SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

M.Tech Degree Program (CBCS)

Curriculum & Syllabi for Environmental Engineering

(w.e.f 2018-19)

MAY, 2018

M. Tech (ENVIRONMENTAL ENGINEERING) – I Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Program Core									
EEPC01	Advanced Water Treatment	3	-	-	3	3	40	60	100
EEPC02	Air Pollution and Control	3	-	-	3	3	40	60	100
Program Elective- I Any One from the Following		3	-	-	3	3	40	60	100
EEPE11	Environmental Chemistry								
EEPE12	Environmental Quality and Pollution Monitoring Techniques								
EEPE13	Rural Water Supply and Onsite Sanitation System								
EEPE14	Ecological Engineering and Stream Ecology								
Program Elective- II Any One from the following		3	-	-	3	3	40	60	100
EEPE 21	Environmental Microbiology								
EEPE 22	Noise Pollution and Control								
EEPE 23	Ground Water Contamination								
EEPE 24	Transport of Water and Wastewater								
Program Practicals									
EECP 01	Environmental Engineering Lab - I	-	-	4	4	2	40	60	100
EECP 02	Environmental Engineering Lab – II	-	-	4	4	2	40	60	100
Audit Course – I		2	-	-	2	-	100	-	100
PGPA11	English for Research Paper Writing								
PGPA12	Disaster Management								
PGPA13	Sanskrit for Technical Knowledge								
PGPA14	Value Education								
Mandatory Course									
PGMC41	Research Methodology and IPR	2	-	-	2	2	40	60	100
	Total	16	-	8	24	18	380	420	800

M. Tech (ENVIRONMENTAL ENGINEERING) – II Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Program Core									
EEPC03	Advanced Wastewater Treatment	3	-	-	3	3	40	60	100
EEPC04	Municipal Solid Waste Management	3	-	-	3	3	40	60	100
Program Elective- III Any One from the Following		3	-	-	3	3	40	60	100
EEPE 31	Industrial Wastewater Treatment								
EEPE32	Urban Water Management								
EEPE33	Hazardous Waste Management								
EEPE34	Wastewater Reclamation and Reuse								
Program Elective- IV Any One from the Following		3	-	-	3	3	40	60	100
EEPE 41	Environmental Impact Assessment								
EEPE 42	Sustainable Engineering and Technology								
EEPE 43	Bioremediation								
EEPE 44	Environmental Legislation and Audit								
Program Practicals									
EECP 03	Environmental Modeling Lab	-	-	4	4	2	40	60	100
EECP 04	Unit Operations and Processes laboratory	-	-	4	4	2	40	60	100
Audit Course – II									
PGPA 21	Constitution Of India	2	-	-	2	-	100	-	100
PGPA 22	Pedagogy Studies								
PGPA 23	Stress Management By Yoga								
PGPA 24	Personality Development Through Life Enlightenment Skills								
Mini Project									
EEMP 01	Mini Project with Seminar	-	-	4	4	2	100	-	100
	Total	14	-	12	26	18	440	360	800

M. Tech (ENVIRONMENTAL ENGINEERING) – III Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Program Elective- V Any One from the Following		3	-	-	3	3	40	60	100
EEPE51	Clean Technology								
EEPE52	Mathematical Modeling in Environmental Engineering								
EEPE53	Environmental Management								
EEPE54	Climate Change								
Open Elective Any One from the Following		3	-	-	3	3	40	60	100
EEOE 11	Business Analysis								
EEOE 12	Industrial Safety								
EEOE 13	Operations Research								
EEOE 14	Cost Management of								
EEOE 15	Composite Materials								
EEOE 16	Energy Generation from Waste								
Dissertation									
EEPD 01	Dissertation- Phase-I	-	-	20	20	10	100	-	100
Total		6	-	20	26	16	180	120	300

M. Tech (ENVIRONMENTAL ENGINEERING) – IV Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Dissertation									
EEPD 02	Dissertation- Phase – II	-	-	32	32	16	40	60	100
Total		-	-	32	32	16	40	60	100

EEPC01 ADVANCED WATER TREATMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT –I

WATER QUALITY AND CRITERIA: Water quality criteria and standards for different uses-drinking, irrigation, industrial and construction. Water quality indices, physical, chemical and physicochemical unit operations and processes -Typical treatment flow sheet of surface and underground water.

AERATION: Aeration, solubility of gases-two film theory, aeration methods, design of different aeration systems-sprinkler, cascade and mechanical.

UNIT –II

SEDIMENTATION: Different types of settling, settling column analysis, settling velocity and design principles of sedimentation tank, Tube settlers.

COAGULATION AND FLOCCULATION: Theory and mechanism of chemical coagulation and flocculation, determination of optimum coagulant doses, Chemical feed system. Theory of flocculation – orthokinetic and perikinetic, G and Gt factor, Hydraulic and mechanical mixing arrangements, design of different types of flash mixing and flocculator units.

UNIT –III

FILTRATION : Theory of filtration, Filter media-characteristics, hydraulics of flow through porous media, slow sand filtration, rapid sand filtration, precoat filtration, direct filtration of water, their design, back washing of filters – design of backwash ,Operational and maintainence problems.

DISINFECTION : Mechanism of disinfection, Factors affecting the disinfection process. Common disinfectants.Chemistry of chlorination, Chlorine handling and dosing, Ozonation, U.V. Disinfection-design criteria.

UNIT –IV

OTHER TREATMENT METHODS:

Adsorption- Definition ,factors affecting adsorption, isotherms. Removal of taste and odour, colour, iron and manganese, fluorides,arsenic,nitrates and desalination of water.

INDUSTRIAL WATER TREATMENT: Boiler feed water-Softening , Ion – exchange and reverse osmosis, Water stabilization, process water for food processing industries.

UNIT –V

WATER PLANT WASTE MANAGEMENT: Need for sludge management, Characteristics and quantities of water processing sludges, Design of water – treatment sludge thickners.Application of pressure filtration and centrifugation for dewatering of sludges. Alum recovery practices. Ultimate disposal of dewatered sludges.

LAYOUT AND HYDRAULIC DESIGN OF WATER TREATMENT PLANTS

Reference Books :

1. Montgomery, water treatment principles and design, Johnwiley and sons, Newyork..
2. Warren Viessman, Jrand Mark J. Hammer, Water Supply and Pollution Control by Harper & Row Publishers, New York.

3.Hazard S. Peavy, Donald R. Rowe and George Tchobanoglous, (1985). Environmental Engineering, McGraw-Hill Book Company, New York.

4J.RWeber (1972), Physicochemical Processes for Water Quality Control,John Wiley and Sons,USA.

Course Outcomes

After completion of course students are

1. Able to assess water quality parameters and aeration methods of water treatment
2. Able to design primary sedimentation tank and clariflocculator

3. Able to plan and design suitable filtration units and disinfection methods for drinking water treatment

4. Capable of applying appropriate advanced water treatment techniques.

5. Able to manage water treatment plant sludges and carry hydraulic design of Water treatment plant.

EEPC02 AIR POLLUTION AND CONTROL

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

GLOBAL EFFECTS: Acid Rains, Green house effect and Ozone layer depletion.

POLLUTION SOURCES: Anthropogenic and Natural sources of Air pollutants. Types of Air pollutants. Properties of Air pollutants-Particulates, Carbon monoxide, Oxides of sulphur, Nitrogen Oxides, Hydrocarbons.

AIR POLLUTION SAMPLING AND MEASUREMENT –Devices for sampling, Different sampling methods, Sampling of Particulate Matter and Sampling of stack gas. Analysis of air pollutants Sulphur Dioxide, Nitrogen Oxides, Carbon Monoxide, Oxidants and Ozone, Hydrocarbons, Particulate Matter.

UNIT – II

EFFECTS OF AIR POLLUTANTS:

Effects of Carbon monoxide, Particulate Matter, Sulphur Dioxide, Oxides of Nitrogen, Hydrocarbon and photochemical oxidants on human beings. Effects on vegetation - Necrosis, Epinasty, Abscission and Chlorosis. Effects of Arsenic, Fluorine and Lead on animals. Effects of Air pollutants on metals, building materials, paints, textiles, electrical Materials, paper, leather, rubber and economy.

UNIT – III

METEOROLOGICAL ASPECTS OF AIR POLLUTANT DISPERSION:

Wind direction and speed, Temperature, Atmospheric stability, mixing height, Precipitation, Humidity, Solar radiation, Visibility, Inversions and plume behavior. The Gaussian Dispersion Model, Diffusion coefficients, Box model and Puff model.

UNIT - IV

AIR POLLUTION CONTROL METHODS:

CONTROLL OF PARTICULATE MATTER-General methods of control - Zoning - Town planning. Control of particulate matter –Gravity settling chambers, Cyclones, Inertial seperators, scrubbers, bag- filter, Electrostatic Precipitators.

REMOVAL OF GASEOUS MATTER–Control of Sulphur Dioxide by Reinluft process and Westvaco process; Control of $NO_X$by combustion modification, post-flame treatment;VOCs control by adsorption, combustion, condensation and process modification.

BIOMONITORING AND PHYTOREMEDIATION.

UNIT - V

AIR QUALITY AND EMISSION STANDARDS – Ambient Air Quality Standards (2015)

AUTOMOBILE POLLUTION:

Sources, emissions from diesel and petrol engines, Bharat V standards, catalytic convertors, Management of automobile pollution.

AIR POLLUTION AND LEGISLATION: Air Pollution Control Act, 1981, and Environment (Protection) Act, 1986.

Reference Books :

1. Crawford, M (1976). Air Pollution Control Theory, McGraw-Hill, New York.
2. H.C.Perkins (1974). Air Pollution, Mc-Graw Hill, Tokyo.
3. Wark, Kenneth and Cecil F. Warner (1976). Air Pollution : Its Origin and Control, Dun-Dunnelley, New York.

Course Outcomes (COs)

After completion of course student can able to

1. Describe the global effects of air pollution, air pollutants characteristics and sampling methods of air pollutants.
2. Capable of recognizing the effects caused by different air pollutants on human beings, animals, plants and materials.

3. Apply the meteorological aspects of air pollutants dispersion in the different dispersion modeling.
4. Capable of applying advanced technologies to reduce air pollution.
5. To manage automobile pollution and evaluate their efficiency

EEPE11 ENVIRONMENTAL CHEMISTRY

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

REACTION KINETICS : The rate law – Order of reactions ,Zero and First order reactions, second order reactions, Pseudo first order reactions– half life and its relationship to the rate constant – Factors affecting rate of reactions.

RECTORS-BATCH, CONTINUOUS, PLUG FLOW, PROCESS SELECTION

Reactors- mass balance analysis- batch, completely mixed and plug flow reactors – process selection Solution equilibrium – Le Chatlier principle -Activity and activity coefficients –Ion activity coeffs – solubility of salts – oxidation-reduction reactions - complex formation, solubility product,LCD for solubility determination, Oxidation-Reduction equillibria.

UNIT – II

CHEMICAL THERMODYNAMICS AND EQUILIBRIUM: Heat and work-Energy- Enthalpy, Free energy and its relationship to the equilibrium constant, calculation of change free energy at standard and ambient conditions. Entropy, Free energy.

EQUILIBRIUM PROCESSES : Volatilization – Air – water equilibrium – Henry's constant with units for a gas dissolving in a liquid – Dimensionless Henrry's constant for species transferring from a liquid to a gas.

UNIT – III

ACID – BASE EQUILIBRIUM: Hydrogen ion concentration (pH) – acids and bases and their equilibrium constants, PC-PH diagram: Log concentration Diagram – The carbonate system, alkalinity, and buffering capacity – Hydrolysis of salts and gases.

CHEMISTRY OF ORGANICS: Major groups of organic compounds – Difference between organics and inorganics – Organic compounds generally encountered in industrial wastewater –

Biodegradable and non - biodegradable organics. Hydrocarbons, Alcohols, Aldehydes, ketones and Acids, Carbohydrates, detergents, fats of organics.

UNIT –IV

NUCLEAR CHEMISTRY-Atomicstructure-stable and radioactive nuclidesnuclear reactions-Nuclear Fission-Nuclear fusion-Effect of Radiation on man, safety of nuclear reactors.

SURFACE AND COLLOIDAL CHEMISTRY-Properties of colloids, environmental significance, colloidal dispersion in liquids and air, EDL Theory, destabilization of colloids, Adsorption at solid-liquid interfaces.

UNIT-V

TREATMENT OF COOLING WATER: Water stabilization, Langumuir saturation Index, Caldwell-Lawrence diagrams, water softening- Chemical precipitation ,split treatment and Ion exchange process.

BIOCHEMISTRY-Biodegradation of carbohydrates, protein, fats and oils, biochemical pathways, Energetics and bacterial growth, enzymes.

Reference Books :

1. Sawyer, C.N., P.L.Mc Carty, and G.F.Parkin, (1994). Chemistry for Environmental Engineering,McGraw Hill, New York.
2. De, A.K. (1994). Environmental Chemistry, Wiley Eastern Limited, New Delhi.
3. Warner Stumn and James J. Morgen (1996). Aquatic Chemistry, 3rd ed., Wiley-Interscience series of tests and monographs.
4. Larry D. Benefield and Joseph F. Judkins. Jr. and Barron L.Weand (1981). Process Chemistry for water and waste water treatment, Printice Hall Inc.

