Critical Void Ratio and Dilatancy, Liquefaction of Soils, Factors affecting Shear Strength of Clays and Sands.

Text Books

1. Soil Mechanics and Foundation Engineering by K.R.Arora, Standard Publishers
2. Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R Rao, New Age International Publishers.
3. Geotechnical Engineering by P.Purushothama Raj, Pearson Publishers.
4. Principals of Geotechnical Engineering by Braja.M.Das, Cengage Learning Publishers.

Reference Books

1. Gopal Ranjan and Rao, P. Basic and Applied Soil Mechanics, New Age International Pvt. Limited, New Delhi, 2002.

2. Murthy, V.N.S., Soil Mechanics and Foundation Engineering, UBS PublishersDistributors Ltd., New Delhi, 1999
3. Punmia, B.C. Soil Mechanics and Foundation Engineering, Laxmi Publications Pvt. Ltd., New Delhi,1995.
4. Braja M. Das, Fundamentals of Geotechnical Engineering, Thomson Asia Pvt. Ltd., Singapore, 2005.

2. ELEMENTS OF COASTAL ENGINEERING

Course Objectives

- To familiarize the students about the coastal engineering and coastal processes
- Making student to understand about the generation and propagation of surface gravity waves, tides, storm surges and Tsunamis
- To import the skills of analyzing the wave transformations and breaking processes
- To develop the skills to estimate wave forces
- To develop the skill in analyzing the different types of coastal protection structures

Course Outcomes

Students will be able to

- Understand the different types of coastal processes, beaches, and landforms.
- Learns different types of wave theories and prediction models
- Understands wave transformations and wave breaking
- Familiarize the basic governing equations for the design of coastal protections structures.
- Analyze the wave forces on marine structures.

SYLLABUS

Introduction: General Design Considerations for Coastal Engineering. Long Period Waves: Tides, Seiches, Tsunamis, Storm Surge and Wind Set Up.

Solutions of Linear Wave Equation for Progressive and Standing Waves – Pressure Velocity Fields – Surface Profile and Dispersion Relationship – Principle of Super Position – Wave Energy, Energy Flux and Energy Principle – Group Velocity.
Wave Mechanics and Wave Transformation: Celerity and Group Velocity. Wind Generated Waves. Wave Statistics- Shoaling, Refraction, Diffraction and Reflection. Wave Breaking Criteria. Wave Forecasting for Deepwater Waves.

Beach Profiles and Surf Zone Wave Breaking. Sediment Transport. Impacts of Coastal Structures on Shoreline Changes. Seawalls, Breakwaters, Groins, Jetties, Wharves.

Wave Forces on Walls and piles: Design of Breakwaters: Rubble Mound-Type, Wall-Type, Structural Cross-Section. Wave Forces on Piles – Basic Assumptions – Values of the Inertia and Drag Coefficients and Their Dependence on the Wave Theory used

Text Books

1. Water Wave Mechanics for Engineers and Scientists by R.G.Dean and R.A.Darlymple, World Scientific Publishers.

2. Coastal Hydrodynamics by J.S.Mani. PHI Publishers 2nd Edition.

Reference Books

1. Basic Coastal Engineering by R.M.Sorense, 3rd Edition, Springer.
2. Coastal Engineering Manual (CEM). US Army Coastal Engineering Research Center, 2002-2006. (Download from CECIL or USACE website).

3. FUNDAMENTALS OF CHEMICAL REACTION ENGINEERING

Course Objectives

- To learn principles of rate law and stoichiometry. Isothermal reactors
- To impart knowledge on various types of reactors such as batch, plug flow reactor and mixed flow reactor.
- To provide design of single and multiple reactors
- To endow with the knowledge on thermal characteristics of various reactions

Course Outcomes

At the end of the course, the student will be able to

- Derive the rate law for non-elementary chemical reactions and determine the kinetics of chemical reaction using integral, differential and fractional life methods.
- Design reactors for homogenous reactions under isothermal conditions for single and multiple reactions
- Select optimal sequence in multiple reactor systems

SYLLABUS

Introduction and overview of chemical reaction engineering: Variables affecting a chemical reaction – Kinetics of homogeneous reactions – Concentration dependent term of rate equation – Elementary and nonelementary reactions – Temperature dependent term – Arrhenius law, activation energy, collision theory, transition state theory Searching for a mechanism.

Interpretation of batch reactor data – Methods of analysis, integral, differential and half-life methods – Analysis of different types of reactions, irreversible and reversible – Variable volume reactor.

Ideal reactors for a single reaction – Performance equations for batch, mixed flow and plug flow reactors – Space time, space velocity and mean residence time.

Design for single reactions – Size comparison of reactors – Multiple reactor systems – Recycle reactor.

Design for parallel and series reactions – Qualitative and quantitative discussion about product distribution of both types of reactions.

Text Book

1. “Chemical Reaction Engineering”, Levenspiel, O. 3rd Edition, John Wiley and Sons.

Reference Books

1. “Chemical Engineering Kinetics”, Smith, J.M, 3rd Edition. McGraw Hill Inc.
2. “Elements of Chemical Reaction Engineering”. Fogler, H.S, 3rd Edition, Prentice Hall India Ltd

4. HYDROLOGY AND WATER RESOURCES ENGINEERING

Course Objectives

- To build knowledge in hydrology and hydraulics and understanding of water resources systems
- To develop skills in the groundwater flow, type of aquifer, and yield from the well
- To provide the knowledge of the design of reservoir operation, sedimentation, and flood routing techniques
- To develop skills in modeling flood flows and flood routing
- To study the effect, causes, and remedial measures of water logging and canal systems

Course Outcomes

The students will be able to
- Demonstrate the concepts of the hydrograph, S-hydrograph, Unit hydrograph, and IUH
- Analysis of groundwater flow hydraulics along with rainwater harvesting methods
- Demonstrate the basic types of irrigation, irrigation standards, and crop water assessment.
- Identify various types of reservoirs and their design aspects along with flood routing techniques.
- Design aspects of canal systems and water logging remedies

SYLLABUS

Introduction to Hydrological Aspects: Water Resources in India, Hydrology in Water Resources Planning – Hydrologic Planning –Water Budget Equation;

Climate and Weather: Precipitation – Types, Measurement of Rainfall; Influence and Feedbacks of Hydrological Changes Due to Climate Change; Average Depth of Rainfall over an Area, Mean Annual Rainfall, Analysis of Rainfall Data – Consistency of Rainfall Record, Double Mass Curve, Depth –Intensity, Depth-Area-Duration Curves, Frequency of Point Rainfall – Intensity-Duration-Frequency (IDF) Curves, Probable Maximum Precipitation (PMP) Curves; Infiltration – Factors affecting and its Determination, Evaporation and Evapo-Transpiration – Pan Evaporation; Runoff – Factors Affecting Runoff, Methods of Determination of Runoff, Hydrograph Analysis, Base Flow Separation, Unit Hydrographs, Hydrograph of Different Durations, Applications of Unit Hydrograph; S-Hydrograph, Synthetic Unit Hydrograph; Stream Flow Measurement methods.

Groundwater Flow: Mechanics of Interstitial Flow, Definitions, Subsurface Distribution of Water, Ground Water Movement; Darcy’s Law; Permeability – Intrinsic Permeability; Well Hydraulics – Steady Flow in Different Types of Aquifers and Wells; Determination of Hydraulic Properties of Aquifer; Well Losses; Specific Capacity of Well; Well Efficiency – Pumping Tests – Recuperation Test Method for Determination of Well Yield. Infiltration Galleries, Infiltration Wells, springs.
Methods of Construction of Open Well–Yield of an Open Well – Methods of Construction of Tube Wells, Well Shrouding and Well Development, Spacing of Tube Wells, Design of Tube Well; Pumping Requirements.

Reservoir Planning and Flood Routing: Types of Reservoir – Investigations for Reservoir Planning, Selection of Site for a Reservoir, Zones of Storage in a Reservoir; Purpose of Reservoir, Design Studies, Reservoir Regulation, Reservoir Yield, Mass Curve and Demand Curve, Determination of Reservoir Capacity, Yield From a Reservoir of given Capacity; Reservoir Losses – Measures To Reduce Evaporation Loss in Reservoirs, Control of Reservoir Sedimentation. Flood Routing – Hydrologic Reservoir Routing by Pulse Method of Routing, Channel Routing by Muskingum Method.

Irrigation: Definition of Irrigation, Types of Irrigation Systems – Direct and Indirect, Lift and Inundation Irrigation Systems, Methods of Irrigation – Surface and Sprinkler Methods, Trickle or Drip Irrigation, Soil Moisture Constants, Depth of Water Held By Soil In Different Zones, Water Extraction – Quality of Irrigation Water, Irrigation Efficiencies – Soil Moisture – Irrigation Relationship – Estimating Depth and Frequency of Irrigation on the Basis of Soil Moisture Regime Concept; Water Requirements of Crops, Duty, Delta and Base Period – Their Relationship, Crops – Seasons, Factors Affecting Duty and Methods of Improving Duty, Consumptive Use of Water –Determination of Evapotranspiration – Blaney-Criddle and Penman Equations and Hargreaves Method(concepts only); Assessment of Irrigation Water Charges.

Canal Systems: Classification of Irrigation Canals – Canal Alignment, Design of Unlined Canals, Regime Theories – Kennedy's and Lacey's Theories, Critical Tractive Force Method, Design Problems – Balancing Depth; Regulation of Channel System – Canal Outlets, Requirements of a Good Outlet – Types of Outlets; Water Logging – Causes and Control – Land Drainage; Canal Lining – Methods, Design of Lined Canals, Canal Navigation – Requirements, Methods to make Navigability Feasible.

Text Books

1. Irrigation and Water Power Engineering by B.C.Punmia and P.B.B. Lal, Laxmi Publications Pvt. Ltd.

2. Irrigation and Water Resources & Water Power by P.N.Modi, Standard Book House.

Reference Books

1. Irrigation and Hydraulic Structures by S.K.Garg, Khanna Publishers.

2. Engineering Hydrology by K.Subramanya, Tata McGraw-Hill Education Private Limited.

3. Hand Book of Applied Hydrology by V.T.Chow, McGraw-Hill Book Co.

4. Impacts of Climate Change and Climate Variability on Hydrological Regimes by Jan C. van Dam, Cambridge University Press.

5. Hydrology: Principles, Analysis and Design by H.M.Raghunath, New Age International.

6. Ground Water by H.M.Raghunath, New Age International.

5. ESTIMATION SPECIFICATIN AND CONTRACTS

Course Objectives

- Quantity estimation for different civil engineering works like single storey residential building, BT road, canal etc.
- Cost estimation for different civil engineering works like single storey residential building, BT road, canal etc.
- Rate analysis for different items of work.
- Quantity estimation and preparing schedule of bars of different items of RC works.