Course Outcomes (Cos)

After completion students are

1. Able to apply principles of reaction kinetics and solution equillibrium

2. Able to apply the enthalpy and its relation with equilibrium constant

3. Able to find acid base equilibrium constants and capable of classifying organic and inorganic compounds.

4. able to understand surface and nuclear chemistry processes

5. To understand principles of softening and biochemistry.

EEPE12 ENVIRONMENTAL QUALITY AND POLLUTION MONITORING TECHNIQUES

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

INTRODUCTION- Importance of Quantativemeasurements,Character of Environmental Engineering and science problems,standards methods of analysis, scope of a course in analysis of environmental samples, expression of results. Gravemetric methods for solids analysis in water and wastewater.

UNIT-II

TITRAMETRIC METHODS

Determination of acidity, alkalinity,hardness, chloride and residual chlorine.

UNIT-III

INSTRUMENTAL METHODS

Optical methods of analysis, electrical methods of analysis,chromatographic methods,AAS,UV-VIS. Material characterization techniques- SEM, TEM, XRD, FTIR, thermal analysis- working principles and applications. Determination of nitrogen and phosphate.

UNIT-IV

BIOLOGICAL METHODS AND MICROBIOLOGY

Biochemical oxygen demand MPN test for microbial pollution Plate counts Confirmatory test.

UNIT-V

AIR POLLUTION ANALYSIS

Sampling techniques for air pollution measurements, analysis of particulates like PM_{10}, $PM_{2.5}$, $PM_{1.0}$ and common chemical air pollutants like VOC, Hydrocarbons, oxides of nitrogen and sulphur.

Course Outcomes

After completion of course student can

1. Able to do the gravimetric methods for solids analysis
2. Able to apply the different titrametric methods for pollution monitoring

3. Able to use the different instrumental methods for pollution monitoring.
4. Able to apply the different biological methods for pollution monitoring
5. Able to use the different air analysis methods of pollution monitoring

Reference Books :

1.Chemistry for environmental engineering and science ,fifth edition, by clair N sawyer,PerrylMccarty and Gene F, Parkin.

EEPE13 RURAL WATER SUPPLY AND ONSITE SANITATION SYSTEMS

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

Rural Water Supply: Issues of rural water supply –Various techniques for rural water supply- merits- National rural drinking water program- rural water quality monitoring and surveillance- operation and maintenance of rural water supplies

UNIT-II

Low Cost Water Treatment: Introduction – Epidemiological aspects of water quality- methods for low cost water treatment - Specific contaminant removal systems for contaminants like nitrites ,fluoride and arsenic

UNIT-III

Rural Sanitation: Introduction to rural sanitation- Community and sanitary latrines - Planning of wastewater collection system in rural areas- Treatment and Disposal of wastewater - Compact and simple wastewater treatment units and systems in rural areas- stabilization ponds – Pit latrines-dry latrine-wet latrine-septic tanks - Imhoff tank- soak pits- low cost excreta disposal systems- Effluent disposal.

UNIT-IV

Industrial Hygiene And Sanitation: Occupational Hazards- Schools- Public Buildings- Hospitals- Eating establishments- Swimming pools – Cleanliness and maintenance and comfort- Industrial plant sanitation.

UNIT-V

Solid Waste Management: Disposal of Solid Wastes- Composting- land filling- incineration- Biogas plants - Rural health - Other specific issues and problems encountered in rural sanitation.

ANIMAL WASTE DISPOSAL

Sanitary way of dung storage. Bio-gas plants – Classification, operation and maintenance problems.

Reference:

1. Eulers, V.M., and Steel, E.W., Municipal and Rural Sanitation, 6th Ed., McGraw Hill Book Company, 1965

2. Park, J.E., and Park, K., Text Book of Preventive and Social Medicine, BanarsidasBhanot, 1972

3. Wright, F.B., Rural Water Supply and Sanitation, E. Robert Krieger Publishing Company, Huntington, New York, 1977

4. Juuti, P., Tapio S. K., and Vuorinen H., Environmental History of Water: Global Views on Community Water Supply and Sanitation, IWA Publishing (Intl Water Assoc), 2007

5.WB Mannual –onsite sanitation systems.

6.WHO Mannual

Course Outcomes

After completion of the course student can

1. Able to apply various techniques for rural water supply
2. Able to plan low cost water treatment methods for rural areas.
3. Able to understand the salient aspects of rural sanitation and design wastewater treatment units
4. Able to frame water sanitation plan for industry, hospitals, swimming pools and eating places.
5. Able to manage rural solid wastes and animal waste.

EEPE 14 ECOLOGICAL ENGINEERING AND STREAM ECOLOGY

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

INTRODUCTION TO ECOSYSTEMS

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.

UNIT-II

MODELING AND ECOTECHNOLOGY

Modeling and ecotechnology – Classification of ecological models – Applications- Ecological economics- Self-organizing design and processes.

UNIT-III

FLUVIAL ECOSYSTEM

Introduction To Fluvial Ecosystems: Fluvial Ecosystem Diversity- The Water Cycle – Stream flow-Flow Variation- The Stream Channel- Sediments and their Transport- Fluvial Processes along the River Continuum

UNIT-IV

STREAM WATER CHEMISTRY

Dissolved Gases -Major Dissolved Constituents of River Water-Variability in ionic concentrations -The dissolved load -Chemical classification of river water-The Bicarbonate Buffer System-Influence of Chemical Factors on the Biota-Variation in ionic concentration-Salinization -Effects of acidity on stream ecosystems

UNIT-V

WATER QUALITY

Water quality models – Historical development – Non point source pollution- Mass balance equation – Streeter - Phelps Equation – Modification to Streeter – Phelps Equation – Waste load allocations – Dissolved oxygen in Rivers and estuaries; Lake Water Quality Models; Models for Nitrogen, Bacteria, Phosphate and toxicants - Ground Water Quality Modeling - Contaminant solute transport equation, Numerical methods- legislations for water quality.

Reference:

1. Tebutt T.H.Y., Principles of Water Quality Control, 5th Ed., Pergamon Press, 1998
2. Thomann V. R., and Mueller A. J., Principles of Surface Water Quality Modelling and Control, Prentice Hall, 1997
3. Welch, E.D., Ecological Effects of Wastewater, Cambridge University Press, 1992
4. Frank R. Spellman and Joanne Drinan, Stream Ecology and Self Purification: An Introduction, 2nd Ed., CRC Press, 2001

Course Outcomes

After completion of course student can able to

1. Understand concepts of ecology
2. Explain the different types of ecological models
3. Understand the fluvial ecosystem
4. Use aspects of water chemistry for stream ecology
5. Apply suitable models for water quality assessment.

ELECTIVE- II

EEPE 21 ENVIRONMENTAL MICROBIOLOGY

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

GENERAL: Importance of Microorganisms. Classification of Microorganisms based on nutrition and metabolic activity

PROCARYOTIC ANDEUCARYOTIC MICRO ORGANISMS:

BACTERIA: Distribution, cytology, forms, size, cell structure,chemical composition, metabolism and classification.

FUNGI : Classification, identification, terminology and cultivation, chemical composition

ALGAE : Classification, identification, culture media, metabolism,pigments.

HIGHER FORMS : Protozoa - identification, classification,metabolism,nutrition. Rotifers; crustaceans; worms and larvae.

UNIT – II

STUDY OF MICROORGANISMS: stains and staining.

STUDY OFMICROSCOPES: ordinary, dark field, reflectance and electron microscopes.

GROWTH PATTERN OF MICROORGANISMS: Growth curve, food-microorganism relationship, aerobic-anaerobic growth, temperature,types of culture media, inhibitory media, Fungi media, Algae media, Protozoa media and isolation of microorganisms.Estimation of bacterial numbers.

NUTRITIONAL REQUIREMENTS FOR GROWTH: Required elements, organic growth factor requirements, Carbon source, Nitrogen source, control of synthetic reaction, energy source and selective effect of nutrients.

CONTROL OF MICROORGANISMS: Pattern of death, heat, disinfection, oxidizing agents, surfactants, heavy metals, Antimetabolites and Antibiotics,and PH.

UNIT – III

QUANTATIVE MEASUREMENT OF GROWTH:

Measurement of usable substrate,Measurement of oxygen uptake, Measurement of biomass,relationships between X and S.

ENZYMES AND GENETICS : Enzymes - Nature of enzymes, mode of action, effect of temperature, pH, salts and heavy metals on enzyme activity; Colloidal nature of enzyme, extracellular and intracellular enzymes, hydrolytic enzymes, oxidation-reduction enzymes, classification of enzymes. Genetics.

MICROBIOLOGY OF WATER: Bacterial content of various types of water sources - water borne diseases, differentiation of fecal and non-fecal coli forms, M.P.N. and other microbiological tests on water.

UNIT – IV

MICROBIOLOGY OF WASTEWATER:Aerobic and anaerobic metabolism.

CENTRAL PATHWAYS OF METABOLISM:Embden Meyerhof pathway, Tricarboxylic Acid Cycle(TCA),Hexose Monophosphate (HMP) pathway,Entner-Douderoff pathway.

AEROBIC METABOLISM-Metabolism of carbohydrates, metabolism of proteins, metabolism of lipids, metabolism of nucleic acids, metabolism of hydrocarbons.

ANAEROBIC METABOLISM-Fermentation of sugars-Formation of pyruvate from Glyceraldehyde 3-phosphate, formation of lactic acid,Decarboxylation of pyruvate, Formation of butanediol, Formation of butyric acid and butanol, Formation of propionic acid,Formation of glycerol. Fermentation of non carbohydratesubstrates.Anaerobic digestion process.

UNIT – V

MICROBIOLOGY OF COMPOSTING:Microorganisms involved in composting process.

MICROBIOLOGY OF AIR: Types of microorganisms, Air-borne diseases, control of air-borne diseases.

SOIL MICROBIOLOGY: Types of microorganisms, distribution,Bioremediation.

References Books:

1. R.E.McKiney, (1977), Microbiology for Sanitary Engineers, McGraw Hill, New York.
2. Anthony F.Gaudy and Elizabeth T.Gaudy (1980), Microbiology for environmental scientists and engineersMcGraw Hill publishers,Tokyo.
3. Michael J.Pelczar,JR.Chan, E.C.S. and Noel R. Krieg (2004) ,Microbiology,McGraw Hill, Inc., New York.
4.Ralph Mitchel and JiDonguGu (2010).Environmental Microbiology.Johnwiley and sons.Canada.

Course Outcomes (COs)

After completion of course student can able to

1. Classify the different types of microorganisms and use microscope and cultures suitably.
2. Analyze microbial growth kinetics
3. Understand salient aspects of enzymatic relationships and microbiology of water, wastewater and soil
4. Apply microbiological principles in air pollution control and composting
5. Able to control air borne disease due to microorganisms in the air and able to carry out composting process

EEPE 22 NOISE POLLUTION AND CONTROL

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

ACOUSTICAL CONCEPTS : Nature of Sound - Sound propagation characteristics - Propagation of sound in air - Absorption of sound in air - Hearing mechanics - Measurement scale - Equal loudness contours.

NOISE CHARACTERISTICS AND SOURCES OF NOISE : Noise characterization - Sources of noise.

UNIT – II

MEASURING INSTRUMENT AND TECHNIQUES: Methodology of noise measurements - Sound level meter - Noise dose meter - Audiometer - Noise survey techniques - Vehicular noise measurement techniques - Aircraft noise measurement techniques - Sound power determination techniques - Techniques for characterization of acoustical materials.

UNIT – III

HEALTH EFFECT OF NOISE: Annoyance - Sleep disturbance - Effect of noise on task performance and cardio-vascular system - Effect of noise on speech communication - Noise induced hearing loss (NIHL) : Effect of continuous sounds - Hearing damage due to impulse sounds.

ENVIRONMENTAL NOISE MEASUREMENTS : Introduction - Traffic noise survey - Vehicular noise level - Domesticappliances noise - Industrial noise - Aircraft noise - Community noise - Shipboard noise - Impulse noise.

UNIT – IV

NOISE STANDARDS AND LIMITS : Introduction - Legal position in India - Environmental standards - Occupational / Industrial noise standards - Road vehicles noise standards - Noise vehicles noise standards - noise standards for construction equipment and domesticappliances - Impulse noise (Fireworks) exposure standards.

NOISE IMPACT ASSESSMENT STUDIES: Definition of the problem - Elements of environmental noise - Assessment - Fractionalization approach to impact assessment - Impact of vibration environments - Case study.

UNIT – V

NOISE CONTROL TECHNIQUES: Mechanism of noise generation - Control methodology - Noise control at source - Noise control along the path - Control on the receiver end.

NOISE STRATEGY: FUTURE GUIDELINES: Current trend - Noise control measures - Environmental noise management - Noise labeling - Diagnostics - Noise strategy - Problems for future investigations.

Reference Books:

1. S.P.Singal, (1999) Noise Pollution and Control, Narosa Publishing House, New Delhi.
2. Cunniff, P.F. (1977), Environmental Noise Pollution, Wiley, New York.
3. Thumann, A., and R.K.Miller (1986). Fundamentals of Noise Control Engineering, Prentice Hall, Englewood Cliffs, N.J.

Course Outcomes

After completion of course student can

1. Able to describe about the sound propagation and noise characteristics
2. Able to assess noise levels
3. Able to classify different types of noise and its effect on environment and human beings
4. Able to apply the noise standards and limits and carry noise impact assessment.
5. Able to plan suitable noise control technologies.

EEPE 23 GROUND WATER CONTAMINATION

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

INTRODUCTION- The Hydrological cycle, Ground water Hydrology, Ground water contamination and Transport, Evolution of Ground water Information, Ground Water Remediation. Confined aquifer and unconfined aquifers.

UNIT-II

SOURCES AND TYPES OF GROUNDWATER CONTAMINATION

Introduction, Underground storage tanks, Landfills, surface Impoundments, waste Disposal Injection Wells, septic systems, Agricultural wastes, Land application and Minning, Radioactive Contaminants, Military sources of contamination, classification of organic compounds, Inorganic compounds in ground water.

UNIT-III

CONTAMINANT TRANSPORT MECHANICS

Introduction, Advection process, Diffusion and Dispersion processes, Mass Transport equations, one–Dimensional Models, Governing Flow and Transport Equations, Analytical Methods, Multi dimensional Methods, Tests for Dispersivity, Natural Gradient Field Tests for Dispersion.

UNIT-IV

CONTAMINATION FATE PROCESSES

Sorption and Desorption, Abiotic Fate process, Volatilization, Biodegradation, Evaluation of Fate processes.

MODELLING BIODEGRADATION AND NATURAL ATTENUATION

Kinetics and Rates of Biodegradation, Modeling Biodegradation, Biodegradation Models, Analytical Natural Attenuation Models, Numerical Natural Attenuation Models, Field Applications.

UNIT-V

GROUND WATER REMEDIATION ALTERNATIVES

Remediation Methods, Remedial Alternatives, Containment Methods for source control, Hydraulic controls and pump and treat systems, Bioremediation, soil vapour Extraction systems, Remediating NAPL sites, Emerging Remediation Technologies.

Reference Books :

1.PhilipB.Bedient, Hanadi.s, J.charles (1994).Ground water contamination transport and remediation, PTR Prentice Hall.

2.Geo Environmental Engineering(2004),HariD.Sharma and Krishna Reddy, John wiley and sons.

Course Outcomes

After completion of course student can

1. Able to describe the fundamentals of ground water hydrology
2. Able to understand the sources and types of ground water contamination
3. Able to use models for contaminant transport
4. Able to understand contamination fate process and carry modeling of biodegradation rates
5. Able to apply different remediation methods for ground water.

EEPE 24 TRANSPORT OF WATER AND WASTE WATER

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

TRANSPORT OF WATER: Water Storage and Transmission- Storage requirements, impounding reservoirs, intakes, pressure conduits, hydraulics, pumps and pumping units, capacity and selection of water pumps, economic design of pumps and economic design of gravity and pumping mains.

UNIT-II

MATERIALS FOR PIPES: Specification for pipes, pipe appurtenances, types of loads and stresses, water hammer, causes and prevention, control devices.

DISTRIBUTION SYSTEMS : Principles of design, analysis of distribution networks, Hardy Cross, equivalent pipe and Newton Raphson methods, computer applications in distributions network analysis, optimal design of networks, maintenance of distribution systems, methods of control and prevention of corrosion, storage, distribution and balancing reservoirs.

UNIT-III

TRANSPORT OF WASTEWATER

Sanitary Sewerage: Sanitation technology selection - sanitary sewage flow estimation - sanitary sewer materials - hydraulics of flow in sanitary sewers - partial flows - sewer design - sewer layouts, Concept of model based design - hydraulic fundamentals of design models - Basic properties and model formulations for the design of wastewater of collection system - transitions in flow of sewage.

UNIT-IV

STORM DRAINAGE-Basic philosophy in storm drainage - drainage layouts - storm runoff estimation - rainfall data analysis - hydraulics of flow in storm water drains - storm water drain materials and sections - design of storm drains - storm water inlets.

UNIT-V

OPERATION & MAINTENANCE: Maintenance requirements of sanitary sewerage and storm drainage systems - manpower requirement - equipment requirement; preventive maintenance - monitoring safety requirements-corrosion in sewers - prevention and control - Specific problems related to waste water pumping.

Text Books :

1. Hazard S. Peavy, Donald R. Rowe and George Tchobanoglous, (1985). Environmental Engineering, McGraw-Hill Book Company, New York.
2. Warren Viessman, Jr. and Mark J. Hammer (1985). Water Supply and Pollution Control, Harper and Row, Publishers, New York.
3. Sincero and Sincero (1996), Environmental Engineering, Prentice hall, Michigan university.

Course Outcomes (COs)

After completion of course student is

1. Capable of understanding the fundamentals of fluid flow
2. Able to analyze distribution system and design balancing reservoirs.
3. Capable of designing waste water collection system
4. Can able to design the storm drainage system
5. Can able to carry out maintenance of storm and sewerage drainage systems.

EECP 01 ENVIRONMENTAL ENGINEERING LAB - I

P / week : 4Hrs | Sessional Marks : 40

University Exam : 3 Hrs | End Exam Marks : 60

Water and Air Analysis

1. (a) Determination of Colour
   (b) Determination of Turbidity
   (c) Determination of pH
   (d) Determination of Temperature and Odour

2. (a) Determination of Total Solids, Dissolved Solids, Suspended Solids.
   (b) Determination of Total Volatile and Fixed Solids.
   (c) Determination of Electrical Conductivity
3. (a) Determination of Total Acidity
   (b) Determination of Total Alkalinity
   (c) Determination of Dissolved oxygen
4. (a) Determination of Total Hardness
   (b) Determination of Chlorides
   (c) Determination of Sulphates
5. Determination of Residual chlorine content
6. Determination of MPN Index:

Presumptive Test, Confirmation Test, Completed Test, Grams Staining Technique

7. Demonstration of Ambient air quality measurement using High Volume Sampler.

   Analysis – SPM, NO_x, RSPM, SO_x.

Course Outcomes (COs)

After completion of the course the student will :

- Use standard methods for assessment for water quality
- Use statistical principles to analyze and interpret laboratory results
- Communicate effectively either through written or oral

EECP 02 ENVIRONMENTAL ENGINEERING Lab – II (Practical)

P / week : 4Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

Wastewater and Solid waste Analysis

1. Determination of Total solids,Total suspended solids and Total Dissolved solids
2. Determination of settleable solids
3. Determination of BOD - Evaluation of Kinematic constants.
4. Determination of COD – Open Reflux Method, Block digester method, Colorimetric method and Titrimetric analysis.
5. Determination of Nitrates, TotalKjeldal Nitrogen, Ammonia and Nitrites.
6. Determination of Phosphates
5. Determination of Sulphates.
6. Demonstration of Rotating Biological Contactor
7. Analysis of Municipal Solid Waste – Component, Physical and Chemical Analysis.

Course Outcomes (COs)

After completion of the course the student will :

- Able to use standard methods to assess wastewater and municipal solid waste characteristics.
- Use effluent standards to analyze and interpret laboratory results
- Communicate effectively either through written or oral

II SEMESTER

EEPC03 ADVANCED WASTEWATER TREATMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

GENERAL:

CONSTITUENTS IN DOMESTIC WASTEWATER -BOD, COD, TOC, N AND P – biodegradability, nonbiodegradable organics and other inorganic. **TREATMENT PROCESS AND EFFLUENT DISPOSAL STANDARDS**. **PRIMARY TREATMENT**- Design of Screens, Grit chamber, Sedimentation tanks. **SUSPENDED GROWTH PROCESS:** Activated Sludge Process-ASP and its modifications,process design considerations, evaluation of Biokinetic parameter, Aeration, diffused aeration system.

UNIT – II

ATTACHED GROWTH PROCESS: Substrate removal in attached growth process-design of Trickling filter, rotating biological contactors.

PHOSPHOROUS REMOVAL: Biological phosphorus removal, chemical processes-chemical coagulation,precipitation and oxidation.Tracing phosphorous through treatment processes.

NITROGEN REMOVAL: Biological nitrification and denitrification, ammonia stripping, break point chlorination, and ion–exchange for ammonium (NH^{+}_{4}); Combined removal of nitrogen and phosphorus.Tracing nitrogen through treatment processes.

UNIT – III

ADVANCED PROCESSES:

Granular media filtration, micro screening, MSP like Reverse Osmosis, Electrodialysis, Ultra Filtration, Disinfection of waste water.

REMOVAL OF TOXIC COMPOUNDS AND REFRACTORY ORGANICS : Toxic and refractory organics – Detergents, PCB, phenol, Hydrogenated hydrocarbons, Pesticides and Aromatics. Removal by adsorption, chemical coagulation, Advanced Oxidation Process(AOP).

UNIT – IV
WASTE WATER RECYCLE, REUSE AND RECLAMATION

Ponds,Ditches,Lagoons,UASB,MBR,Constructed wetlands.Waste water Reuse Applications, Waste water Reclamation Technologies- Constituent Removal Technologies-Conventional waste water Treatment process flow diagrams for water Reclamation-Advanced waste water treatment process flow diagrams.

EMERGING CONTAMINANTS IN WASTE WATER- organic compounds and microorganism, Priority pollutants.

UNIT – V
WASTEWATER TREATMENT PLANT RESIDUE MANAGEMENT

Solids sources, characteristics and quantities-solid processing flow diagram-preliminary operations-Thickening-Digestion-condition-dewatering-Heat drying and composting-Thermal reduction-Reuse.

ENVIROMENTAL AND HYDRAULIC DESIGN OF WASTE WATER TREATMENT PLANTS

Stages of Design- data collection-site layout-Environmental and Hydraulic design.

Reference Books :

1. Metcalf and Eddy, Wastewater Engineering, Tata McGraw Hill Pub. Co.
2. M.J. Hammer, Water and Wastewater Technology, John Wiley and Sons.
3. Sincero Sr., A.P., and G.A.Sincero (1999), Environmental Engineering. A Design Approach Prentice-Hall of India Pvt. Ltd., New Delhi.

Course Outcomes (COs)

After completion of course student can able to

1. Identify and assess the characteristics of wastewater and hence impacts
2. Plan and design components of wastewater treatment plants
3. Understand the advanced process of wastewater treatment
4. Understand principles of wastewater reclamation and reuse
5. To manage sludge and do hydraulic design of wastewater treatment plant.

EEPC 04 MUNICIPAL SOLID WASTE MANAGEMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

GENERATION AND CHARACTERISTICS OF SOLID WASTE:

Goals and objectives of solid waste management; Impacts of solid waste generation in a technological society, quantities of solid wastes, elements of solid waste management system, conservation of resources.

Solid waste generation sources; classification of solid waste; data on Indian City wastes; factors influencing generation of solid wastes; components characterization and analysis of solid wastes.

UNIT – II

ONSITE HANDLING, STORAGE AND PROCESSING OF SOLID WASTE:

Public health and aesthetics, onsite handling, methods used at residential and commercial sources; onsite storage dust bins; community containers, container locations; onsite processing methods.

COLLECTION, TRANSFER AND TRANSPORT OF SOLIDWASTE

Collection services, Point collection; frequency of collection, equipment and labour requirements; collection routes, transport means and methods and location of transfer stations.

Design of transfer stations.

UNIT – III

PROCESSING OF SOLID WASTE

Purpose of processing; processing techniques-Mechanical and chemical volume reduction, size reduction, component separation, drying and dewatering.

PROCESSING AND RECOVERY: Thermalrecovery of products – Incineration,pyrolysis and recovery of by-products,Air requirements for combustion-Incineration types-Refuse derived fuels (RDF), biological process and recovery ofconversion products-Composting – static pile, windrow,Vermi composting.

UNIT – IV

DISPOSAL OF SOLID WASTES: Open dumping – problems associated with open dumping sanitary landfills - site selection –design of landfills - Gas and leachate collection and control, ocean disposal of solid wastes. Application of GIS in landfill.

MUNICIPAL SOLID WASTE MANAGEMENT HANDLING RULES (2010).

UNIT – V

HAZARDOUS WASTE MANAGEMENT: Identification and classification of Hazardous wastes, storage, collection and treatment of Hazardous wastes, hazardous waste management rules, Management of Hospital wastes, introduction to e-waste management.

Reference Books:

1. WHO publication SWM for developing countries by frank flintoff**.**

2. Bhide, A.D, and Sundaresan, B.B. (1983) Solid Waste Management in Developing Countries, INSDOC, New Delhi.

3. Tchobanglous, G., Theisen, H. and Ehasin, R. (1996). Solid Waste Engineering Principles and Management Issues - McGraw Hill, Tokyo.

Course Outcomes (COs)

After completion of course students are

1.Able to assess the physical and chemical characteristics of municipal solid waste

2. capable of understanding the elements of solid waste management system.

3. Able to apply different processing methods in the management of municipal solid waste

4. Able to plan and design sanitary landfills for municipal solid waste disposal.

5. Able to apply hazardous waste management rules in handling hazardous waste.

EEPE 31 INDUSTRIAL WASTEWATER TREATMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

INDUSTRIAL WASTE REGULATIONS

Industrial activity in India, Guidelines for siting of industries and industrial estates.Characteristics of industrial Wastewater.Differences between industrial wastes and domestic sewage.

IMPACT OF INDUSTRIAL WASTES ON ENVIRONMENT : Impact of acids and alkalies, suspended matter, organic matter (BOD), refractory organics, coloured matter, inorganic solids, heavy metals, foaming agents (detergents), nutrients, oil and greases, biological (pathogenic) wastes, thermal waters and nuclear wastes on the environment.