- To prepare project management report for different civil engineering projects like residential building, BT road, canal etc.

Course Outcomes

By the end of this course, students will have the capability/knowledge of

- Estimated quantities required for different civil engineering works like single storey residential buildings, BT road, canal etc.
- Cost estimation of different civil engineering works like single storey residential building, BT road, canal etc.
- Finding the unit rate of different items of work
- Prepare schedule of reinforcement bars.
- Scheduling a project.
- Analysing a project and finding critical activities and hence allocate resources as per the schedule.

SYLLABUS

Introduction: Standard units, Units of measurement of different items of work. Meaning of "Estimating". Abstract estimate of buildings, Errors in estimation, Different types of estimates - Contingencies and related terms in the estimate - Different types of approvals; Plinth area and related terms used in the estimation of various structures, rules and methods of measurements of different works.

Contracts: Types of contracts, Contract document, Contract procedure, Conditions of contract, Arbitration and Tenders. Specifications: Meaning, purpose, types of specifications, method of preparation of specification, general specifications and detailed specifications of buildings and other structures.

Rate analysis: Data sheet for materials and various items of work in buildings and other structures, schedule of rates. Rate analysis for Building Works , Rate analysis for Sanitary and water supply works , Rate analysis for Road and Railway Works.

Detailed estimate of buildings: Different items of work in building; Principles of taking out quantities, detailed measurement form. Long walls and short walls method of building estimate, Centre line method of building estimate. Estimate of RCC building, Estimate of slope roof buildings, G.I. and A.C. Sheet, Detailed estimate of different types of doors and windows. Estimate of electricity, water supply and Sanitation works etc. **Estimate of earthwork:** Different formulae for calculations, estimate of metaled road. Estimate of Tar road, concrete road, Railway track, Estimate of culverts and bridges etc.

Valuation of buildings: Purpose, different terms used in valuation and their meaning.
Method of valuation.

Text Books

1. Estimation, Costing, Specifications and Valuation in civil Engineering by M.Chakraborti.
2. Estimating and Costing in Civil Engineering by B.N. dutta

Reference Books

1. Textbook of estimating and costing by G.S. Birdie.
2. Textbook on Estimating, Costing and Accounts by D.D. Kohli and R.C. Kohli.

6. DISASTER MANAGEMENT

Course Objectives

- Introduce the fundamental concepts of hazards and disaster management
- Understand approaches of Disaster Management
- Identify the components and describe the process of risk assessment, and apply appropriate methodologies to assess risk
- Distinguish between different hazard types and vulnerability types and vulnerability assessment
- Understand the disaster risk reduction processes

Course Outcomes

After successful completion of the course, the students are able to;
- Understand the nature, cause and effects of disasters
- Comprehend the importance of Disaster Management and the need of awareness
- Acquire knowledge on disaster preparedness, recovery, remedial measures and personal precautions
- Volunteer in pre and post disaster management service activities
- Identify the education and training need of an organization in addressing the disaster challenges

SYLLABUS

Introduction: Disaster Management, Hazards and Disasters: Earthquake Risk Management, Tsunami Risk Reduction, Flood Risk Management, Cyclone Risk Management, Drought Risk Management, Post-tsunami Hazards along the Indian Coast.

Risk and Vulnerability: Building Codes and Land Use Planning, Social Vulnerability, Macro- economic Management and Sustainable Development, Environmental Vulnerability and Disaster Risk Reduction, Climate Change Risk Reduction, Financial Management of Disaster – related Economic Losses.

Disaster Reduction Technology: Implementation Technology for Disaster Reduction, Disaster Management for Infrastructure, Geospatial Information in Agricultural Drought Assessment and Monitoring, Multimedia Technology in Disaster risk Management Training, Transferable Indigenous Knowledge in Disaster Reduction.

Education and Community: Education in Disaster Risk Reduction, Essential of School Disaster Education, Community Capacity and Disaster Resilience, Community-based Disaster Recovery, Community-based Disaster Management and Social Capital, Designing Resilience.

Crosscutting Issues: Disaster, Environment and Development, Impact of Disasters on Poverty and Deprivation, Climate Change adaptation and Human Health, Exposure, Health Hazards and Environmental Risk. Hydro-meteorological disasters and Agriculture, Forest Management and Disaster Risk Reduction.

Rural Livelihood and Disaster Risk Reduction: Essentials of Urban Disaster Risk Reduction, Institutional Capacity in Disaster Management, Corporate Sector and Disaster Risk Reduction, Essentials of Pre-disaster Recovery Planning, Experiences of Disaster Risk Reduction.

Text Books

1. Disaster Management, R.B.Singh, Rawat Publications
2. Natural Disaster Management,Jon Ingleton

Reference Books

1. Disaster Management, Rajib Shaw and RR Krishnamurthy, Universities Press, Hyderabad.
2. Disaster Management by Pandey, Wiley Publications

7. NATURAL RESOURCES MANAGEMENT

Course Objectives

- To understand general concepts of natural resource and their inter relationship
- To impart knowledge on the contribution of various natural resources viz. forest, water, soil, land etc. for better understanding of their importance and management.
- To familiarize the impacts of the economic activities on the natural resources
- To convey the importance of land resource management for the sustainable development
- To comprehend the approaches in natural resource management

Course Outcomes

After successful completion of the course, the students are able to

- Understand the nature, cause and effects of anthropogenic activities on natural resource
- Comprehend the importance of effective resource management for sustainable development
- Acquire knowledge on various approaches in natural resources management
- Identify the natural resources protection and conservation practices for their implementation

SYLLABUS

Introduction to Natural Resource: Concept of resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Inter relationships among different types of natural resources. Ecological, social and economic dimension of resource management. Natural resources and development.

Forest resources: Forest vegetation, status and distribution, contribution as resource. Uses and over-exploitation, deforestation. Timber extraction, mining, dams and their effects on forest and tribal people, Forest products. Developing and developed world strategies for forestry -Use and over-exploitation, deforestation, case studies.

Water resources: Use and overutilization of surface and ground water, dams-benefits and problems
Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies

Land resources Management: 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. Land use Planning – Objective and importance; Land use and capability classification systems; Land use Planning models and their limitations. Impacts of natural and man-made activities on land characteristics and land use planning; Impact of soil erosion and sedimentation control.

Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies

Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies. Poverty and implications in resource management in developing countries – poverty in developing countries, causes and link with resources scarcity and poverty. Resource Management Paradigms: Resource management the evolution and history of resource management paradigms. Resource conflicts: Resource extraction, access and control system. Management of Common International Resources: Ocean, climate, International fisheries and management commissions; Antarctica: the evolution of an international resource management regime.

Text Books

1. Francois Ramade 1984. Ecology of Natural Resources. John Wiley & Sons Ltd.
2. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p

Reference Books

1.Harikesh N Mishra 2014 Managing Natural Resources- Focus on Land and Water. PHI Lerning Publication.
3. Global Change and Natural Resource Management, Vitousek, P.M. 1994. Beyond global warming: Ecology and global change. Ecology 75, 1861-1876.

8. AGRICULTURAL POLLUTION AND CONTROL

Course Objectives

The objectives of the course are to

- Understand the agricultural practices and its connectivity to nature
- Comprehend the usage of fertilizers, pesticides, herbicides in agricultural practices
- Acquire knowledge on impact of irrigation such as water logging and salinity
- Understand the impact of the agricultural practices on the environment
- Identify the possible ways and means to address the challenges of agricultural pollution

Course Outcomes

After successful completion of the course, the students are able to

- Select the agricultural practices which are beneficial to the nature
- Know importance of judicious usage of fertilizers, pesticides, herbicides in agricultural practices
- Plan for the control of water logging and salinity
- Identify the impact of the agricultural practices in the area on the environment
- Choose appropriate methods to address the challenges of agricultural pollution

Agriculture Practice: Types of farming systems, agro meteorology, water and nutrients requirement, connectivity between the agriculture and the environmental attributes.

Fertilizers, pesticides, herbicides: Types of fertilizers, pesticides and other agrochemicals, soil and water conservation practices. Natural fertilizers, pesticides and herbicides- green practices in agriculture yield improvement

Water logging and salinity: causes and effects. Wastewater reuse in agriculture, management and control of agricultural waste, recycling and reuse.

Agriculture and its impacts on environment: pollution of water bodies, air environment, soil pollution, biodiversity etc. and possible remedial measures-Novel methods of pollution control: Methane production, Root zone treatment, Membrane technology.

Alternative Agricultural Practices: Agriculture in reduction of pollution - Biotechnology in reduction of CO_2 emission, Bio-scrubbers, Bio-beds, Bio-trickling filters and their applications.

Text Books

1.The Challenge of Agricultural Pollution Evidence from China, Vietnam, and the Philippines by Emilie Cassou, Steven M. Jaffee, and Jiang Ru2. Molecular Biotechnology: Gleek and Pasternack. International Bank for Reconstruction and Development / The World Bank.
2. A hidden threat to food production: Air pollution and agriculture in the developing world. by Fiona Marshall Mike Ashmore Fiona Hinchcliffe. Gatekeeper Series No. 73. International Institute for Environment and Development
3. Biotechnology: A Text Book of Industrial Microbiology, T. D. Brock

Reference Books

1 Water pollution from agriculture: a global review. Food and Agriculture Organization of the United Nations Rome, 2017
2. Soil & Ground Water Pollution from Agricultural activities, T.V.Ramachandra, TERI

9. CIRCULAR ECONOMY

Course Objectives

- Introduce the Circular Economy concepts for a paradigm change in the approach
- Cultivation of systems thinking in circular design and possible business model integration
- Basic understanding of the aspects of flows in a circular economy (Energy, Material, Waste, Wastewater)
- Expose to the methods for implementing circular systems and the best practices and experiences
- Impart knowledge on the assessment of relative uptake of circular concepts on a global basis and measuring zero waste in business operations

Course Outcome

After completion of the course, the students should be able to

- Understand the knowledge of linear and circular economy and explain the difference between them.
- Explain various trends and driving forces in the circular economy
- Identify the methods for the implementation of circular systems
- Describe the challenges that exist in the adoption of circular economy
- Describe the various measures and indices used in circular economy, and apply solutions using concepts of circular economy

SYLLABUS

Introduction to Circular Economy: Waste generation, characterization and management flows in the Linear Economy - environmental and social impacts of linear and extractive practices;
Definition of circular economy, Measures of success - GDP vs. Human prosperity - economic rationale behind a circular economy- Principles and theoretical foundations and current applications - Constraints to adopting circular practices

Systems Thinking in Circular Design and Possible Business Model: Theoretical foundations of systems thinking and its application to circular economy concept; Definition of circular design – application of systems thinking to circular design; Exploring possible business models in a circular economy - Integrating circular design and business models - Role of consumers to influence circular economy: barriers and opportunities

Flows in a circular economy (Energy, Material, Waste, Wastewater): flows in circular economy and classification of flows -measurement of flows and its management; Impacts of flows beyond raw materials such as transportation, energy etc., review the role of waste as a resource in the circular economy - circular potential of some of the common materials through case studies.