DISPOSAL STANDARDS OF DISTILLERY, TANNERY, PULP AND PAPER INDUSTRIES

UNIT – II

TREATMENT METHODOLOGY

Neutralization, Equalization, Proportioning, Sedimentation, Flotation , Screening, coagulation, Evaporation, Ion Exchange, Reverse Osmosis, Lagooning, High –rate aerobic treatment, Trickling filtration ,Rotating biological contactors,Anaerobic digestion system.

UNIT-III

OUTLINES OF MANUFACTURING PROCESSES, SOURCES, VOLUMES, CHARCTERISTICS, AND TREATMENT PROCESSES OF MAJOR INDUSTRIES:Sugarcane, distillery, tannery, pulp and paper mills, textile millindustry,fruit processing industry, steel plant industry

UNIT – IV

INDUSTRIAL WASTE MINIMIZATION PRACTICES:Volume reduction, strength reduction, process changes, equipment modifications, chemical substitution, segregation of wastes, equalization of wastes, by product recovery, proportioning wastes.

MANAGEMENT OF INDUSTRIAL SLUDGES: Sources of production of industrial sludges,anaerobic and aerobic digestion, vacuum filtration, elutriation, drying beds, Sludge Lagooning, wet combustion process, drying and incineration, centrifuging, sanitary landfill.

UNIT – V

CLEAN MANUFACTURE PROCESS-Basic concepts of clean technologies, Zero pollution industrial complexes, Introduction to ISO 14000,Life cycle Analysis, pollution pays policy, common effluent treatment plants.

Reference Books :

1. Nemerow, N.L. (1977). Liquid waste of Industry, Theories, Practices and Treatment, Addision-Wesly Publishing Company, London.
2. Mahajan, S.P. (1990). Pollution Control Processing Industries. Tata Mc–Graw – Hill Publishing Company Limited, New Delhi.
3. Rao, M.N.andA.K.Datta. (1979). Wastewater Treatment. Rational Methods of Design and Industrial Practices. Oxford and IBH Publishing Co., New Delhi.

Course Outcomes (COs)

1. Able to describe the concepts of industrial waste regulations.
2. Capable of applying the different preliminary, physical, chemical and biological treatment methods to the industrial waste water
3. Able to describe the characteristics of different types of industrial waste water,its manufacturing process and design units of treatment plant.
4. Capable of reducing the industrial waste and manage industrial sludge
5. Able to apply concepts of clean manufacturing process.

EEPE 32 URBAN WATER MANAGEMENT

L / week : 3Hrs	**Sessional Marks : 40**
University Exam : 3 Hrs	**End Exam Marks : 60**

UNIT-I

General introduction to urbanization and its effect on water cycle – urban hydrological cycle – trends in urbanisation – Effect of urbanisation on hydrology.

Urban Hydrological cycle – time of concentration – importance of short duration of rainfall and runoff data – methods of estimation of time of concentration for design of urban drainage systems.

UNIT-II

Master drainage plans – issues to be concentrated upon – typical content of an urban drainage master plan – interrelation between water resources investigation and urban planning processes – planning objectives – comprehensive planning – use of models in planning.

Basic approaches to urban drainage – runoff quantity and quality – wastewater and storm water reuse – major and minor systems.

UNIT-III

Elements of drainage systems – open channel – underground drains – appurtenances – pumping – source control. Storm water Analysis Calculation of runoff and peak – Design of storm water network systems.

UNIT-IV

Best Management Practices – Detention and retention facilities – Swales-constructed wetlands.

UNIT-V

Operation and maintenance of urban drainage system – interaction between storm water management and solid waste management, various model available for storm water management. Legal aspects

Readings:

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

3. Stahre P and Urbonas B , Stormwater Detention for Drainage, Water Quality and CSO Management, Prentice Hall, 1990

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

Course outcomes

After completion of course student can able to

1.Identify factors affecting urban hydrological cycle

2.Estimate urban water demand and urban storm water quantity

3. plan and design storm water control and disposal systems

4. develop integrated urban water management system

EEPE 33 HAZARDOUS WASTE MANAGEMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT- I

SOURCES, CLASSIFICATION AND REGULATORY FRAMEWORK

Types and Sources of hazardous wastes - Need for hazardous waste management ,Hazardous Wastes (Management and Handling) Rules, 1989

POLLUTION PREVENTION

Management strategies, TCLP, Life cycle analysis, volume reduction, toxicity reduction and recycling.

UNIT -II

PHYSICO CHEMICAL TREATMENT OF HAZARDOUS WASTE

Physico-chemical processes-air stripping, soil vapor extraction, carbon absorption, steam stripping, chemicaloxidation, supercritical fluids, membrane processes.

UNIT- III

BIOLOGICAL TREATMENT OF HAZARDOUS WASTE

Biological methods-Basic microbiology, engineeringfactors,growth kinetics, treatment systems ,conventional treatment, in situ bioremediation, slurry-phase treatment, solid-phase treatment, emerging technologies.

UNIT- IV

DISPOSAL METHODS

Thermal methods-regulations, combustion,liquid injection incinerators,solid waste incineration,storage and feed systems

Land disposal –landfill operation,siteselection,liner and leachate collection systems, cover systems,containment transport through landfill barriers,landfillstability,other types of land disposal facilities.

UNIT- V
CONTAINMENT

Objectives,passive contaminant control systems,surface water control technologies,ground water control,ground water control technologies,activesystems,other remedial measures.

REFERENCES:

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.
2. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and Environmental Resources Management, Hazardous waste Management, Mc-Graw Hill International edition, New York, 2001.
3. CPHEEO, "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2000.
4. Vesilind P.A., Worrell W and Reinhart, Solid waste Engineering, Thomson Learning Inc., Singapore, 2002.
5. Paul T Williams, Waste Treatment and Disposal, Wiley, 2005

OUTCOMES:

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

1. Understand the characteristics of different types of hazardous wastes and the factors affecting variation
2. To plan suitable management strategies to handle hazardous waste
3. Apply different treatment methods in the management of hazardous waste
4. Apply concepts of thermal techniques for hazardous disposal and design landfill
5. Understand different surface and ground water control technologies

EEPE 34 WASTEWATER RECLAMATION AND REUSE

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT - I

INTRODUCTION –The Role of Water Recycling in the Hydrological cycle, Wastewater Reuse Applications, Need for Water Reuse.

PUBLIC HEALTH AND ENVIRONMENTAL ISSUES IN WATER REUSE- Constituents in Reclaimed Water ,Public Health Issues, Environmental Issues, Environmental Issues.

UNIT - II

WASTEWATER RECLAMATION TECHNOLOGIES-Conventional wastewater Treatment process -Flow Diagrams for water Reclamation, Advanced Wastewater Treatment process flow diagrams, Performance expectations for water reclamation processes, Predicting the performance of Treatment process Combinations .

UNIT - III

STORAGE OF RECLAIMED WATER – Need for Storage, Meeting water quality discharge Requirements, Operations of Storage reservoirs, Problems involved with storage of Reclaimed Water.

AGRICULTURAL AND LANDSCAPE IRRIGATION EVALUATION OF IRRIGATION WATER QUALITY.

UNIT - IV

INDUSTRIAL WATER REUSE- Industrial water use, Cooling Tower Makeup water, water and salt balances in cooling Tower, Common water quality problems in cooling towers.

GROUND WATER RECHARGE WITH RECLAIMED WATER-Groundwater Recharge Methods, pretreatment Requirements for Groundwater Recharge ,Fate of Contaminants in Groundwater.

UNIT- V

PLANNED INDIRECT AND DIRECT POTABLE WATER REUSE-Planned Indirect Potable Water Reuse, Planned Direct Potable Water Reuse, Planned Potable Water Reuse Criteria.

CASE STUDIES IN WASTE WATER REUSE.

Reference:-

Metcalf and Eddy(2003), Wastewater Engineering Treatment and Reuse,Fourth Edition, Mc-Graw hill education.

Course Outcomes (COs)

After completion of course students are

1. Able to describe the applications of wastewater reuse and constituents in reclaimed water and its implications
2. Capable of planning and designing the advanced wastewater treatment processes.
3. Able to understand aspects of reclaimed water storage.
4. Capable of reusing industrial waste water to suitable applications
5. Capable of applying direct and Indirect Potable Water Reuse methods in the field

EEPE 41 ENVIRONMENTAL IMPACT ASSESSMENTS

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

INTRODUCTION:

Impact of Development on Environment and Environmental Impact Assessment (EIA) and Environmental Impact Statement (EIS) – Objectives – Historical development – EIA Types – EIA in Project cycle- capability and limitations- Legal provisions on EIA.

UNIT-II

METHODOLOGIES:

Elements of EIA – Process screening, Methods of EIA- Strengths, weaknesses and applicability – appropriate methodology.

UNIT-III

PREDICTION AND ASSESSMENT

Socio Economic Impact – Prediction and Assessment of Impact on land, water, air and noise energy impact; Impact on flora and fauna; Mathematical models for prediction; Public participation – Reports – Exchange of Information – Post Audit – rapid EIA.

UNIT-IV

ENVIRONMENTAL MANAGEMENT PLAN:

Plan for mitigation of adverse impact on environment - options for mitigation of impact on water, air and land, flora and fauna; Addressing the issues related to the Project Affected People – Environment management Plan

UNIT-V

LIFE CYCLE ANALYSIS

Elements of Life Cycle Assessment **(**LCA) – Life Cycle Costing – Eco Labelling – Design for the Environment – International Environmental Standards – ISO 14001.

ENVIRONMENTAL AUDIT:

Environmental Audit and Environmental legislation objectives of Environmental Audit,Types of environmental Audit, Audit protocol, stages of Environmental audit, onsite activities,evaluation of Audit data and preparation of Audit report.

TEXT BOOKS

1. Anjaneyulu, Y. Environmental Impact Assessmentmethodologies B.S. Publications, Hyderabad 2002.
2. Canter, R.L. Environmental Impact Assessment, McGraw Hill Inc., NewDelhi,1996.
3. S.K. Shukla and P.R. Srinivastava, Concepts in Environmental Impact Analysis, Common Wealth Publishers, New Delhi, 1992.
4. Environmental science and Engineering by j. Glynn and Gary W. Hein Ke-Prentice Hall Publishers.

REFERENCE BOOKS

1. John G.Rau and David C Hooten (Ed)**.,**Environmental Impact Analysis Hand book, McGraw Hill Book Company, 1990.
2. Environmental Assessment Source book, Vol. II and III. The World Bank, Washington, D.C., 1991.
3. Judith Petts, Handbook of Environmental Impact Assessment Vol.I and II. Blackwell Sciencce, New York, 1999.
4. Environmental science and Engineering, by Suresh K.Dhaneja-S.K., Katania and sons Publication., New Delhi.

5. Environmental pollution and control, by Dr. H. S. Bhatia - Galgotia Publication (P) Ltd, Delhi.
6. P. Modak, C. Visvanathan and M. Parasnis, Cleaner Production Audit, Environmental System Reviews, Asian Institute of Technology, Bangkok, 1995.

Course Outcomes

After completion of course student can able to

1. Understand various aspects of EIA
2. Identify suitable methodologies for EIA study
3. Predict and assess the impact on environment
4. Prepare EMP
5. Understand LCA methodology and Environmental audit.

EEPE 42 SUSTAINABLE ENGINEERING AND TECHNOLOGY

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

Unit I

ENERGY SOURCES

Introduction to energy, Environment and SustainableDevelopment; Energy transformation from source to services; Energy sources, sun as the sourceof energy; biological processes; photosynthesis; food chains, classification of energy sources,quality and concentration of energy sources; fossil fuel reserves - estimates, duration; theory of renewability, renewable resources; overview of global/ India's energy scenario.Non-renewable energy sources.

Unit II

ECOLOGICAL PRINCIPLES

Ecological principles, concept of ecosystems, ecosystem theories, energy resources and their inter-linkages, energy flow, the impacts of human activities on energy flow in major man-made ecosystems- agricultural, industrial and urban ecosystems.

Unit III

ENERGY SYSTEMS AND ENVIRONMENT

Environmental effects of energy extraction, conversion and use; sources of pollution from energy technologies (both renewable and non renewable); primary and secondary pollutants; consequence of pollution and population growth; air, water, soil, thermal, noise pollution -cause and effect; pollution control methods, sources and impacts; environmental laws on pollution control. Montrosal Protocol, Kyoto Protocol; Conference of Parties (COP); Clean Development Mechanism (CDM); Reducing Emissions from Deforestation and Degradation (REDD).

Unit IV

GREEN INNOVATION & SUSTAINABILITY

Criteria for choosing appropriate green energyTechnologies, life cycle cost; the emerging trends – process/product innovation-, technological/Environmental leap-frogging; Eco/green technologies for addressing the problems of Water,Energy, Health, Agriculture and Biodiversity- WEHAB (eco-restoration/ phyto-remediation,Ecological sanitation, renewable energy technologies, industrial ecology, agro ecology and other Appropriate green technologies); design for sustainability (D4S).

Unit V

GREEN ENERGY AND SUSTAINABLE DEVELOPMENT

The inseparable linkages of life supporting systems, 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); sustainable development.

References:

[1] Energy and EnvironmentSet: Mathematics of Decision Making, Loulou, Richard; Waaub, Jean-Philippe;Zaccour, Georges (Eds.), 2005, XVIII, 282 p. ISBN: 978-0-387-25351-0

[2] Energy and the Environment, 2nd Edition, John Wiley, 2006, ISBN:9780471172482; Authors: Ristinen, RobertA. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A., Publisher: Wiley, Location: New York, 2006.