Implementation: Methods for implementing circular systems - Best practices and experiences - Introduction to the policy considerations and incentives for circular economies - Consider the role of government, regulatory authorities and other stakeholders -Materials

conducive to circularity based on physical properties, including biological materials - Proprietary versus open-source circular systems and the implications for product design and branding –Repair and reuse

Equity in the Circular Economy: Assess the relative uptake of circular concepts on a global basis - components (economic, technical, policy) required to move to a circular model- Corporate sustainability, zero waste - Measuring zero waste and circular progress in business operations -moral economy, economic inclusion and the circular economy workforce

Text Books

1. Circular Economy: A Wealth of Flows. By Webster, K.Ellen, MacArthur Foundation, 2nd Edition.
2. Seven Ways to Think Like a 21st-Century Economist. By Raworth, K. Doughnut Economics. Random House, 2017.
3.Delivering the Circular Economy: A Toolkit for Policymaker, K. Ellen, MacArthur Foundation. 2015.
4. A. Tukker, et al, "The Impacts of Household Consumption and Options for Change," Journal of Industrial Ecology, Vol. 14: 13-39, 2010. Some additional suggested readings include:
5. Tim Brown: Design & the circular economy – Circular Design Guide.
6. Ellen MacArthur Foundation, "Towards the Circular Economy Vol. 1: Economic and Business Rationale for an Accelerated Transition" Ellen MacArthur Foundation. 2013. Web: p6-62 (56 pages)

Reference Books

1. Cradle to Cradle: Remaking the Way We Make Things. By McDonough, William, and Michael Braungart, New York: North Point, 2002. Chapter 2: p45-67 (22 pages)
2. Circular Economy: A Wealth of Flows. Introduction and Chapter 3 Doughnut Economics. Chapters 2 and 6 Robin Wall Kimmerer, Serviceberry essay
3. What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050 Circularity Gap Report 2020, Excerpts to be assigned
4. Ellen MacArthur Foundation, "The New Plastics Economy: Rethinking the Future of Plastics"
5. Lovins, B, Amory, Michael Braungart et al. A New Dynamic: Effective Business in A Circular Economy. Ellen MacArthur Foundation Publishing, 2013. Print. Chapter 2, A Concise Guide to the Circular Economy, p19- 28 (9 pages)
6. DG Environment Consortium. "Scoping study to identify potential circular economy actions, priority sectors, material flows & value chains"
7. Kim, Daniel. Introduction to Systems Thinking, Pegasus Communications, 1999. Print.
8. Franconi, Ellen, Brett Bridgeland et al. A New Dynamic 2: Effective Systems in a Circular Economy
9. E. Franklin-Johnson, et al, "Resource Duration as a Managerial Indicator for Circular Economy Performance," Journal of Cleaner Production Vol 133: 589-598, 2016.

10. ENVIRONMENTAL BIOTECHNOLOGY AND BIOREMEDIATION

Course Objectives

- Familiarize the principles and concepts of biotechnology and its usefulness in environmental management
- Disseminate the knowledge on the Biofilm Kinetics as part of biotechnology
- Develop understanding of biotechnological remedies and strategies for environmental pollution management
- Provide knowledge on bioremediation and bio augmentation for bioremediation that will be useful in pollution control activities.
- Understand the role of biotechnology in detoxification and replacement of chemicals

Course Outcomes

The student will be able to
- Describe the role of microorganisms in processes such as biodegradation of wastes, biofilm formation, oxidation, biotransformation of metals etc.,
- Explain how environmental conditions can be manipulated to enhance or retard the above processes
- Describe biotechnological solutions to address environmental issues
- Understand the usefulness of any of the bioremediation processes used for the reclamation of natural resources.
- Understand the significance in environmental biotechnology

SYLLABUS

Environmental Biotechnology: Principles and concepts of biotechnology and its usefulness to the mankind. Degradation of high concentrated toxic pollutants- halogenated, non-halogenated, petroleum hydrocarbons, metals - Mechanisms of detoxification – oxidation - dehalogenation - biotransformation of metals - biodegradation of solid wastes.

Biofilm Kinetics: Microbial aggregation-idealized biofilm-Steady state biofilm – soluble microbial products and inert biomass- non steady state biofilms.

Microbial cell/enzyme technology: – adapted microorganisms – biological removal of nutrients – algal biotechnology– extra cellular polymers - Biofuels and Biogas technology. Concept of rDNA technology – expression vectors – mutation – construction of microbial strains - radioactive probes - protoplast fusion technology – applications.

Biotechnological remedies for environmental pollution - Biotechnological methods for pollution detection, Biosensors. Decontamination of groundwater –Bioremediation: Scope and characteristics of contaminants- contaminant availability for biodegradation- Engineering strategies for bioremediation – evaluation of bioremediation.

Detoxification of hazardous chemicals: Metal biotechnology: Microbial leaching, chemistry of microbial leaching, leaching process. Leaching Environmental effects and ethics of microbial technology – genetically engineered organisms-Microbial containment -Risk assessment.

Bioremediation: Types of bioremediations, Bio augmentation for bioremediation, Bioreactors, Bioremediation of herbicides, pesticides, hydrocarbons, oil spills, Novel methods of pollution control – Vermi-technology, Methane production, Root zone treatment, Membrane technology, Biodegradable plastics. Contaminated sites – Site Assessment – Remediation Technologies – Onsite and offsite remediation techniques - Bioremediation-

Phytoremediation- Physico chemical techniques, Soil flushing - Pump and treat systems – restoration of remediated sites

Text Books

1. Environmental Biotechnology: Principles and Applications by Rittmann., B.E. and McCarty, P.L,Tata McGraw-Hill,
2. Environmental Biotechnology by Bhattacharya and Banerjee, Oxford Publications

Reference Books

1. Biological degradation of wastes by Martin.A.M, Elsevier Applied Science.
2. Environmental Biotechnology by Scraqq, Oxford Publications

11. CLIMATE CHANGE IMPACT MITIGATION AND ADAPTATION

Course Objectives

- To familiarize the climate parameters, climate change and the causes of the phenomenon
- To create better understanding on the global warming, potential, past present and future scenario of global warming
- To realize the impacts of climate change on various attributes of environment and the activities of the people
- To educate the students on the mitigation of climate change impacts and importance of adaptation to combat the climate change impact
- To introduce the alternative energy sources, CDM to reduce the impact on the environment

Course Outcomes

The student should be able to

- categorize the factors influencing climate change at local and global level
- understanding the global warming and the future scenario of global warming
- identify the sectors that will be getting affected due to the climate change
- Plan for the adaptation to combat the climate change impact
- know the alternative energy sources, CDM to reduce the impact on the environment

SYLLABUS

Introduction: Atmosphere – weather and Climate - Causes of global and regional climate change- climate parameters – Temperature, Rainfall, Humidity, Wind – Global Ocean circulation – El Nino and its effect - Carbon cycle.

Global Warming: Emission sources of greenhouse gases, Green House effect as a natural phenomenon, and due to anthropogenic activities, recent role of greenhouse effect. Global warming potential, past present and future scenario of global warming.

Impacts of Climate Change: Effects of Climate Changes on living systems – health effects, agriculture and food security, forestry, human migration, socioeconomic impacts- coastal areas, tourism, industry and business, vulnerability assessment- infrastructure. Sea level rise, Coastal erosion and landslides, strategies to combat global warming.

Mitigating Climate Change: IPCC Technical Guidelines for Assessing Climate Change Impact and Adaptation -Identifying adaption options – designing and implementing adaption measures – surface albedo environment- reflective roofing and reflective paving – enhancement of evapotranspiration - tree planting programmes – green roofing strategies – energy conservation in buildings – energy efficiencies –Concept of carbon sequestration, Carbon sequestration modalities and procedures, Carbon capture and storage, Carbon trading, Montreal protocol, Kyoto protocol, Role and functions of IPCC, National and International action plan on climate change.

Alternate Fuels and Renewable Energy: Energy source – coal, natural gas – wind energy, hydropower, solar energy, nuclear energy, geothermal energy – biofuels – Energy policies for a cool future - Clean Development Mechanism - Energy Audit.

Text Books

1. Climate Change: causes, Effects and Solutions, John T. Hardy. Willy Publication, USA.

2. Principles and Practices of Air Pollution Control and Analysis, J.R. Mudakavi, I.K.international Publishing House Pvt. Ltd., New Delhi.

3. Carbon Capture: Sequestration and Storage (Issues in Environmental Science and Technology), RE Hester and RM Harrison.

Reference Books

1. Global Warming and Climate Change. Vol I and II. By Velma. I. Grover,Science Publishers, 2005.

2. Climate Change – An Indian Perspective, by Dash Sushil Kumar, Cambridge University Press India Pvt. Ltd, 2007

3. IPCC Fifth Assessment Report, Cambridge University Press, Cambridge, UK,

4. Impacts of Climate Change and Climate Variability on Hydrological Regimes, by Jan C. van Dam, Cambridge University Press, 2003.

12. URBAN STORM WATER MANAGEMENT

Course Objectives

- Understand the urbanization effects on the storm water and its quality
- Emphasize the difference between the conventional urban storm water management and the present low impact development philosophy
- Realize the impacts of climate change on various attributes of environment and the activities of the people
- Introduce the integration of water resources investigation and urban planning processes
- Impart knowledge on the basic approaches to urban drainage

Course Outcomes

The student should be able to

- Select the method of estimation for design of urban drainage system
- Identify the differences between the conventional and LID models of urban drainage
- Plan the drainage systems and its designs

- Recognize the best management practices in the urban areas
- Evaluation of BMPs in the storm water management

Introduction: Urbanization and its effect on hydrological cycle and hydrology. Urban Hydrological cycle –rainfall and runoff estimations– time of concentration and methods of its estimation for design of urban drainage systems - urban runoff quality.

History and paradigm shifts of urban water management- Conventional storm water management- Urban drainage master plans – integration of water resources investigation and urban planning processes – planning objectives – use of models in planning.