[3] Energy and the Challenge of Sustainability, World Energy assessment, UNDP, N York, 2000.

[4] E H Thorndike, Energy & Environment: A Primer for Scientists and Engineers, Addison-Wesley PublishingCompany

[5] R Wilson & W J Jones, Energy, Ecology and the Environment, Academic Press Inc.

[6] D W Davis, Energy: Its Physical Impact on the Environment, John Wiley & Sons

[7] AKN Reddy, RH Williams, TB Johansson, Energy after Rio, Prospects and challenges, UNDP, United NationsPublications, New York, 1997.

[8] Global Energy Perspectives : Edited by NebojsaNakicenovic, ArnulfGrubler and Alan McDonald, CambridgeUniversity Press, 1998.

[9] Environment – A Policy Analysis for India, Tata McGraw Hill, 2000.Environmental Considerations in EnergyDevelopment, Asian Development Bank, Manila (1991).

[10] G. Masters (1991): Introduction to Environmental Engineering and Science, Prentice –Hall InternationalEditions.

[11] Fowler, J.M., Energy and the Environment, 2nd Ed. ,McGraw Hill, New York, 1984.

[12] Energy: Science, Policy, and the Pursuit of Sustainability by Robert Bent, ISBN13: 9781559639118, ISBN10:1559639113, 2002.

[13] New Approaches on Energy and the Environment: Policy Advice for the President, by Richard D. Morgenstern,ISBN13: 9781933115016, ISBN10: 1933115017, Publisher: Resources for the Future, Publication Date: February2005.

[14] http://unfccc.int/

[15] http://cdm.unfccc.int/

Course outcomes

After completion of course student can

1. Able to explain about the energy sources and sustainability
2. Able to understand the ecological principles
3. Capable of understanding consequences of pollution and its control methods.
4. Able to apply suitable the green energy systems
5. Capable of developing green sustainability

EEPE 43 BIOREMEDIATION

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

Fundamental Aspects Of Environmental Microbiology:

Structure and Functions of Procaryotic Cells -Structure and Functions of Eucaryotic Cells

Taxonomy of Microorganisms: Bacteria- Algae, Fungi and Protozoa -Study of Microbial Structure -Light Microscopy -Dark-field and Phase-contrast Microscopy -Electron Microscopy - Environmental Significance of Bacteria, Fungi, and Algae -Microbial Metabolism, Growth and Biokinetics - Microbial Nutrition and Metabolism - Microbial Growth and Energy - Enzymes and Their structures - Biokinetic Models - Batch and Continuous Chemostat Studies - Determination of Biokinetic Parameters

UNIT-II

Microbiology Reactions:

Suspended Growth Reactors - Biofilm Reactors - Batch Reactors - Completely Stirred Tank Reactors - Plug Flow Reactors - Reactors in Series - Engineering Design of Reactors

UNIT-III

Bioflim Processes:

Trickling Filters and Biological Towers -Rotating Biological Contactors - Granular Media Filters - Fluidized-bed Reactors -Hybrid Biofllm Processes

UNIT-IV

Bioremediation For Soil Environment:

Environment of Soil Microorganisms -Soil Organic Matter and Characteristics -Soil Microorganisms Association with Plants - Pesticides and Microorganisms -Petroleum Hydrocarbons and Microorganisms -Industrial solvents and Microorganisms -Biotechnologies for Ex-Situ Remediation of Soil - Biotechnologies for in-Situ Remediation of Soil - Phytoremediation Technology for Soil Decontamination

UNIT-V

Biotreatment of Metals:

Microbial Transformation of Metals -Biological Treatment Technologies for Metals Remediation - Bioleaching and Biobenificiation -Bioaccumulation -Oxidation/Reduction Processes -Biological Methylation -Case studies

Emerging Environmental Biotechnologies:

Phytoremediation -Sequestering Carbon Dioxide -Biomonitoring -Application of Microbial Enzymes -Biomembrane Reactors

Readings:

1. Ergas, S.J., Chang, D.P.Y., Schreoder, E.D., and Eweis J.B., Bioremediation Principles , WCB/McGraw-Hill, 1998

2. Rittmann, B.E., and McCarty, P.L., Environmental Biotechnology : Principles and Applications, McGraw Hill, 2001

Course outcomes:

After completion of course student can able to

1.understand the fundamentals of environmental microbiology

2.design process for enhancing biodegradation

3.apply principles of bioremediation of soil environment

4.describe biotreatment of metals

5.identify ethical, environmental,societal and safety issues related to bioremediation.

EEPE 44 ENVIRONMENTAL LEGISLATION

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT I

INTRODUCTION

Common environmental laws-Role of judiciary in environmental protection-criminal law,common law-criminal procedure code-Indian penal code-fundamental rights and fundamental duties-international and national efforts at environmental protection –green funding and taxes-national environmental policies

UNIT II

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.

UNIT III

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.

UNIT IV

ENVIRONMENT (PROTECTION) ACT 1986 Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting 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, authorisation – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

UNIT V

OTHER TOPICS

Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

ENVIRONMENTAL AUDIT:

Environmental Audit and Environmental legislation objectives of Environmental Audit,Types of environmental Audit, Audit protocol, stages of Environmental audit, onsite activities,evaluation of Audit data and preparation of Audit report.

REFERENCES

1. CPCB "Pollution Control acts, Rules and Notifications issued there under "Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997.

2. Shyam Divan and Armin Roseneranz "Environmental law and policy in India "Oxford University Press, New Delhi, 2001.

3. GregerI.Megregor "Environmental law and enforcement", Lewis Publishers, London.

4. A. Singh and O.P. Ward Biodegradation and bioremediation, Springer-Verlag Berlin Heidelberg New York, 2004.

5. K.H. Baker and D.S. Herson, Bioremediation, McGraw-Hill, Inc., New York, 1994.

6. M. Alexander, Biodegradation and Bioremediation, Academic Press, 1999.

Course Outcomes:

After completion of course students are able to

1. Apply the different environmental laws and penal codes for environmental protection.
2. To take steps for the control of water pollution
3. Understand the salient features of air act
4. Describe the salient features of environmental act
5. Understand the salient features of Indian forest act, public liability act , public interest litigations and audit.

EECP 03 ENVIRONMENTAL MODELLING LABORATORY

P / week : 4Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

Design of water supply pipe sections and networks using Software packages like EPANET – Design of Wastewater collection systems, integrated design of water and wastewater treatment plants by using appropriate free domain software packages. Modeling of Air pollutant dispersion using softwares.

Course Outcomes (COs)

1.Able to apply the application of computing techniques in the environmental engineering field.

2. capable of designing the water supply pipe sections and treatment plants using software packages

3. Able to do Modeling of air pollutant dispersion using software packages.

EECP 04 UNIT OPERATIONS AND PROCESSES LABORATORY

P / week : 4Hrs	**Sessional Marks : 40**
University Exam : 3 Hrs	**End Exam Marks : 60**

LIST OF EXPERIMENTS

1. Jar test
2. Sedimentation column analysis
3. Studies on Filtration
4. Adsorption Studies
5. Adsorption studies/Kinetics
6. Activated sludge process
7. Trickling filter
8. Anaerobic Reactor systems (Demonstration)
9. Disinfection for Drinking water

REFERENCES:

1. Metcalf and Eddy. Inc. „Wastewater Engineering, Treatment, Disposal and Reuse, Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
2. Lee, C.C. and Shun dar Lin. Handbook of Environmental Engineering Calculations, McGraw Hill, New York, 1999.
3. Casey T.J., Unit Treatment Processes in Water and Wastewater Engineering, John Wileys Sons, London, 1993.
4. David W.Hendricks, „Water Treatment Unit Processes: Physical and Chemical", CRC Press, Boca Raton, 2006.

Course Outcome:

1. Able to conduct Treatability studies of water and wastewater treatment by various Unit Operations and Processes using laboratory scale models

EEPE51 CLEAN TECHNOLOGY

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

INTRODUCTION

Industrial Society- an overview; Resource Limitations - forests, water, air, soil, material resources; Environmental Problems - local problems such as population, energy, water, pollution etc, global problems such as global warming, climate change, ozone layer depletion, green house effect etc.

Sustainable development - principles, environmental, economic and social dimensions of sustainable development by focusing on changing patterns of consumption, production and distribution resources.

UNIT-II

Thermodynamics

Definitions; Earth as a thermodynamic system; Thermodynamics of the technosystem; Thermodynamics and energy in society; Thermodynamics and environmental pollution; Towards a thermodynamically sustainable development.

UNIT-III

Energy :

The global energy situation; The energy system; Fossil energy, fuel cells; Renewable energy- biomass, photovoltaic, solar thermal, wind energy, future of renewable energy production, fusion; Net energy analysis- energy breeders

Engineering :

Separation, supercritical extraction, membranes, reverse osmosis, ultrafiltration, electrodialysis, pervaporation, liquid membranes, adsorption, parametric pumping, biosorbents; Process development, centralization/decentralization/integration, engineering; photochemistry; Thermochemistry; Energy saving; Energy storage

UNIT-IV

Industrial And Hazardous Waste

Industrial waste types, characteristics of industrial wastes, pollution from major industries, effects of industrial effluents, cleaner production, treatment technologies; Hazardous wastes definition, sources of hazardous waste, transportation, - treatment and disposal methods and processes

UNIT-V

System Analysis, Materials & Products

Flexible processes; Ecodesign; Material recycling; Biodegradable materials - degradation mechanisms, test methods, structural factors influencing biodegradability, microbial polymers, other natural polymers, synthetic and decomposable polymers, mixtures of decomposable and non-decomposable materials.

Course Outcomes:

After completion of course student can able to

1. Apply concepts of thermodynamics in arriving at clean technologies
2. Plan engineered conditions for improved waste management
3. Design hazardous waste treatment disposal options

Readings:

1. Allan Johansson, Clean Technology, 1st edition CRC Press, 1992

2. Aswathanarayana U., Harikrishnan T., and Kadher-Mohien S. T.**,** Green Energy Technology, Economics and Policy, CRC Press, 2012

3. Bernard Ganne and Yveline Lecler, Pollution Prevention Handbook, CRC Press, 1995

4. T.T.Shen, Industrial Pollution Prevention, Springer, 1999.

5. Blackman, William C. Basic hazardous waste management, 3rd edition, CRC Press, 2001

EEPE52 MATHEMATICAL MODELLING IN ENVIRONMENTAL ENGINEERING

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT – I

INTRODUCTION : Components of Environment. Necessity of mathematical models in Environmental Engineering.Mass-Volume relationships.Engineering dimensions and units.Approximations in engineering calculations.Information analysis.

FILTRATION: Mathematical models in filters for prediction of head loss and back expansion during back washing**.**

.**UNIT – II**

REACTIONS : Zero-order, first-order, second-order and non-integer-order reactions. Half-life reactions and consecutive reactions.

REACTORS : Mixing models and reactor models - Mixed batch reactors, plug flow reactors, completely-mixed flow reactors in parallel and series and Arbitrary flow reactors.

UNIT – III

SURFACE WATER QUALITY MODELLING : Mathematical models for water quality - model development, calibration and verification , Model requirements and limitations. D.O. Models for Streams: sources and sinks of dissolved oxygen - estimation of system parameters - Streeter - Phelps model - oxygen 'sag' curve - determination of deoxygenating and reaeration coefficients - Benthal oxygen demand - mass transport mechanisms - Advective and diffusive mass transport - Models by O'connor, Dobbins and Thomann. Models for Estuary and Lakes.

SUBSURFACE WATER QUALITY MODELS : Groundwater and vadose zone water quality modelling.

UNIT – IV

AIR QUALITY MODELLING: Micrometeorological processes, wind rose, dispersion, coefficients and stability classes, Gaussian and dispersion model, Stack height computation, Regional air quality models, Source inventories and significance.

NOISE QUALITY MODELS: Simple noise quality models for point and non-point sources.

UNIT – V.

SOLID WASTE MANAGEMENT: Macro and Micro Routing-Heuristic- Models for the prediction of optimal routes for solid waste disposal.

Reference Books:

1. Gilbert M. Masters(1997), Introduction to Environmental Engineering and Science,second edition, Prentice-Hall of India, New Delhi

2. Nemerow,Stream sanitation.

Course Outcomes (COs)

After completion of course students are

1. Capable of describing the importance of mathematical models in environmental engineering.
2. Able to use suitable reactions for modeling reaction kinetics.
3. Capable of applying suitable mathematical modeling in the assessment of surface and sub surface water quality.
4. Able to apply suitable mathematical model in the prediction of air and noise pollution based on requirements.
5. Capable of applying Models for the prediction of optimal routes for solid waste disposal.

EEPE 53 ENVIRONMENTAL MANAGEMENT

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

Environmental Management Standards :

Development, trade and environment linkages – Environmental guidelines – Business and Citizen Charters for Sustainable Production and Consumption - National policies on environment, abatement of pollution and conservation of resources - Environmental quality objectives – Environmental standards - Concentration and Mass standards- Effluent and stream standards – Emission and ambient standards -Minimum national standards - Measuring performance evaluation: Indicators, Benchmarking - Systems approach to environmental management

UNIT-II

Preventive Environmental Management:

Pollution control vis a vis Pollution Prevention - Opportunities and Barriers – Cleaner production and Clean technology, closing the loops, zero discharge technologies - source reduction, raw material substitution, toxic use reduction and elimination, process modification – Cleaner Production Assessment- Material or resource balance – CP option generation and feasibility analysis

UNIT-III

Environmental Management System:

EMAS, ISO 14000 - EMS as per ISO 14001– benefits and barriers of EMS – Concept of continual improvement and pollution prevention - environmental policy – initial environmental review – aspect and impact analysis – legal and other requirements- objectives and targets – environmental management programs – structure and responsibility – training awareness and competence-communication – documentation and document control – operational control – monitoring and measurement – management review.

UNIT-IV

Environmental Audit And Applications:

Environmental management system audits 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 - Due diligence audit -Applications of EMS .

UNIT-V

Waste audits in Industries : Waste Audits and Pollution Prevention opportunities in Textile , Sugar, Pulp & Paper, Electroplating, Mining, petroleum refining, Tanning industry, Dairy, Cement, Chemical industries, etc.

Readings:

1. Hillary, R., Environmental Management Systems and Cleaner Production, Wiley Publishers, 1997

2. Christopher Sheldon and Mark Yoxon, Installing Environmental management Systems – a step by step guide, Earthscan Publications Ltd, London, 1999

3. ISO 14001/14004: Environmental management systems – Requirements and Guidelines – International Organisation for Standardisation, 2004

4. Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations, Second Edition, NSF International, Ann Arbor, Michigan, January 2001

Course Outcomes:

After completion of course student can able to

1. Identify the complex environmental issues and their impact on business and industry
2. Specify strategies and polices used to promote cleaner production in industry
3. Describe criteria and process for implementing environmental management systems
4. Understand different environmental audits
5. Carry waste audits in industries

EEPE 54 CLIMATE CHANGE

L / week : 4Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

Earth's Climate System: Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes – The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation –The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.

UNIT-II

Observed Changes And Its Causes: Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC –Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.

UNIT-III

Impacts Of Climate Change: Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions– Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

UNIT-IV

Climate Change Adaptation And Mitigation Measures: Adaptation Strategy/Options in various sectors – Water – Agriculture –- Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS)- Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

UNIT-V

Clean Technology And Energy: Clean Development Mechanism –Carbon Trading- examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding.

Readings:

1. Anil Markandya , Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002

2. Heal, G. M., Interpreting Sustainability, in Sustainability: Dynamics and Uncertainty, Kluwer Academic Publ., 1998

3. Jepma, C.J., and Munasinghe, M., Climate Change Policy – Facts, Issues and Analysis, Cambridge University Press, 1998

4. Munasinghe, M., Sustainable Energy Development: Issues and Policy in Energy, Environment and Economy: Asian Perspective, Kleindorfor P. R. et. al (ed.), Edward Elgar, 1996

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

Course outcomes:

After completion of course student can able to

1. Identify factors influencing the global climate systems
2. Assess impacts of climate change on global, regional and local scales
3. Describe impacts of climate change on different sectors
4. Develop strategies for adaptation and mitigation measures
5. Identify clean technologies for sustainable development.

PGMC 41 RESEARCH METHODOLOGY AND IPR

Instruction Hours/week : 2(L) **Credits : 2**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT II

Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT V

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition , “Research Methodology: A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall , “Industrial Design”, McGraw Hill, 1992.
6. Niebel , “Product Design”, McGraw Hill, 1974.
7. Asimov , “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New
9. Technological Age”, 2016.
10. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes:

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understand that when IPR would take such important place in growth of individuals & Nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

OPEN ELECTIVES

EEOE 11 BUSINESS ANALYTICS

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT I

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT II

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics technology.

UNIT III

Organization Structures of Business analytics, Team management, Management Issues, designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear optimization.

UNIT IV

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT V

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

References:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Course outcomes:

At the end of the course, students will demonstrate

1. The knowledge of data analytics.
2. The ability of think critically in making decisions based on data and deep analytics.
3. The ability to use technical skills in predicative and prescriptive Modeling to support business decision-making.
4. The ability to translate data into clear, actionable insights.

EEOE 12 INDUSTRIAL SAFETY

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination: 60**

UNIT I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in achine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

References:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course outcomes:

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

1. understand the preventive steps for industrial safety
2. apply the corrosion prevention methods
3. find the causes and tracking of faults in machine tools and equipment
4. understand the periodic and preventive maintenance of mechanical and electrical equipment

EEOE 13 OPERATIONS RESEARCH

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT II

Formulation of a LPP - Graphical solution revised simplex method- duality theory - dual Simplex method - sensitivity analysis - parametric programming

UNIT III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

UNIT IV

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Course Outcomes:

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

1. apply the dynamic programming to solve problems of discreet and continuous variables.
2. apply the concept of non-linear programming
3. carry out sensitivity analysis
4. model the real world problem and simulate it.

EEOE 14 COST MANAGEMENT OF ENGINEERING PROJECTS

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT I

Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT II

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents, Project team: Role of each member. Importance Project site: Data required with significance.

UNIT III

Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning,

UNIT IV

Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT V

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Course outcomes:

At the end of the course, students will be able to
1. understand the cost concepts in decision - making
2. commission, execute and manage Engineering projects
3. apply the quality management techniques in the execution of projects
4. apply the quantitative techniques for cost management of projects

EEOE 15 COMPOSITE MATERIALS

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT–I:

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II:

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III:

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V:

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

References:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials – K.K.Chawla.
5. Composite Materials Science and Applications – Deborah D.L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Course outcomes:

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

1. demonstrate the characteristics of composite materials and composite performance
2. understand the use of fibres as reinforcement
3. understand the manufacturing process of metal and polymer matrix composites
4. demonstrate the failure criteria

EEOE 16 ENERGY GENERATION FROM WASTES

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, design, construction and operation - Operation of all the above biomass combustors.

UNIT V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion biomass

gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course outcomes :

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

1.demonstrate the energy generation from wastes

2. understand the biomass pyrolysis and gasification

3. design, construct and operate biomass combustors

4. develop bio-energy system

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

M.Tech Degree Program (CBCS)

Curriculum & Syllabi for Geotechnical Engineering

(w.e.f 2018-19)

MAY, 2018

PROGRAMME OBJECTIVES

1. To make students learn the principles of soil and rock mechanics. Understand different problems Associated with geotechnical engineering. Explain how to select design soil/rock parameters for Design purpose based on the subsurface exploration. Develop Analysis and Design procedure for Various geotechnical structures.
2. Students should gain competency in the design of shallow/deep foundations, earth retaining Structures, embankment and earthen dams, underground structures. Can assess stability of slopes and apply preventive measures for stability.

PROGRAMME OUTCOMES (POs)

1. Students will learn soil and rock behavior. Students will be able to perform various laboratory and in-situ tests on soil/rock to find out design parameters.
2. Students can design shallow/deep foundations, earth retaining structures, embankment and earthen dams, tunnel support systems for given site conditions.
3. Student can compute factor of safety to assess stability of slopes and apply preventive measures for stability.
4. Student can develop numerical models to estimate response of various geotechnical structures under different loadings.

M. Tech (GEOTECHNICAL ENGINEERING) – I Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Program Core									
GTPC01	Advanced Soil Mechanics	3	-	-	3	3	40	60	100
GTPC02	Advanced Foundation Engineering	3	-	-	3	3	40	60	100
Program Elective- I Any One from the Following		3	-	-	3	3	40	60	100
GTPE11	Soil Structure Interaction								
GTPE12	Ground Improvement Techniques								
GTPE13	Pavement Analysis and Design								
Program Elective- II Any One from the Following		3	-	-	3	3	40	60	100
GTPE21	FEM in Geomechanics								
GTPE22	Environmental Geotechnology								
GTPE23	Critical State Soil Mechanics								
Program Practicals									
GTCP01	Geotechnical Engineering Lab - 1	-	-	4	4	2	40	60	100
GTCP02	Geotechnical Engineering Lab - 2	-	-	4	4	2	40	60	100
Audit Course-I		2	-	-	2	-	100	-	100
PGPA11	English for Research Paper Writing								
PGPA12	Disaster Management								
PGPA13	Sanskrit for Technical Knowledge								
PGPA14	Value Education								
Mandatory Course									
PGMC01	Research Methodology and IPR	2	-	-	2	2	40	60	100
	Total	16	-	8	24	18	380	420	800

M. Tech (GEOTECHNICAL ENGINEERING) – II Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Program Core									
GTPC03	Dynamics of soils and foundations	3	-	-	3	3	40	60	100
GTPC04	Subsurface investigations and instrumentation	3	-	-	3	3	40	60	100
Program Elective- III Any One from the Following		3	-	-	3	3	40	60	100
GTPE31	Offshore Geotechnical Engineering / Marine Geotechniques								
GTPE32	Computational Geomechanics								
GTPE33	3. Engineering rock mechanics								
Program Elective- IV Any One from the Following		3	-	-	3	3	40	60	100
GTPE41	Earth Retaining Structures								
GTPE42	Design of underground excavations								
GTPE43	Physical and Constitutive Modelling in Geomechanics								
Program Practicals									
GTCP03	Sub soil exploration	-	-	4	4	2	40	60	100
GTCP04	Numerical Analysis Lab	-	-	4	4	2	40	60	100
Audit Course-II		2	-	-	2	-	100	-	100
PGPA21	Constitution Of India								
PGPA22	Pedagogy Studies								
PGPA23	Stress Management By Yoga								
PGPA24	Personality Development Through Life Enlightenment Skills								
Mini Project									
GTMP01	Mini Project with Seminar	-	-	4	4	2	100	-	100
	Total	14	-	12	26	18	440	360	800

M. Tech (GEOTECHNICAL ENGINEERING) – III Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Program Elective- V Any One from the Following		3	-	-	3	3	40	60	100
GTPE51	Stability analysis of slopes								
GTPE52	Foundations on weak rocks								
GTPE53	Geotechnical earthquake engineering								
Open Elective Any One from the Following		3	-	-	3	3	40	60	100
GTOE11	Business Analytics								
GTOE12	Industrial Safety								
GTOE13	Operations Research								
GTOE14	Cost Management of Engineering Projects								
GTOE15	Composite Materials								
GTOE16	Energy Generation from Waste								
Dissertation									
GTPD01	Dissertation- Phase-I	--	-	20	20	10	100	-	100
Total		6	-	20	26	16	180	120	300

M. Tech (GEOTECHNICAL ENGINEERING) – IV Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Dissertation									
GTPD02	Dissertation - Phase-II	-	-	32	32	16	40	60	100
Total		-	-	32	32	16	40	60	100

GTPC01 ADVANCED SOIL MECHANICS

L / week	**: 3Hrs**	**Sessional Marks**	**: 40**
University Exam	**: 3 Hrs**	**End Exam Marks**	**: 60**

UNIT I

COMPRESSIBILITY OF SOILS consolidation theory (one, two, and three dimensional consolidation theories), consolidation in layered soil and consolidation for time dependent loading, determination of coefficient of consolidation (Casagrande method and Taylors method)

UNIT II

STRENGTH BEHAVIOR OF SOILS Mohr Circle of Stress; UU, CU, CD tests, drained and undrained behavior of sand and clay, significance of pore pressure parameters; determination of shear strength of soil; Interpretation of triaxial test results.

UNIT III

STRESS PATH Drained and undrained stress path; Stress path with respect to different initial state of the soil; Stress path for different practical situations.

UNIT IV

CRITICAL STATE SOIL MECHANICS Critical state parameters; Critical state for normally consolidated and over consolidated soil; Significance of Roscoe and Hvorslev state boundary surface; drained and undrained plane. Critical void ratio; effect of dilation in sands; different dilation models.

UNIT V

ELASTIC AND PLASTIC DEFORMATIONS elastic wall; introduction to yielding and hardening; yield curve and yield surface, associated and non-associated flow rule.

References

1. Atkinson, J.H. and Bransby, P.L, The Mechanics of Soils: An introduction to Critical Soil Mechanics, McGraw Hill, 1978.

2. Atkinson J.H, An introduction to the Mechanics of soils and Foundation, McGraw- Hill Co., 1993.
3. Das, B.M., Advanced Soil Mechanics, Taylor and Francis, 2nd Edition, 1997.
4. Wood, D.M., Soil Behavior and Critical State Soil Mechanics, Cambridge University Press, 1990.
5. Craig, R.F., Soil Mechanics, Van Nostrand Reinhold Co. Ltd., 1987.
6. Terzaghi, K., and Peck, R.B., Soil Mechanics in Engineering Practice, John Wiley & Sons, 1967.
7. Lambe, T.W. and Whitman, R.V., Soil Mechanics, John Wiley & Sons, 1979.

Course Outcomes

1. The students obtain the complete knowledge on Strength and Compressibilty of soil mass of soil mass.
2. To learn importance of stress paths on strength Characteristics.
3. The students are able to develop mathematical models for solving different problems in soil mechanics using critical state frame work.

GTPC02 ADVANCED FOUNDATION ENGINEERING

L / week	**: 3Hrs**	**Sessional Marks**	**: 40**
University Exam	**: 3 Hrs**	**End Exam Marks**	**: 60**

UNIT I

SHALLOW FOUNDATIONS Requirements For Satisfactory Performance Of Foundations, Methods Of Estimating Bearing Capacity, Settlements Of Footings And Rafts, Proportioning Of Foundations Using Field Test Data, IS Codes.