Basic approaches to urban drainage –wastewater and storm water reuse – major and minor systems. Elements of drainage systems – open channel – underground drains – appurtenances – pumping – source control. Stormwater Analysis Calculation of runoff and peak – Design of storm water network systems.

Best Management Practices –low impact development philosophy-Detention and retention facilities – Swales-constructed wetlands. Operation and maintenance of urban drainage system – interaction between stormwater management and solid waste management, Various model available for stormwater management.

BMP performance metrics and technical uncertainty - Integration of the conventional stormwater management and infrastructures to low impact development (LID). Legal aspects of urban storm water management.

Text Books

1. Geiger W. F., J Marsalek, W. J. Rawls and F. C. Zuidema, Manual on Drainage in Urbanised area–2 volumes, UNESCO, 1987

2. Hall M J, Urban Hydrology, Elsevier Applied Science Publisher, 1984

Reference Books

1. Stahre P and UrbonasB, Stormwater Detention for Drainage, Water Quality and CSO Management, Prentice Hall, 1990

2. Wanielista M P and Eaglin, Hydrology – Quantity and Quality Analysis, Wiley and Sons, 1997

13. FUNDAMENTALS OF MASS TRANSFER

Course Objectives

- To explain the students with the basic principles of mass transfer operations and other separation processes with examples.
- To impart knowledge on how certain substances, undergo the physical change with diffusion/mass transfer of components from one phase to other phases.
- To describe the students with equipment used in operations involving mass transfer and other separation processes and their advantages and disadvantages.
- To focus on absorption and distillation operations and the process design aspects of the same operations.
- To provide the knowledge on humidification and dehumidification operations and their applications in real situations

Course Outcomes

At the end of the course, the student will be able to

- Identify diffusion phenomena in various chemical processes
- Determine diffusivity coefficient in gases and liquids
- Calculate mass transfer coefficients at interfaces of multiphase mass transfer systems
- Understand the VLE concepts and application to different distillations
- Understand the importance of humidification and dehumidification processes and their industrial applications
- Design equipment for gas-liquid mass transfer operations

SYLLABUS

Introduction: Mass transfer Operations

Molecular diffusion in fluids: Binary solutions, Fick's law, equation of continuity, Steady state equimolar counter current diffusion, Stefan's diffusion, estimation of diffusivity of gases and liquids, application of molecular diffusion.

Mass transfer coefficients: Mass transfer coefficients in turbulent flow, theories of mass transfer, analogy between momentum, heat and mass transfer in laminar and turbulent flow, correlations for mass transfer coefficients in simple situations, diffusion in solids.

Inter-phase mass transfer: Concept of equilibrium, diffusion between phases, two resistance theory, material balances in steady state co-current and counter-current stage processes, Murphy stage efficiency.

Equipment for gas-liquid operations: Sparged vessels, mechanically agitated vessels for single phase liquids and gas-liquid mixtures, tray towers, sieve tray for absorption and distillation, venturi scrubbers, spray towers and spray chambers, packed towers for absorption and distillation, tray towers versus packed towers.

Humidification operations: Definition of fundamental terms, Psychrometric charts, theory of adiabatic saturation and wet bulb temperature, Lewis relation, gas-liquid contact operations, water cooling with air, dehumidification of air-water-vapor mixture, cooling towers, evaporative cooling.

Absorption: Solubility's of gases in liquids, two component systems, multi-component systems, ideal and non-ideal solutions, choice of solvent for absorption, single component absorption material balances, counter current multistage operations, dilute gas mixtures, on isothermal operation, tray efficiency, continuous contact equipment, HETP, HTU, NTU concepts for single operation absorption with chemical reaction.

Distillation: Principles of VLE for binary systems, phase diagrams, relative volatility, ideal solutions, azeotropes, enthalpy concentration diagrams, flash vaporization, partial condensation, differential distillation, steam distillation, continuous distillation, McCabeThiele method, Ponchon-Savarit method, tray efficiencies, introduction to multi-component distillation, azeotropic and extractive distillations

Text Books

1. Mass transfer Operations, Robert E. Treybal, 3rd edition, McGraw-Hill Book Co

Reference Books

1." Unit Operations in Chemical Engineering" by McCabe,W.L.,Smith,J.C.andHarriot,P., 5th Edition, McGraw-Hill Book Co.,

2. "Chemical Engineering Hand Book" by J.H. Perry

14. AIR AND WATER QUALITY MODELLING

Course Objectives

- Provide fundamentals of modeling concepts
- Explain the modeling principles of air quality and the theory of air quality modeling
- Enlighten on water quality modeling principles and transport phenomenon in water bodies.
- Impart knowledge on the numerical solution techniques to the air and water quality models
- Introduce various air and water quality models

Course Outcomes

The students should be able to

- Describe the modeling concepts and the process of calibration and verification of a model
- Understand the importance of various air quality models.
- Select a water quality models to study the transport of pollutant
- Apply the finite difference techniques to the water and air quality models
- Get an insight on air and water quality model software

SYLLABUS

MODELING CONCEPTS: Casual and statistical models-Characteristics- Steps in model development - Importance of model building- conservation of mass and mass balance – calibration and verification of models

AIR QUALITY MODELLING: Modelling for nonreactive pollutants, single source, short term impact, multiple sources and area sources, Metrological Modelling – Diagnostic Models –Prognostic Models - diffusion models, modifications of Gaussian plume equation -long term average- receptor oriented and source-oriented air pollution models, Numerical Models, model performance, accuracy and utilization

WATER QUALITY MODELS: Mass balance equation –Mathematics of Pollutant Transport – Advection- dispersion-In-Water Transformation- Waste load allocations – Basic mechanisms of river self-purification, Dissolved Oxygen dynamics Streeter-Phelps and Dobbins models, Pollutant and nutrient dynamics, Temperature dependence and transport, Dissolved oxygen in Rivers and estuaries; Lake Water Quality Models; Models for Nitrogen, Bacteria, Phosphate and toxicants - Ground Water Quality Modelling - Contaminant solute transport equation, Numerical methods.

COMPUTER BASED SIMULATION

Solution techniques and computer programming; Fundamentals of linear optimization models. Finite difference and finite element method of pollutant dispersion – Optimization

river pollutant and management models -Application of models- simulation, parameter estimation and experimental design. Model Uncertainty and reliability.

SOFTWARES

Air quality Model -ARMOD, CALPUFF –ALOHA, UNAMAP– BLP-RAM – ISCMPTER-Surface water quality models -HSPF, QUAL2K,

Text Books

1. Deaton, M.L and Winebrake, J.J., Dynamic Modelling of Environmental Systems, Verlag, 2000.
2.Chapra, S.C. Surface Water-Quality Modelling, McGraw-Hill, 2008.
3. Arthur C.Stern., Air Pollution (Third Ed.) Volume I – Air Pollutants, their transformation and Transport, (Ed.), Academic Press, 2006.

Reference Books

1. Wainwright, J and Mulligan, M., Environmental Modelling Finding simplicity in complexity, John Wiley & Sons Inc., New York, 2013
2. Dykes, A.P., Mulligan, M., and Wainwright, J, Monitoring and Modelling dynamic environment, Wiley – Blackwell 2015.
3. PaoloZannetti ., "Air Pollution Modelling – Theories, computation Methods and available Software " Springer. Newyork , 1990
4.M.Benedini .,G.Tsakiris "Water Quality Modelling for Rivers and streams " Springer , New York , 2013

15. INTEGRATED WATER RESOURCES MANAGEMENT

Course Objectives

- Introduce the basic principles and complexities involved in the integrated water resources management
- Expose to the interdisciplinary analysis of water and conceptual design of intervention strategies.
- Learn the water resource planning and the data required for the planning and management of water resources
- Impart knowledge on the evaluation of Water Resources Management Options
- educate on the environmental, social, and political issues in Water Resources Management

Course Outcomes

After completion of the course, the student will be able to

- Identify the paradigm shift in the integrated water resources management and interdisciplinary approaches.
- Understand the complexities of dealing with water resources issues and challenges including risk and uncertainties
- Understand objectives, principles and evolution of integrated water resources management.
- Develop the water resource plans and identify the data required for the planning and management of water resources
- Recognize the legal settings and the importance of environmental, social, and political Issues in Water Resources Management

SYLLABUS

Integrated Water Resources Management - Definition of IWRM - Principles of IWRM- Water as a global issue: key challenges and needs –Basic - Complexity of the IWRM process – Examining the key elements of IWRM process- Implement IWRM.

Water Resources Planning - Planning Concepts and Definitions - Aim of Water Resources Planning - Levels of Water Resources Planning - Measurement of Objectives (Utility Trade-off Analysis) - Function and Role of Water Resources - Risk and Uncertainty - Phases of Water Resources Planning - Water Master Planning - Data Requirements for Water Resources Planning

Water Resources Management - Functions of Water Resources Management - Water Scarcity and its impacts -Water Shortages vs. WRM - Evaluation of Water Resources Management Options. Water Demand Management- Concept - Potential Stresses on Water Demand - The Demand Management Approach - Water Demand and Water Quality Management

Environmental, Social, and Political Issues in Water Resources Management: Environmental Issues & Challenges, Key Social Issues & Challenges, Water governance, Political Issues & Challenges Integration of Challenges and Opportunities

Water Legal and Regulatory Settings: Basic notion of law and governance: principles of international and national law in the area of water management – Development of IWRM in line with legal and regulatory framework. Economic view of water issues- policy options for water conservation and sustainable use –Links between PPP and IWRM.

Text Books

1. Technical Advisory Committee, Integrated Water Resources management, Technical Advisory Committee Background Paper No: 4. Global water partnership, Stockholm, Sweden. 2002.

2. Technical Advisory Committee, Poverty Reduction and IWRM, Technical Advisory Committee Background paper no: 8. Global water partnership, Stockholm, Sweden, 2003.

3. Technical Advisory Committee, Regulation and Private Participation in Water and Sanitation section, Technical Advisory Committee Background Paper No:1. Global water partnership, Stockholm, Sweden, 1998.

Reference Books

1. Technical Advisory Committee, Dublin principles for water as reflected in comparative assessment of institutional and legal arrangements for Integrated Water Resources Management, Technical Advisory Committee Background Paper No: 3. Global water partnership, Stockholm, Sweden. 1999.

2. Technical Advisory Committee, Water as social and economic good: How to put the principles to practice". Technical Advisory Committee Background Paper No: 2. Global water partnership, Stockholm, Sweden, 1998.

3. Technical Advisory Committee, Effective Water Governance". Technical Advisory Committee Background paper No: 7. Global water partnership, Stockholm, Sweden, 2003.

4. Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003.

4 Mollinga.P. etal "Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006

OPEN ELECTIVES

1. PLUMBING SERVICES AND MAINTENANCE

Course Objectives

- To present basic knowledge on the plumbing systems and various elements of plumbing system
- To provide the details of various appurtenances used in water supply and distribution systems for its effective operation and maintenance
- To get well acquitted with the details of sanitary drainage systems that include building drains, house sewers, stack sizing, pipe joints, fittings etc.
- To give a basic understanding of various plumbing components such as vents, traps, clean-outs and interceptors
- To familiarize storm drainage and special piping and storage systems

Course Outcomes

On completion of the course, the student is expected to be able to

- Learn various plumbing systems and its elements along with their functions
- Design the water supply and distribution's plumbing along with the presentation of details
- Provide inputs for the selection of the appropriate vents, traps, clean-outs and interceptors as part of plumbing systems
- Understand the necessary details of sanitary drainage systems
- Plan the storm drainage and special piping and storage systems

SYLLABUS

Introduction to Plumbing systems: Definition-classification of plumbing systems- plumbing appliance- plumbing appurtenance- plumbing fixture- Single-Multi Family buildings, Restaurants, Handicap Fixtures: Toilets, Sinks and Lavatories, Sink and Lavatory Faucets, Bathing Units, Drinking Units. Standard Fixture Installation Regulations; Sewers- building sewers-faucet- self-closing faucet- Interceptor; Water safety plans in operation and managements of water systems- The role of plumber in risk assessment and risk management-codes of practice for plumbing.

Water Supply and Distribution: The Main Water Pipe: Supplies, Pressure-Reducing Valves, Water Hammer, Tanks, Pressurized Water Tanks. Pipe Support: Water Conservation, Anti-

scale Precautions, Valve Regulations, Cutoffs. Backflow Prevention. Hot-Water Installations-Water Heaters. Water Supplies –Fixture. Minimum Pipe Size.

Sanitary Drainage Systems: Sizing Building Drains and Sewers -Horizontal Branches -Stack Sizing –Installation: Pipe Joints, Fittings -Offsets in Horizontal Piping- Horizontal to Vertical Changes in Direction -Vertical to Horizontal Changes in Direction

Vents, Traps, clean-outs and Interceptors: Sewer Gas -Trap Seals, Plumbing Vents -Individual Vents -Relief Vents -Circuit Vents -Developed Length -Branch Vents -Vent Stacks -Stack Vents -Common Vents -Island Vents -Wet Vents -Crown Vents -Vent-Installation Requirements. Clean-outs --Types of Clean-outs –Traps: P-Traps -S-Traps -House Traps -Crown-Vented Traps -Other Traps -Trap Sizes -Tailpiece Length -Standpipe Height -Proper Trap Installation -Grease Traps -Backwater Valves.

Storm Drainage and Special Piping and Storage Systems: Sizing -Sizing Rain Leaders and Gutters -Roof Drains -More Sizing Information, Sump Pumps -Variations. Special Piping and Storage Systems: General Requirements -Sterilizers -Aspirators -Medical Gases -Oxygen Systems.

Text Books

1. Plumbing Systems: Analysis, Design and Construction 1st Edition by Tim Wentz. ISBN-13: 978-0132352840.
2. Handbook on Plumbing Installation for Buildings. Water Supplies Department, HKSARG.

Reference Books

1. Understanding Boat Plumbing and Water Systems: John C. Payne: 9781574092639

2. Design of Potable Water Plumbing Systems: Quick Book (Quick Books): Anuj Bhatia: 9781508662853

2. OCCUPATIONAL HEALTH AND INDUSTRIAL HYGIENE

Course Objectives

- To realize and became aware of the OHSH codes of practice and the need for the EHS at work places
- To understand the categories of occupational health hazards and the risks involved
- To get enlightened with the hierarchy of control measures for occupational health vulnerabilities
- To impart knowledge on the industrial and workplace safety and safety systems
- To update the factors to be considered in the development of effective training programs and principles of effective training programs

Course Outcomes

The student will be

- Equipped with the knowledge on various organizational behaviors
- Able to classify the hierarchy of control methods for occupational health issues and challenges or risks
- Capable of selecting and implement industrial safety provisions and safety systems
- Able to develop effective training programs for the people of the industry

Introduction: Need for developing Environment, Health and Safety systems in work places. Regulations and Codes of Practice. Role of trade union safety representatives. International initiatives. Ergonomics and work place.

Occupational Health and Hygiene: Definitions. Categories of health hazards. Exposure pathways and human responses to hazardous and toxic substances. Advantages and limitations of environmental monitoring and occupational exposure limits. Hierarchy of control measures for occupational health risks. Role of personal protective equipment and the selection criteria. Effects on humans, control methods and reduction strategies for noise, radiation and excessive stress.

Workplace Safety and Safety Systems: Features of the satisfactory design of work premises HVAC, ventilation. Safe installation and use of electrical supplies. Fire safety and first aid provision. Significance of human factors in the establishment and effectiveness of safe systems. Safe systems of work for manual handling operations. Control methods to eliminate or reduce the risks arising from the use of work equipment. Requirements for the safe use of display screen equipment. Procedures and precautionary measures necessary when handling hazardous substances. Contingency arrangements for events of serious and imminent danger.

Techniques of Environmental Safety: Methods of effective implementation and review of health & safety policies. Functions and techniques of risk assessment, inspections and audits. Investigation of accidents- Principles of quality management systems in health and safety management. Industry specific EHS issues

Education and Training: Quality manuals, safety policies and risk assessments - Records and other documentation required by an organization for health and safety - Requirements for and benefits of the provision of information, instruction, training and supervision. Factors to be considered in the development of effective training programmes. Principles and methods of effective training. Feedback and evaluation mechanism.

Text Books

1. Environmental and Health and Safety Management by Nicholas P. Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995
2. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007.

Reference Books

1. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services 2005

3. SUSTAINABLE ENGINEERING

Course Objectives

- To inculcate an awareness of environmental issues and the global initiatives towards attaining sustainability
- To realize the potential of technology in bringing in sustainable practices
- To know the complex environmental, economic, and social issues related to sustainable engineering

- To become aware of clean resources and its utilization that helps in environmental protection
- To familiarize the green engineering and green building concepts and rating systems

Course Outcomes

After successful completion of this course, students will be able to

- Understand the relevance of the concept of sustainability in engineering designs
- Summarize the concepts related to conventional and non-conventional energy
- Describe the global environmental challenges and may adapt the necessary systems in the engineering practices
- Learn about the natural resources, its exploitation, related pollution, Carbon credit and mitigation measures
- Use the concepts of the green building for efficient resources utilization

SYLLABUS

Sustainability: Introduction, concept, evolution of the concept; Principles of sustainable engineering - Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM).

Global Environmental Issue: Resource degradation, Climate change, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon foot print Carbon sequestration – Carbon capture and storage (CCS). Environmental management standards, ISO 14000 series frame work and benefits, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking.

Clean Resources and its utilization: Rainwater harvesting – Energy from waste - Basic concepts of Conventional and non-conventional energy, General idea about solar energy, microbial Fuel cells, Wind energy, Small hydro plants, bio-fuels,

Urban Sustainability: Green Engineering, Sustainable Urbanization, Sustainable cities, Sustainable transport Water resources, demands, distribution and use, Water quality & wastewater treatment - Water-Energy-Food Nexus; solid waste and design a future without waste

Green Buildings: Basic concept of sustainable habitat -Green buildings, green materials for building construction, material selection for sustainable design, green building certification-GRIHA & IGBC Certification for buildings, Methods for increasing energy efficiency in buildings, - Passive solar design technique, Thermal storage, Cooling strategies, high performance insulation.

Text Books

1. Sustainable Engineering: Concepts, Design and Case Studies, D.T. Allen, and D.R. Shonnard, Prentice Hall, (2011).
2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning

Reference Books

1.Environment Impact Assessment Guidelines, Notification of Government of India, 2006
2.Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
3.ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
4.Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
5. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS). 8.Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios Publication

4. ENVIRONMENTAL LAW AND POLICY

Course Objectives

- To be aware of national and international policies and protocols related to environmental issues and challenges
- To educate on the salient features of Water (O & CP) Act
- To educate on the salient features of Air (P & CP) Act,
- To educate on the salient features of EP act, 1986
- To get acquainted with the Indian Forest Act, other Environmental Management systems and ISO 14000

Course Outcomes

The student will be able to

- Recognize the importance of the international agreements and protocols
- Understand the environmental legal framework in India
- Formulate the necessary environmental compliance details in accordance with the law
- Understand the principles and elements of ISO14000 series and various environmental management systems
- Comprehend the provisions of EP Act, 1986

SYLLABUS

Introduction: Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – National and International multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration etc – Institutional framework (SPCB/CPCB/MOEF) - Supreme Court Judgments in Landmark cases

Water (P & CP) Act, 1974: Power & functions of regulatory agencies - responsibilities of Occupier, Provision relating to prevention and control, Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

Air (P & CP) Act, 1981: Power& functions of regulatory agencies - responsibilities of Occupier, Provision relating to prevention and control, Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State

Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

Environment (Protection) Act 1986: Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting guidelines of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorization – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

Other Acts & Management Systems: Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC - Public Interest Litigation - Fundamentals of Environmental Management and ISO 14000 series - principles and elements. The ISO 14001-Environmental management systems standards.

Text Books

1. CPCB, "Pollution Control acts, Rules and Notifications issued there under "Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997.
2. "Environmental law and policy in India "by Shyam Divan and Armin Roseneranz, Oxford University Press, New Delhi, 2001.
3. "Environmental law and enforcement", by Greger I. Megregor, Lewis Publishers, London1994.
4. Constitution of India [Referred articles from part-III, part-IV and part-IV A]

Reference Books

1. Handbook of environmental management and technology: Gwendolyn Holmes, Ben Ramnarine Singh, Louis Theodore.
2. The ISO 14000 Handbook: Joseph Cascio.
3. ISO 14004: Environmental management systems: General guidelines on principles, systems and supporting techniques (ISO 14004:1996 (E)).
4. ISO 14001: Environmental management systems.