UNIT II

PILE FOUNDATIONS Methods Of Estimating Load Transfer Of Piles, Settlements Of Pile Foundations, Pile Group Capacity And Settlement, Negative Skin Friction Of Piles, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation Of Load- Settlement Behavior Of Piles, Proportioning Of Pile Foundations, Lateral And Uplift Capacity Of Piles.

UNIT III

WELL FOUNDATION IS and IRC codal provisions, elastic theory and ultimate resistance methods

UNIT IV

FOUNDATIONS ON PROBLEMATIC SOILS Foundations for collapsible and expansive soils

UNIT V

COFFER DAMS Various Types, Analysis And Design Foundations.

References

1. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997.
2. Das B.M., Shallow Foundations: Bearing capacity and settlement, CRC Press, 1999.
3. Tomlinson M.J., Pile design and construction Practice, Chapman and Hall Publication, 1994.
4. Poulos, H. G. and Davis, F. H., "Pile Foundation Analysis and Design", Wiley and Sons. 1980

Course Outcomes

1. The students will be able to analyse and proportion shallow foundation.
2. To learn load transfer mechanisms and proportioning of deep foundations.
3. To comprehence design aspects of foundations in problematic soils
4. The students will be able to assess the type of foundations to be recommended for construction design of coffer dams.

GTPE11 SOIL STRUCTURE INTERACTIONS

L / week	**: 3Hrs**	**Sessional Marks**	**: 40**
University Exam	**: 3 Hrs**	**End Exam Marks**	**: 60**

.

UNIT I: Soil-Foundation Interaction: Introduction to soil-foundation interaction problems, Soil behavior, Foundation behavior, Interface behavior, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behavior, Time dependent behavior.

UNIT II: Beam on Elastic Foundation- Soil Models: Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.

UNIT III: Plate on Elastic Medium: Thin and thick plates, Analysis of finite plates, Numerical analysis of finite plates, simple solutions.

UNIT IV: Elastic Analysis of Pile: Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.

UNIT V: Laterally Loaded Pile: Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis.

References

1. Selvadurai, A.P.S, Elastic Analysis of Soil-Foundation Interaction, Elsevier, 1979.
2. Poulos, H.G.,and Davis, E.H.,Pile Foundation Analysis and Design, John Wiley, 1980.
3. Scott, R.F., Foundation Analysis, Prentice Hall, 1981.
4. Structure Soil Interaction-State of Art Report, Institution of Structural Engineers,
5. ACI 336. (1988), Suggested Analysis and Design Procedures for combined footings and Mats, American Concrete Institute.

Course Outcomes

1. The student is exposed to soil foundation interaction behavior
2. The student learns analysis of structures using soils modeling soil as elastic half space and descretes springs.
3. The student will be able to analyse settlements and load distributions in piles and pile groups subjected to vertical and lateral loads.

GTPE12 GROUND IMPROVEMENT TECHNIQUES

L / week : 3Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT I

INTRODUCTION: situations Where Ground Improvement Becomes Necessary

MECHANICAL MODIFICATION: Dynamic Compaction, Impact Loading, Compaction By Blasting, Vibro-Compaction; Pre-Compression, Stone Columns; Hydraulic Modification: Dewatering Systems, Preloading And Vertical Drains, Electro-Kinetic Dewatering

UNIT II

CHEMICAL MODIFICATION; Modification By Admixtures, Stabilization Using Industrial Wastes, Grouting

UNIT III

THERMAL MODIFICATION: Ground Freezing And Thawing.

UNIT IV

SOIL REINFORCEMENT: Reinforced Earth, Basic Mechanism, Type Of Reinforcements, Selection Of Stabilization/Improvement Of Ground Using Geotextiles, Goegrid, Geomembranes, Geocells, Geonets, And Soil Nails.

UNIT V

APPLICATION OF SOIL REINFORCEMENT: shallow foundations on reinforced earth, design of reinforced earth retaining walls, reinforced earth embankments structures, wall with reinforced backfill, analysis and design of shallow foundations on reinforced earth, road designs with geosynthetics.

References

1. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw-Hill
2. International Editions, 1990.
3. Yonekura, R., Terashi, M. and Shibazaki, M. (Eds.), Grouting and Deep Mixing, A.A. Balkema, 1966.
4. Moseley, M.P., Ground Improvement, Blackie Academic & Professional, 1993.
5. Xanthakos, P.P., Abramson, L.W. and Bruce, D.A., Ground Control and Improvement, John Wiley & Sons, 1994.
6. Koerner, R. M., Designing with Geosynthetics, Prentice Hall Inc. 1998.
7. Shukla, S.K., Yin, Jian-Hua, “Fundamentals of Geosynthetic Engineering”, Taylor & Francis.

Course Outcomes

1. Assess the site or ground conditions and judge for adopting ground improvement techniques for a particular structure and site conditions.
2. Select suitable compaction techniques or stabilization methods for improving engineering properties of soils in shallow layers.
3. To modify ground conditions by freezing and thermal methods.
4. Select suitable reinforced earth methods for stabilizing soils in retaining walls and slopes.

GTPE13 PAVEMENT ANALYSIS AND DESIGN

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Philosophy of design of flexible and rigid pavements,

UNIT II

Analysis of pavements using different analytical methods,

UNIT III

Selection of pavement design input parameters – traffic loading and volume,

UNIT IV

Material characterization, drainage, failure criteria, reliability,

UNIT V

Design of flexible and rigid pavements using different methods, Comparison of different pavement design approaches, design of overlays and drainage system.

References:

1. Yang and H. Huang, Pavement Analysis and Design, Pearson Prentice Hall, 2004.
2. Yoder and Witzech, Pavement Design, McGraw-Hill, 1982.
3. Sharma and Sharma, Principles and Practice of Highway Engg., Asia Publishing House, 1980.
4. Teng, Functional Designing of Pavements, McGraw- Hill, 1980.

Course Outcomes (COs)

The students will be able to

1. Assess the factors affecting the performance of pavements.
2. Identifying failure criteria and design flexible and rigid pavements.
3. Compare and select suitable pavement design approaches, overlays, and design aspects.

GTPE22 ENVIRONMENTAL GEOTECHNOLOGY

L / week	**: 3Hrs**	**Sessional Marks**	**: 40**
University Exam	**: 3 Hrs**	**End Exam Marks**	**: 60**

UNIT I

SOIL AS A MULTIPHASE SYSTEM; Soil-environment interaction; Properties of water in relation to the porous media; Water cycle with special reference to soil medium.

UNIT II

SOIL MINERALOGY; significance of mineralogy in determining soil behavior; Mineralogical characterization.

UNIT III

MECHANISMS OF SOIL-WATER INTERACTION: Diffuse double layer models; Force of attraction and repulsion; Soil-water-contaminant interaction; Theories of ion exchange; Influence of organic and inorganic chemical interaction.

UNIT IV

CONCEPTS OF WASTE CONTAINMENT; Sources, production and classification of wastes, Environmental laws and regulations, physico-chemical properties of soil, ground water flow and contaminant transport, desirable properties of soil; contaminant transport and retention; contaminated site remediation.

UNIT V

SOIL CHARACTERIZATION TECHNIQUES; volumetric water content; gas permeation in soil; electrical and thermal properties; pore-size distribution; contaminant analysis. contaminated site characterization, estimation of landfill quantities, landfill site location, design of various landfill components such as liners, covers, leachate collection and removal, gas generation and management, ground water monitoring, end uses of landfill sites,

References

1. Mitchell, J.K and Soga, K., Fundamentals of Soil Behavior, John Wiley and Sons Inc., 2005.
2. Fang, H-Y., Introduction to Environmental Geotechnology, CRC Press,1997.
3. Daniel, D.E, Geotechnical Practice for Waste Disposal, Chapman and Hall, 1993.
4. Rowe, R.K., Quigley, R.M. and Booker, J.R., Clay Barrier Systems for Waste Disposal Facilities, E & FN Spon, 1995.
5. Rowe, R.K, Geotechnical and Geoenvironmental Engineering Handbook, Kluwer
6. Academic Publishers, 2001.
7. Reddi, L.N. and Inyang, H.F, Geoenvironmental Engineering - Principles and Applications, Marcel Dekker Inc, 2000.
8. Sharma, H.D. and Lewis, S.P, Waste Containment Systems, Waste Stabilization and Landfills: Design and Evaluation, John Wiley & Sons Inc., 1994.

Course Outcomes

1. Students can understand Soil-environment interaction, Soil mineralogy and
2. Mechanisms of soil-water interaction
3. Students can lean ground water flow and predict contaminant transport phenomenon.
4. Can apply remediation techniques for contaminated site.

GTPE23 CRITICAL STATE SOIL MECHANICS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

SOIL BEHAVIOR: State of stress and strain in soils, Stress and strain paths and invariants, behavior of soils under different laboratory experiments.

UNIT II

THE CRITICAL STATE LINE and the Roscoe surface: Families of undrained tests, Families of drained tests, the critical state line, drained and undrained surfaces, The Roscoe surface.

UNIT III

BEHAVIOR OF OVER CONSOLIDATED SAMPLES: The Hvorslev surface: Behavior of Over consolidated samples, drained and undrained tests, The Hvorslev surface, complete State Boundary Surface, Volume changes and pore water pressure changes.

UNIT IV

BEHAVIOUR OF SANDS: The critical state line for sands, Normalized plots, the effect of dilation, Consequences of Taylor's model.

UNIT V

BEHAVIOR OF SOILS BEFORE FAILURE: Elastic and plastic deformations, Plasticity theory, Development of elastic-plastic model based on critical state soil mechanics, The Cam-clay model, The modified Cam-clay model.

References:

1. J. H. Atkinson and P. L. Bransby, “The mechanics of soils: An introduction to
2. critical state soil mechanics”, McGraw Hill, 1978.
3. D. M. Wood, “Soil behaviour and critical state soil mechanics”, Cambridge University Press, 1990
4. B. M. Das, “Fundamental of geotechnical engineering”, Cengage Learning, 2013

Course Outcomes

The students will be able to :

1. Acquire fundamentals concept of Stresses and Strains and their states in soils.
2. Comprehend the critical state line and the Roscoe surface.
3. Gain knowledge on Cam-Clay model for analyzing the the plastic behaviour of soils before failure.
4. Familiarize with the Development of constitutive laws for geotechnical materials including linear or nonlinear elastic (hyperbolic), linear elastic perfectly plastic, and non-linear elastic-plastic models based on the Critical State Soil Mechanics theory.

GTCP01 GEOTECHNICAL ENGINEERING LAB - 1

Practicals / week	**:**	**4Hrs**	**Sessional Marks : 40**
University Exam	**:**	**3 Hrs**	**End Exam Marks : 60**

LIST OF PRACTICAL'S:

1. Determination of Moisture Content and Specific gravity of soil

2. Grain Size Distribution Analysis and Hydrometer Analysis

3. Atterberg Limits (Liquid Limit, Plastic limit, Shrinkage limit)

4. Visual Classification Tests

5. Vibration test for relative density of sand iclusive of in-situ density test.

6. Standard and modified proctor compaction test

7. Falling head permeability test and Constant head permeability test

8. Consolidation test.

Course Outcomes (COs):

The students will be able to:

1. Determine all Index Properties for Cohesive and Cohsionless Soils
2. Determine Density Index for Cohesionless Soils.
3. Determine Compaction Characteristics for Cohesive Soils
4. Determine Permeablity Characteristics for Cohesive and Cohesionless Soils.

GTCP02 GEOTECHNICAL ENGINEERING LAB - 2

Practicals / week :	**4Hrs**	**Sessional Marks**	**: 40**
University Exam :	**3 Hrs**	**End Exam Marks**	**: 60**

LIST OF PRACTICALS

1. Unconfined compression test
2. Direct shear test
3. Tri-axial compression test – UU, CU, CD tests
4. Laboratory vane shear test
5. Swelling Characteristics (Swell Pressure, Swell Potentiol and swelling Index) by Free-Swell Odo-Meter method.
6. Swelling Characteristics by Constant Volume Method.

Course Outcomes (COs):

The students will be able to:

1. Determine Unconfined Compressive Stress for Cohesive Soils.
2. Determine shear parameter for Cohesionless Soils.
3. Dertermine Swelling Characeristics by different methods.

GTPC41 - RESEARCH METHODOLOGY AND IPR

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT 1

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT 2

Effective literature studies approaches, analysis Plagiarism, Research ethics.

UNIT 3

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT 4

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT 5

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT 6

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition , “Research Methodology: A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall , “Industrial Design”, McGraw Hill, 1992.
6. Niebel , “Product Design”, McGraw Hill, 1974.
7. Asimov , “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.

Course Outcomes

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & Nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

GTPC03 DYNAMICS OF SOILS AND FOUNDATIONS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

FUNDAMENTALS OF VIBRATIONS: single, two and multiple degree of freedom systems, vibration isolation, vibration absorbers, vibration measuring instruments.

UNIT II

WAVE PROPAGATION: elastic continuum medium, semi-infinite elastic continuum medium, soil behavior under dynamic loading.

UNIT III

DYNAMIC ELASTIC CONSTANTS OF SOIL: determination of dynamic elastic constants, various methods including block resonance tests, cyclic plate load tests, wave propagation tests, oscillatory shear box test.

UNIT IV

MACHINE FOUNDATIONS: Design criteria for machine foundations; Elastic homogeneous half space and lumped parameter solutions, analysis and design of foundations for reciprocating and impact type machines, turbines, effect of machine foundation on adjoining structures.