5. ENVIRONMENTAL MANAGEMENT SYSTEM ANDAUDIT

Course Objectives

- To get acquaintance with the methodologies of Environmental Management System through ISO Guidelines
- To know the concepts of preventive environmental management
- To provide elements of social management system and social accountability
- To study the environmental performance evaluation
- To learn the implementation of Environmental Management System through Environmental Audits

Course Outcomes

The students will be able to

- understand the elements of Corporate Environmental Management system complying to international environmental management system standards
- serve and guide the industrial sector as good corporate citizens.
- evaluate strategies within Environmental Management from a systems perspective.
- lead pollution prevention assessment team and implement waste minimization options

- develop, Implement, maintain and audit Environmental Management systems for Organizations

SYLLABUS

ENVIRONMENTAL MANAGEMENT PRINCIPLES: Systems approach to Corporate environmental management –Business Charter for Sustainable Production and Consumption –Environmental Stewardship –National policies on environment, abatement of pollution and conservation of resources – Charter on Corporate responsibility for Environmental protection; Social Accountability: Requirements, Social Accountability (SA) 8000, Certification, Elements of Social Management System, Social policy, Planning, Implementation, Business Benefits, Corporate Social Responsibility (CSR), different Models.

ISO Guidelines in Environmental Management Systems: ISO 14000 Series, Principles; Accreditation Process, Environmental Auditor Criteria, Benefits of EMS; Aspect-Impact Analysis, Continual Improvement, Environmental Policy, Vision and Mission, Objective and Target, Environmental Management Planning, Implementing EMS, Plan-Do-Check-Act (PDCA), Preventive and Corrective Action, Internal and External Audits, Documentation, Roles and Responsibilities, Management Reviews & Improvements; Legal and Regulatory Concerns; Preparation of ISO Manuals.

Environmental Performance Evaluation: Environmental quality objectives – Environmental performance evaluation: Operational Performance Indicators, Management Performance Indicators – Environmental condition Indicators- benchmarking Concentration and Mass standards, Effluent and stream standards, Emission and ambient standards, Minimum national standards.

Preventive Environmental Management: Pollution control Vs Pollution Prevention - Four Stages and nine approaches of Pollution Prevention - source reduction, raw material substitution, toxic use reduction and elimination, process modification –Material balance – Technical, economic and environmental feasibility evaluation of Pollution Prevention options in selected industries – Design for the Environment over Product cycle.

Environmental Audit: Objectives, Types of Audits, Features, Audit Criteria, Planning and Organizing Audits; Pre-visit data collection, Audit Protocol; Onsite Audit; Data Sampling - Inspections - Evaluation and Presentation; Exit Interview; Audit Report - Action Plan - Management of Audits; Waste Management Contractor Audits; Environmental Statement Environmental management system audit as per ISO 19011 – Roles and qualifications of auditors - Environmental performance indicators and their evaluation – Non-conformance – Corrective and preventive actions -compliance audits – waste audits and waste minimization planning – Environmental statement (form V) - Due diligence audit

Text Books

1. Marek Bugdol and Piotr Jedynak, Integrated Management Systems, Springer International, 2015.
2. Ken Whitelaw, ISO 14001 Environmental Systems Handbook, Elsevier Butterworth-Heinemann, 2004

Reference Books

1. ISO 14001/14004/: Environmental management systems – Requirements and Guidelines – International Organization for Standardization, 2015

2. ISO 19011: “Guidelines for quality and/or Environmental Management System
3. Auditing, Bureau of Indian Standards, New Delhi, 2015
4. Barrow, C. J.. Environmental Management for Sustainable Development. Taylor & Francis, Oxon, UK, 2006
5. Paul L Bishop ‘Pollution Prevention: Fundamentals and Practice’, McGraw- Hill
6. International, Boston, 2004.
7. Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations, Second Edition, NSF International, Ann Arbor, Michigan, January 2001
8. dol and Piotr Jedynak, Integrated Management Systems, Springer International Publishing.

6. ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

Course Objectives

- To introduce sustainable development concepts, challenges of sustainable development and boundaries of sustainable development.
- To give a basic understanding of sustainable development framework, its pillars and application.
- To aware, the students about various issues related to environmentally sustainable urban environment and different engineering tools assess and design them.
- To aware them about the role of technology towards environmental sustainability.
- To update students about the individual and social responsibilities and role of government towards sustainable development

Course Outcomes

The student will be able to
- Understand the basics about sustainable development & its concepts.
- Understanding different dimensions of sustainability as well as its possible applications
- Identify the environmental sustainability of transport system and capable to suggest required steps for further enhancement.
- Describe the national and global environmental, economic and social issues and the principles of different sustainable development frameworks
- Development of responsibilities towards the protection of environment and society

SYLLABUS

Evolution of sustainability: History of sustainability, Definitions of sustainability, Brundtland commission report, Principles of sustainable development, Objectives of sustainable development, Conceptualization of sustainability, Barriers of sustainable development.

Sustainable development framework: Pillars of sustainable development, Impediments to achieving sustainability, Concept of environmentally sustainable development, Environmental dimensions of sustainability, Frameworks to measure sustainable development, Indicators of Sustainability, Sustainability Strategies-Barriers to Sustainability – Industrial activity and Environment – Industrialization and sustainable development

Challenges of Sustainable Development and Global Environmental Issues: Concept of sustainability – Factors governing sustainable development – Linkages among

sustainable development- Environment and poverty – Determinants of sustainable development – Case studies on sustainable development - Population, income and urbanization – Health care – Food, fisheries and agriculture – Materials and energy flows

Strategies for promoting environmentally sustainable development: technology role towards environmentally sustainable, Importance of incorporating sustainability in design, Case studies of Sustainable design. Issues of environmentally sustainable urban environment, Sustainable urban transport, Sustainable transport indicators, engineering tools for assessment and design for environment and sustainability

Sustainable Development Indicators: Need for indicators – Statistical procedures – Aggregating indicators – Use of principal component analysis – Three environmental quality indices; Social and environmental, responsibilities towards environmentally sustainable development, Role of local Government, Sustainability in the Third World, Steps for adopting a sustainability approach.

Text Books

1. Abdul Malik, Elisabeth Grohmann. Environment protection strategies for sustainabledevelopment by. ISBN 978-94-007-1591-2.

2. Sylvie Faucheux, Martin O' Corner Jan van der strateen. Sustainable development: concepts, rationalities, and strategies, ISBN 978-94-017-3188-1.

3. Jennifer A. Elliott. An introduction to sustainable development. ISBN-13: 978-0415590730.

Reference Books

1. LEAD India (Editor) Rio to Johannesburg: India's Experience in Sustainable Development, Orient Longman, Hyderabad, 2002.

2. Chopra, K., and Kadekodi, G.K. (1999), Operationalizing Sustainable Development, Sage Publication, New Delhi.

7. WASTEWATER TREATMENT PLANT OPERATION AND MAINTENANCE

Course Objectives

- To educate on the various processes and related equipment in the wastewater Treatment Plants
- To familiarize the treatment flows and various units in the treatment flow of a typical plant
- To provide the fundamentals of sampling and analysis of the effluents or wastewater
- To impart knowledge on operation and maintenance of collection and conveyance systems
- To get acquaint with the operation and maintenance of mechanical and electrical equipment in treatment plants

Course Outcomes

After completion of the course the students will be able to

- get basic concepts and insight on operation and maintenance of waste water treatment plants.
- gain the knowledge on effluent analysis and sampling techniques.
- understand the concepts and knowledge on the operation of treatment plants.
- know the wastewater collection system and its management so that those can be implemented in the field.
- get an insight of maintenance of treatment plants and various electrical and mechanical equipment generally used in the wastewater treatment facilities

SYLLABUS

Elements of Operation and Maintenance of Treatment Plants: Introduction - Plant operation roles - Plant Maintenance program- Knowledge of process and equipment - Proper and adequate tools - Spare units and parts - Laboratory control- Records and Reports- Housekeeping - Safety measures - Corrosion prevention and control

Sampling and Analysis of Effluents: Introduction - Sampling procedures - Analysis of samples- Determination of pH using pH meter – Color – Conductivity – Solids - Estimation of dissolved oxygen (D.O) – Winkler's method - Estimation of biochemical oxygen demand (BOD) - Estimation of biochemical oxygen demand (COD) - Estimation of chloride (Mohr's method) - Estimation of Sulphate (turbidimetric method) -Code of practice for analytical laboratories - Work tables – Glassware – Safety - Handling in laboratory - Pipetting and others - Laboratory equipment and glassware's – Equipment's - Glassware's – Case Studies.

Operation and Maintenance of Treatment Units: Screening - Bar screens - Equalization - Equalization basins - Strategy for operation – Physico-chemical treatment- processes- - Flash mixer – Clarifiers - Operation guidelines for clarifier - Operation and maintenance - Chemical feed systems - Rapid mix and flocculators – Clarifiers - Normal operation - Chemical feed system - Flash mixer - Flocculation tanks – Clarifiers - Abnormal operation - Safe working habits - Jar test for selection of coagulant and their dosages- Sludge management – Case Studies.

Operation and Maintenance of Collection and Conveyance Systems: Operation and Maintenance of water/wastewater collection and conveyance systems - Functions of collection system – Components of collection system – Conduits or pipes – Manholes – Ventilating shaft – Maintenance of collection system – Problems generally faced – Clogging of pipes – Hazards – Precautions – Precautions against gas hazards – Precautions against infections – Devices for cleaning the conduits – Preventive maintenance – Corrective maintenance – Case Studies

Operation and Maintenance of Mechanical and Electrical Equipment in Treatment Plants: Operation of General Mechanical and electrical equipment in treatment plants- metering-online line monitoring systems of units, pumps- Motors and Divers-paddles, skimmer

Text Books

1. Ghose D.N. (1991) "Operation and Maintenance of Sewage treatment plants CBS publishers and distributors, Delhi.
2. Kenneth D. Kerri, Bill B. Dendy, John Brady and Willam Crooks (1996) "Industrial Waste Treatment – A field study training program" Third edition, prepared by California State

University in Cooperation with the California water pollution on control association for the USEPA.

References Books

1. Metcalf and Eddy (1996) "Wastewater Engineering – Treatment – Disposal – Reuse" Tata McGraw Hill. 3rd Edition.
2. Sawyer C.N. Mccarty P.L. and Parkin G.F. (1994) "Chemistry for Environmental Engineering" McGraw Hill publishers.
3. UNIDO (1999) "Manual on Design, Operation and Maintenance of Tannery Effluent Treatment Plant"UNIDO, regional workshop, 13 – 14 October

8. WATER SHED AND RIVER BASIN MANAGEMENT

Course Objectives:

- To give an overview of watershed management and principles of WSM.
- To impart knowledge on water resources and conjunction use of ground water and surface water to meet water demand.
- To impart knowledge on river basin watershed management and ground water management.
- To expose students about social aspects of WSM such as public aspects participation and integrated development.
- To emphasis on conservation of water through recycle and reuse of waste water, water harvesting.
- To explain the interference of integrated watershed management for sustainable development.
- To expose students to applications of RS and GIS for watershed management.

Course Outcomes:

At the end of the course the student will be able to:

- Plan for sustainable development by proper use of all available water resources of a watershed for optimum production with minimum hazards to natural resources.
- Determine the various solutions to meet the water demand.
- Implement damage mitigation measures to control soil erosion.
- Adopt appropriate techniques or methods for water harvesting.
- Knowledge on determining effective watershed modeling.

Principles of Watershed Management: Basics concepts, Hydrology and water availability, Surface water, Groundwater, Conjunctive use, Human influences in the water resources system, Water demand, Integrated water resources system

River basins Watershed Management Practices in Arid and Semi-arid Regions, Watershed management through wells, Management of water supply - Case studies, short term and long-term strategic planning

Conservation of Water: Perspective on recycle and reuse, Wastewater reclamation. Social Aspects of Watershed Management: Community participation, Private sector participation, Institutional issues, Socio-economy, Integrated development, Water legislation and implementations, Case studies

Sustainable Watershed Approach: Sustainable integrated watershed management, natural resources management, agricultural practices, integrated farming, Soil erosion and conservation

Water Harvesting: Rainwater management - conservation, storage and effective utilization of rainwater, Structures for rainwater harvesting, roof catchment system, check dams, aquifer storage

Applications of Geographical Information System and Remote Sensing in Watershed Management, Role of Decision Support System in Watershed Management

Text Book

1. Murthy, J.V.S."Watershed Management in India" Wiley Eastern, New Delhi, 1994.

2. Murty, J.V.S., Watershed Management, New Age Intl., New Delhi 1998.

Reference Books

1. Allam, G.I.Y., Decision Support System for Integrated Watershed Management, Colorado State University, 1994.
2. Vir Singh, R., Watershed Planning and Management, Yash Publishing House, Bikaner, 2000.
3. American Society of Civil Engineers, Watershed Management, American Soc. of Civil Engineers, New York, 1975.

9. ENVIRONMENTAL MODELLING AND SIMULATION

Course Objectives

- Learning the fundamentals of environmental systems, Systems approach, Models and modelling.
- Understanding the modes of contaminant transport and their modelling.
- Study of groundwater flow models and contaminant transport.
- Modelling of surface water flow models. Modelling in computer-based software.

Course Outcome

- Learning the fundamentals of environmental systems, Systems approach, Models and modelling.
- Understanding the modes of contaminant transport and their modelling.
- Study of groundwater flow models and contaminant transport.
- Modelling of surface water flow models. Modelling in computer-based software.

SYLLABUS

Environmental systems: Introduction, An overview of mathematical models applied to various environmental issues, Concept, Need, Scope and objectives of environmental modeling, Role of mathematical models in environmental quality management

Model classification: Brief review of different types of models, Mathematical (Deterministic), Numerical, Stochastic and Physical Models. Different stages involved in model building, Calibration and verification of model, Limitations in modelling.

Contaminant Transport phenomenon: Advection, Diffusion, Dispersion, Adsorption, Conservative and non-conservative pollutants. biological process models-simplified models for transport phenomenon in River and streams, Estuaries and lakes.

Sub-surface flow models: Governing Equations for sub-surface flow and transport of pollutants, Simplified models for sub-surface plume movements. Case studies using appropriate software for sub-surface flow and transport of pollutants.

Surface flow models: Surface water quality modeling– Dissolved oxygen models – DO sag model, BOD model, Streeter Phelps equation for point and distributed sources. Eutrophication models for lakes and flowing water; Use of QUAL2K and Water Quality Analysis Simulation Program (WASP).

Air pollution: basic principles of air pollution dispersion modelling. Various types of models available. The relative merits and demerits of the models. The fundamental mathematical equations used in the AERMOD modelling and its limitations

Text Books

1. Ramaswami A. "Integrated Environmental Modelling", John Wiley, New York.

2. Chapra S.C., "Surface water quality modelling", McGraw Hill., New York.

3. Rumynin B.G., "Subsurface Solute Transport Model", Springer, Netherlands.

4. Schnoor J., "Environmental Modelling", John Wiley, New York.

Reference Books

1. Jacobson M.Z., "Fundamentals of Atmospheric Modelling", Cambridge UniversityPress, New York.

2. Schnelle K.B. and Dey P.R., "Atmospheric Dispersion Modelling Compliance (1999) Guide", McGraw-Hill, New York

3. Gordon Geoffrey, "System Simulation", Prentice Hall (Higher Education Division, Pearson Education)

10. SOCIAL AND ECOLOGICAL IMPACT ASSESSMENT

Course Objectives

- To develop an understanding of the role and scope of Social Impact Assessment (SIA)
- To familiarize the Social Impact Assessment Process and the role of public in the SIA
- To understand the policies and guidelines of rehabilitation and resettlements in India
- To impart knowledge on the ecological impact assessment fundamentals and processes
- To comprehend the ecological impact mitigation, monitoring and evaluation process

Course Outcomes

After completion of the course the student will be able to

- Understand the different dimensions of the Social Impacts and its assessment
- Prepare the baseline conditions and identify the social impact direct, indirect and cumulative impacts
- Identify the relevant policies and guidelines for rehabilitation planning and procedure and method of R&R

- Know the ecological impact assessment fundamentals and processes
- Plan the ecological impact mitigation, monitoring and evaluation process

SYLLABUS

Social Impact Assessment: Introduction: Evolution of Social Impact Assessment (SIA), SIA Policy in Indian Context, Provision of SIA in Fair Compensation Transparency in Land Acquisition and R&R, 2013 SIA Policy. Need and Advantages of Legal Mandates and Administrative Procedures for Social Impact Assessment, Basic Model for Social Impact Assessment: SIA Framework, Project Policy Development, Type and Setting, Identification of Assessment Variables

Basis of Evaluation of Social Costs: Quality of Life (QoL) - Steps in the Social Impact Assessment Process: Public Involvement, Identification of alternatives, Baseline Conditions, Scoping, Projection of Estimated Effects - Investigate the probable impacts, Predicting Responses to Impacts, Indirect and Cumulative Impacts, Mitigation Plan, Monitoring. Social impacts of industrial and developmental activities. Social surveys and socio-economic data generation. Social cost of environmental pollution.
Rehabilitation & Resettlement: Rehabilitation and resettlement of project affected people. Policies and guidelines of rehabilitation planning, corporate social accountability / responsibility. National Policy of Resettlement and Rehabilitation, R&R policy, its critical evaluation, objectives and general principles, PAPs, Types of compensations.

Ecological Impact Assessment: Definition and Description -factors affecting ecological impact assessment - baseline conditions: survey and inventory - identification of valued ecosystem components -Impact Identification/Focusing-Prediction of Impacts- Impact Measurement-Predictive Ability

Ecological Impact Mitigation and monitoring: Impact mitigation- evaluation - evaluation criteria indicators - mitigation-relationship to other forms of impact assessment-theoretical and practical problems-Independent review and guidance-monitoring- information availability- sampling and statistical Problems-Decision Making-Strategic Assessment-Ecological Impact Assessment Design and Analysis

.

Text Book

1. Jo Treweek. Ecological Impact Assessment, Wiley-Blackwell, ISBN: 978-0-632-03738-4; March 1999

2. Davide Geneletti: Ecological evaluation for environmental impact assessment;

Netherlands Geographical Studies, Utrecht, 2002, ISBN: 90-6809-337-1

3. Social Impact Assessment, Council for Social Development, New Delhi (2010).

4. General Sociology, K E Verghese, Macmillan India Limited, 2012

Reference Books

1. Ecological Impact Assessment (EcIA) EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems March 2015, Published by EIANZ, Melbourne, Australia ISBN: 978-0-9805878-2-1

2. Environmental Management in Mining Areas– Saxena NC, Singh Gurdeep and Ghosh R, (Ed.), Scientific Publishers (India), Jodhpur 2003.
2. Community Development in Coal Mining Complexes, ENVIS Monograph No.7 (March 2001), N. Panda, A.K. Pal, G. Singh, N. C. Saxena.
3. National R&R Policy (2007), Ministry of Rural Development, Govt. of India.

11. Environmental Economics

Course Objectives:

- To introduce the fundamentals of environmental economics
- To give basic concepts of sustainable economics and economics of pollution
- to familiarize absence of market, demand and supplyin nature
- To recognize or realize the importance in conservation of biodiversity and ecosystems through understanding of associated economic costs
- To expose the aspects of Economics of Natural Resources

Course Outcomes:

At the end of the course, the student will be able to:

- Assess and describe various economic aspects of environmental issues.
- Identify the economic operation and environmental issues, markets and environmental assets as part of environmental management
- Understand the environmental values; social and environmental cost benefit and related economic incentive which are useful to the organization
- Recognize the importance of the total cost assessment of an activity and the environmental compensation process
- Comprehend the valuation of various Natural Resources such as water, biodiversity etc.

SYLLABUS

Introduction: Basic concepts in economics, GDP, GNP, GEP, Green rating of industries, cost benefit analysis of environmental management - brief introduction to major components of economy: consumer, firm and their interaction in the market, producer and consumer surplus, market failure, law of demand and supply, tangible and non-tangible benefits; consumerism; measures of economic values; Pareto principle or criterion;

Environmental Economics: Definition and scope of environmental economics; Historical development of environmental economics; environmental economics versus traditional economics; Economic operation and environmental issues, Environmental pollution and sources, Markets and environmental assets, Incomplete markets, Externalities, Non-exclusion, Non-rivalry and public good, Non-convexities, Asymmetric information. Methods of abatement of externalities. Tradable pollution permits, Basic theory of tradable pollution permits, Issues in tradable permits.

Economy and Environment: Economics of Pollution: optimal level of pollution, market achievement of optimal pollution, Taxation and optimal pollution, Environmental standards, Taxes and subsidies, Marketable pollution permits, Measuring environmental damage - circular economy, sustainable economy. Main characteristics of environmental goods; marginal analysis; social benefit, costs and welfare functions; meaning and types of

environmental values; social cost benefit analysis; cost-effectiveness analysis. Economic incentive and environmental protection.

Total economic volume and valuation: methodology, Total costs assessment - pollution control policy in mixed economics. Environmental Values Ethics; discounting the future, alternative to adjusting discounting rates; Principles of Cost Allocation, Preventive, Punitive and social costs –environmental costs -Liability rules: Non-compliance fees, bonds and deposit refunds– Environmental compensation laws in India

Economics of Natural Resources: Renewable resources, optimal use of exhaustible resources - economics of renewable resources; Measuring and mitigating natural resource scarcity. Development and Environment; Development, Preservation and conservation, Irreversibility and sustainability. Cost Benefit Analysis of Environmental Change; Economics of non-renewable resources; economics of fuels and minerals; economics of biodiversity - economics of water use, management of fisheries and forests; introduction to natural resource accounting.

Text Books

1. Environmental Economics in Practice, Gopal K. Kadekodi, Oxford University Press
2. Values for the Environment: A Guide to Economic Approach – Winpeny JT, Overseas Development
Institute, London, HMOS, 1991.
3. Kolstad, C.D. "Environmental Economics", Oxford University Press.
4. Bhattacharya, R. "Environmental Economics: An Indian Perspective", Oxford University Press.

References Books

1. Economic Analysis of Environmental Impacts – Dixon, John, A, Scura LF, Carpenter RA and Sherman PB,
Earthscan Publications Ltd., London 1995.
2. Environmental Assessment Source Book (Vol – 1)- World Bank, Environment Department, Washington
DC, The World bank, 1991
3. Jhingan, M.L. "Environmental Economics - Theory, Management & Policy", Vrinda Publications
4. Singh, K. and A. Shishodia (2007), Environmental Economics: Theory and Applications, Sage Publications, New Delhi.

12. GREEN TECHNOLOGIES

Course Objectives

- To provide introductory knowledge about green technology and green innovations.
- To give a basic idea about greener nano particle synthesis and its characterization.
- To introduce about role of green energy and sustainable development in life.
- To aware and provide knowledge about green management
- To update students about the application of green process in different industries.

Course Outcomes

- The student will be able to understand the basics of green technology and its applications.

- Understanding about green nanotechnology and green materials.
- Able to comprehend about the role of green energy and sustainable development in life.
- The students will learn about the importance of green management in corporate as well as in industrial sector.
- Learn about the application of green processes in various industries.

SYLLABUS

Introduction of Green protocol: Need, Goal and Limitation of Green Technology, Principles of Green Technology.

Green Innovation & Sustainability: Criteria for choosing selection of green energy technologies. Emerging trends – process/product innovation, technological/environmental leap-frogging; Eco/green technologies for addressing the problems of Water, Energy, Health, Agriculture and Biodiversity sanitation, renewable energy technologies, industrial ecology.

Green Nanotechnology: Nano particles preparation techniques, Greener Nano synthesis, Nanoparticle characterization methods, Green materials: biomaterials, biopolymers, bioplastics, and composites. Nano materials for Fuel Cells and Hydrogen; Generation and storage, Nano structures for efficient solar hydrogen production, Metal Nano clusters in Hydrogen Storage Applications, Metal Nano particles as Electro catalysts in Fuel Cells

Green Energy: biodiversity and ecosystem services and their implications for sustainable development: global warming; greenhouse gas emissions, impacts, mitigation and adaptation; future energy Systems- clean/green energy technologies; International agreements/ conventions on energy and sustainability- United Nations Framework Convention on Climate Change (UNFCC);

Green Management: The concept of green management; evolution; nature, scope, importance and types; developing a theory; Definition green management in India; relevance in twenty first century, Green techniques and methods; green tax incentives and rebates (to green projects and Companies); green project management in action; climate change business and ISO 14064; green financing; financial initiative by UNEP; green energy management; green product management

Text Books

1. Kelliher, F., Reinl, L. Green Innovation and Future Technology. ISBN 978-1-137-47982-

2. Leo A. Meyer. The Green Energy Management. ISBN 0880690534.

Reference Books

1. Jadhav, Nilesh Y. Green and Smart Buildings. ISBN 978-981-10-1002-6.

2. Sengupta, Amretashis, Sarkar, Chandan Kumar. Introduction to Nano. ISBN 978-3-662-47314-6.

3. Kalia, Susheel, Kaith, B. S., Kaur, Inderjeet. Cellulose Fibers: Bio- and Nano-PolymerComposites. ISBN 978-3-642-17370-7.

HSS ELECTIVES

1. INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP
(Effective from the admitted Batch 2020-2021)
Course Objectives:

 To familiarize the students with the concepts of Management.

 To relate the concepts of Management with industrial organizations.

 To explain the factors affecting productivity and how productivity can be increased in an Industrial undertaking.

 To set forth a basic framework for understanding Entrepreneurship.

Course Outcomes:
On completion of the course, the students will be able to:

 Understand the roles, skills and functions of management.

 Distinguish the different types of business organizations.

 Identify the factors involved in Production Operations Management.

 Diagnose organizational problems and take suitable decisions.

 Establish good Human Resource Management practices.

 Acquire necessary knowledge and skills required for organizing and carrying out entrepreneurial activities.

SYLLABUS

Basic Concepts of Management: Management: - Definition, Nature and Importance; Functions of the Management; Levels of Management; F.W Taylor's Scientific Management; Henry Fayol's Principles of Management;
Forms of Business Organizations: Introduction, Types of Business organizations: Private Sector- Individual Ownership, Partnership, Joint stock companies and Co-Operative organizations; Public sector- Departmental Organizations, Public Corporations and Government Companies; The Joint sector Management.
Production and operations Management: Plant location- Factors to be considered in the selection of Plant location; Break - even analysis- Significance and managerial applications; Importance of Production Planning and Control and its Functions; Human Resource Management and Functions of Human Resource Manager (in brief); Functions of Marketing; Methods of Raising Finance.

Entrepreneurship: Definition, Characteristics and Skills, Types of Entrepreneurs, Entrepreneur vs. Professional Managers, , Growth of Entrepreneurs, Nature and Importance of Entrepreneurs, Women Entrepreneurs, Problems of Entrepreneurship.
Entrepreneurial Development and Project Management: Institutions in aid of Entrepreneurship Development, Idea generation: Sources and Techniques; Stages in Project formulation ; Steps for starting a small enterprise - Incentives for Small Scale Industries by Government.
Text Books:
1. Sharma, S.C, and Banga, T.R., Industrial Organization & Engineering Economics, Khanna Publishers, Delhi, 2000.

2. Vasant Desai, The Dynamics of Entrepreneurial Development and Management (Planning for future Sustainable growth), HImalayan Publishing House, 2018.

Reference Books:

1. Aryasri, A.R., Management Science, McGraw Hill Education (India Private Limited, New Delhi 2014.

2. Sheela, P., and Jagadeswara Rao, K., Entrepreneurship, Shree Publishing House, Guntur, Andhra Pradesh, 2017.

2. ORGANIZATIONAL BEHAVIOUR
(Effective from admitted batch 2020-2021)

Course Objectives:

 To understand the basic concepts of organizational behavior, its foundations and importance.

 To enable students to have a basic perspective of Motivation and Motivation theories.

 To acquaint the students about group behavior in organizations, including communication, leadership conflicts and organizational change and how these are linked to an impact organizational performance.

Course Outcomes:

 Identifying fundamental aspects of organizational dynamics.

 Evaluate main theories of motivation and formulating suitable motivational strategies.

 Analyze the behavior of individuals and groups in organizations.

 Understanding of Leadership theories and Leadership behavior.

 Apply relevant theories, concepts to address important Organizational Behavior questions

SYLLABUS

Organizational Behavior: Concept of Organization- Concept of Organizational Behavior - Nature of Organizational Behavior - Role of Organizational behavior - Disciplines contributing to Organizational Behavior.

Motivation: Definition - Nature of Motivation - Role of Motivation - Theories of Motivation: Maslow's Need Hierarchy Theory, Herzberg's Motivation Hygiene Theory and Mc Gregor's Theory X and Theory Y.

Group Dynamics: Meaning - Concept of Group - Types of groups -Formal and Informal groups - Group development - Group cohesiveness and factors affecting group cohesiveness.

Leadership: Concept of Leadership - Difference between Leadership and Management - Importance of Leadership - Leadership styles: Autocratic leadership, Participative leadership and Free Rein leadership.

Communication: Meaning - Communication Process - Forms of communication: Oral, Written and Non- Verbal communication - Direction of communication: Downward, Upward and Horizontal communication.

Organizational conflicts: Concept of conflict - Reasons for conflict - Types of Conflict: Intrapersonal conflict, Interpersonal conflict, Intragroup conflict, Intergroup conflict, Inter-organizational conflict - Conflict management.

Organizational Change: Nature - Factors in Organizational change -Planned change: Process of planned change - Resistance to change: Factors in résistance to change - Overcoming résistance to change.

Text Books:

1. L.M.Prasad: Organizational Behavior, Sultan Chand & Sons, New Delhi -110002

2. K. Aswathappa: Organizational Behavior, Himalaya Publishing House, New Delhi

Reference Books.
1. Stephen Robbins: Organizational Behavior, Pearson's Education, New Delhi.

3. OPERATIONS RESEARCH
(Effective from admitted batch 2020-2021)

Course Objectives:
 To discuss basic Operation Research concepts, Formulation of LPP, and its solution using graphical method.

 To discuss the standard form of LPP. solving LPP using various methods.

 To study the various solutions to transportation problems and assignment problems.

 To discuss PERT and CPM charts

 To discuss replacement problems, inventory problems, and game theory.

Course outcomes:
Students will be able to
 Understand the ability to solve LPP problems using various methods.

 Ability to solve transportation and assignment problems using several methods.

 Analyse the PERT and CPM charts

 Ability to solve replacement problems and game theory problems.

 Understand queuing theory of transportation problems.

SYLLABUS
Linear Programming – Problem Formation, graphical Solution methods
The Simplex Method – Two–Phase Simplex method, Formulation of L.P.P and its solutions by SIMPLEX Method.
Duality in Linear Programming – Fundamental properties of Duality, Duality and Simplex method, Bounded variable simplex algorithm.
The Transportation Problem – The North–West Corner rule, The Row minimum Method, The Column minima method, The Matrix minima method, Vogel's Approximation method, The Transportation Algorithm, Unbalanced Transportation Problems.
Assignment and Routing Problems –The Assignment Problem, Unbalanced Assignment Problem, Travelling Salesman Problem.
Queuing Theory – Characteristics of Queuing systems, Queue discipline, service channels, Poisson process and Exponential distribution, Distribution of Inter-travel times, Classification of Queues, The M/1/1 Queuing system (Model I to IV), The M/M/C Queuing System (Model I to IV), Non – Poisson Queuing Systems.

Text Books
1. Operation research by Kanti Swarup, Gupta, and Manmohan.
2. Operational Research and Statistical analysis by S.D. Sharma

Reference Books
1. Operations Research by Ranganath, Yes Dee Publishing Pvt Ltd
2. Introduction to Optimization: Operation Research by J.C. Pant, Jain Brothers. Delhi.
3. Operation Research by Pannerselvam, Prentice Hall of India

4. Operation Research by Iyer,TMH