UNIT V

BEARING CAPACITY OF FOUNDATIONS: Introduction to bearing capacity of dynamically loaded foundations, such as those of water towers, chimneys and high rise buildings.

VIBRATION ISOLATION: Active and passive types of isolation – Screening of vibrations – Isolation in existing machine foundations.

References

1. Das, B.M., “Fundamentals of Soil Dynamics”, Elsevier,1983.
2. Steven Kramer, “Geotechnical Earthquake Engineering”, Pearson,2008.
3. Prakash, S., Soil Dynamics, McGraw Hill, 1981.
4. Kameswara Rao, N.S.V., Vibration analysis and foundation dynamics, Wheeler Publication Ltd., 1998.
5. Richart, F.E. Hall J.R and Woods R.D., Vibrations of Soils and Foundations, Prentice Hall Inc., 1970.
6. Prakash, S. and Puri, V.K., Foundation for machines: Analysis and Design, John Wiley & Sons, 1998.

Course Outcomes

1. Students understands theory of vibration and resonance phenomenon, dynamic amplification
2. Students understand propagation of body waves and surface waves through soil.
3. Student exposed to different methods for estimation of dynamic soil properties required for design purpose.
4. Students apply theory of vibrations to design machine foundation based on dynamic soil properties and bearing capacity.
5. Students can predict dynamic bearing capacity and methods of vibration isolation.

GTPC04 SUBSURFACE INVESTIGATION AND INSTRUMENTATION

L / week : 3Hrs **Sessional Marks 40**

University Exam : 3 Hrs **End Exam Marks : 60**

UNIT - I GENERAL

Purpose of soil exploration – Planning a sub-surface exploration – Stages in sub-surface exploration – Depth of exploration – Lateral extent of exploration.

UNIT - II OPEN EXCAVATION AND BORINGS OF EXPLORATION

Pits and Trenches – Drifts and shafts – Auger Borings – Wash borings – Rotary drilling – Percussion drilling – Core drilling.

UNIT - III SOIL SAMPLES AND SAMPLERS

Types of soil samples – Disturbed samples – Undisturbed samples – Design features affecting the Sample Disturbance – Split Spoon Samplers – Scraper Bucket Samplers – Shellby Tubes and Thin walled Samplers – Piston Samlers – Denison Samplers – Hand-curved Samplers.

UNIT – IV IN-SITU TESTING

Standard Penetration Tests – Cone Penetration Tests – In-situ Vane Shear Test – Plate Load Test – Field Permeability Tests – In-situ Tests Using Pressure meter – Observation of Ground Water Table.

UNIT – V GEOPHYSICAL METHODS

Seismic Methods – Electrical Resistivity Methods – Electrical Profiling Method – Electrical Sounding Method – Common Soil Tests – Sub-soil Investigation Report.

References

1. Subsurface exploration and sampling of soils for Civil Engineering purposes by Hvorslev, M.J., Waterways Experiment Station, Vicksburg, Mississipi, 1949.
2. Foundation Engineering by S.P.Brahma Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 1985.
3. Analysis and Design of Foundations and Retaining Structures by Shamsher Prakash, Gopal Ranjan and Swami Saran, Sarita Prakasham, Meerut, 1979.
4. Soil Mechanics & Foundation Engineering, Vol.2 by V.N.S. Murthy, Sai Kripa Technical Consultants, Bangalore.
5. Geotechnical Engineering by C.Venkatramaiah, Wiley Eastern Ltd., New Delhi. Relevant I.S. Codes.

Course Outcomes

1. Students can plan subsurface investigation based on the requirement of civil engineering project and site condition. Can finalize depth and number of boreholes
2. Students can execute different subsurface exploration tests, collect Disturbed / undisturbed samples for laboratory tests and can suggest design parameters.
3. Student exposed to different methods for estimation of soil properties required for design purpose.
4. Students can develop instrumentation scheme for monitoring of critical sites

GTPE31 MARINE GEOTECHNIQUES

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

MARINE SOIL DEPOSITS: Offshore environment, Offshore structures and foundations, Specific problems related to marine soil deposits, Physical and engineering properties of marine soils

UNIT II

BEHAVIOR OF SOILS SUBJECTED TO REPEATED LOADING: Effect of wave loading on offshore foundations, Behavior of sands and clays under cyclic loading, Laboratory experiments including repeated loading, Cyclic behavior of soils based on fundamental theory of mechanics, Approximate engineering methods which can be used for practical cases

UNIT III

SITE INVESTIGATION IN THE CASE OF MARINE SOIL DEPOSITS: Challenges of site investigation in marine environment, Different site investigation techniques, sampling techniques, Geophysical methods, Recent advancements in site investigation and sampling used for marine soil deposits

UNIT IV

FOUNDATIONS IN MARINE SOIL DEPOSITS: Different offshore and near shore foundations, Gravity platforms, Jack-up rigs.

UNIT V

DEEP FOUNDATIONS AND ANCHORS: Pile foundation – Axial capacity – Lateral capacity – Deflections – Construction – Anchored foundations.

References

1. H. G. Poulos. “Marine Geotechnics”, Unwin Hyman Ltd, London, UK, 1988
2. D. V. Reddy and M. Arockiasamy, “Offshore Structures*”, Volume: 1,* R.E. Kreiger Pub and Co., 1991
3. D. Thomson and D. J. Beasley, “Handbook of Marine Geotechnical Engineering”, US Navy, 2012

Course Outcomes

The student is introduced to

1. Physical and Engineering properties of marine soils and problems specific to marine soil deposits.
2. Behavior of sands and clays under cyclic loading
3. Site investigation in marine environment including Gepphysical methods.
4. Assess the factors governing the choice of the most suitable type of foundation for a given marine Structure.
5. Select the type of foundation for a given marine Structure.

GTPE32 COMPUTATIONAL GEOMECHANICS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

SOLUTION OF LINEAR EQUATIONS Jacobi's method, Gauss Seidal method, Successive over relaxation method.

UNIT II

FINITE DIFFERENCE METHOD Two point Boundary value problems – Disichlet conditions, Neumann conditions; ordinary and partial differential equations.

UNIT III

CORRELATION AND REGRESSION ANALYSIS Correlation - Scatter diagram, Karl Pearson coefficient of correlation, Limits of correlation coefficient; Regression –Lines of regression, Regression curves, Regression coefficient, Differences between correlation and regression analysis.

UNIT IV

ONE-DIMENSIONAL CONSOLIDATION - Theory of consolidation, Analytical procedures, Finite difference solution procedure for multilayered systems.

UNIT V

FLOW THROUGH POROUS MEDIA - Geotechnical aspects, Numerical methods, Applications and Design analysis.

References

1. S. Chandrakant., Desai and John T. Christian, "Numerical Methods in Geotechnical Engineering", Mc. Graw Hill Book Company, 1977.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, "Numerical Methods for Scientific and Engineering computations", Third edition, New Age International (P) Ltd. Publishers, New Delhi.
3. D.J. Naylor and G.N. Pande, "Finite Elements in Geotechnical Engineering", Pineridge.

Course Outcomes

Student is able to understand

1. Solution of linear equations
2. Finite difference form of ordinary and partial differential equations
3. Difference between correlation and regression analysis.
4. Apply finite difference technique to solve complex consolidation and seepage problems in Geotechnical Engineering.

GTPE33 ENGINEERING ROCK MECHANICS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

ROCK Formation of rocks, Physical properties, Classification of rocks and rock masses, Elastic constants of rock; Insitu stresses in rock. Application of Rock mechanics in Civil Engineering

UNIT II

ROCK TESTING Laboratory and Field tests including field sampling

UNIT III

DISCONTINUITIES IN ROCK MASSES Discontinuity orientation, Effect of discontinuities on strength of rock ;

UNIT IV

STRENGTH BEHAVIOUR Compression, Tension and Shear, Stress-Strain relationships, Rheological behavior

UNIT V

STRENGTH/ FAILURE CRITERION Mohr-Coulomb, Griffith theory, Hoek and Brown, strength and other strength criteria. Stresses in rock near underground openings;

References

1. Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: an Introduction to the Principles, 1997. Elsevier, Oxford
2. Goodman, R.E. Introduction to Rock Mechanics, John Wiley & Sons.
3. Ramamurthy, T., “Engineering in Rocks”, PHI Learning Pvt. Ltd.
4. Jaeger, J.C. and Cook, N.G.W, Fundamentals of Rock Mechanics, Chapman and Hall, 1976.
5. Wyllie, D.C., Foundations on Rock, E & FN Spon. 2nd Edition, 1992.

Course Outcomes

1. Assess the Physical and Mechanical properties of rocks.
2. Adopt direct & indirect methods of rock exploration.
3. Conduct different laboratory tests on rocks and analyse the results for rock properties
4. Stress Strain behavior under Compressive, tension and Shear
5. Strength criteria functions applied to Rocks.

GTPE41 EARTH RETAINING STRUCTURES

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

EARTH PRESSURE: Rankine and Coulomb theories, active, passive and pressure at rest; concentrated surcharge above the back fill, earth pressure due to uniform surcharge, earth pressure of stratified backfills, saturated and partially saturated backfill.

UNIT II

RETAINING WALLS: Proportioning of retaining walls, stability of retaining walls, mechanically stabilized retaining walls/reinforced earth retaining walls

UNIT III

SHEET PILE WALL: Free earth system, fixed earth system

BULKHEADS: Bulkheads with free and fixed earth supports, equivalent beam method, Anchorage of bulkheads and resistance of anchor walls, spacing between bulkheads and anchor walls, resistance of anchor plates.

UNIT IV

BRACED EXCAVATIONS: Earth pressure against bracings in cuts, Heave of the bottom of cut in soft clays.

UNIT V

TUNNEL AND CONDUIT: Stress distribution around tunnels, Types of conduits, Load on projecting conduits; Arching and Open Cuts: Arching in soils.

References

1. Das, Braja M., "Principles of Foundation Engineering", PWS Publishing. 1998
2. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997.

Course Outcomes (COs)

The students will be able to:

1. Develop an understanding of the fundamental concepts that governs the behaviour of Earth and Earth Retaining Structures.
2. Analyze and Design Retaining Walls,
3. Analyze and Design Braced Cuts,
4. Analyze and Design Shafts, Tunnels and Underground Conduits.

GTPE42 DESIGN OF UNDERGROUND EXCAVATIONS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Introduction, planning of and exploration for various underground construction projects, stereographic projection method, principle and its application in underground excavation design.

UNIT II

Elastic stress distribution around tunnels, stress distribution for different shapes and under different in-situ stress conditions, Greenspan method, design principles, multiple openings, openings in laminated rocks, elasto-plastic analysis of tunnels, Daemen's theory

UNIT III

Application of rock mass classification systems, ground conditions in tunneling, analysis of underground openings in squeezing and swelling ground, empirical methods, estimation of elastic modulus and modulus of deformation of rocks; uniaxial jacking / plate jacking tests, radial jacking and Goodman jacking tests, long term behavior of tunnels and caverns, New Austrian Tunneling Method (NATM), Norwegian Tunneling Method (NTM), construction dewatering.

UNIT IV

Rock mass-tunnel support interaction analysis, ground response and support reaction curves, Ladanyi'selasto-plastic analysis of tunnels, design of various support systems including concrete and shotcrete linings, steel sets, rock bolting and rock anchoring, combined support systems, estimation of load carrying capacity of rock bolts

UNIT V

In-situ stress, flat jack, hydraulic fracturing and over coring techniques and USBM type drill hole deformation gauge, single and multi-point bore hole extensometers, load cells, pressure cells, etc.

Instrumentation and monitoring of underground excavations, during and after construction, various case studies.

References

1. Hoek, E and and Brown, E. T.," Underground Excavations in Rocks", Institute of Mining Engineering.
2. Obert, L. and Duvall, W.I., "Rock Mechanics and Design of Structures in Rocks", John Wiley.
3. Singh, B. and Goel, R.K.,"Rock Mass Classification- A Practical Engineering Approach", Elsevier.
4. Singh, B. and Goel, R.K., "Tunnelling in Weak Rocks", Elsevier

Course Outcomes

1. Students can plan exploration for various underground projects.
2. Students can understand the use of elastic and plastic analysis in the design of underground support system.
3. Students can classify rock masses and select suitable method for advising tunnels.
4. Design of various tunnel support system.
5. Students will have idea about the field tests generally conducted during and after construction of under structures.

GTPE43 PHYSICAL AND CONSTITUTIVE MODELLING ON GEOMECHANICS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

ROLE OF CONSTITUTIVE MODELING Importance of laboratory testing with relation to constitutive modeling; Elasticity: linear, quasi linear, anisotropic;

UNIT II

PLASTICITY BASICS: yield criteria, flow rule, plastic potential, hardening/softening; Rate Independent Plasticity: mohr-coulomb, nonlinear failure criteria, Drucker Prager, and cap models;

UNIT III

CRITICAL STATE SOIL MECHANICS: critical state concept, cam clay models, simulation of single element test using cam clay,

UNIT IV

CONSOLIDATION, drained and undrained triaxial test; Stress dilatancy theory;

UNIT V

WORK HARDENING PLASTICITY THEORY: formulation and implementation; Applications of elasto-plastic models; Special Topics: hypoelasticity-plasticity, disturbed state concept.

References

1. Hicher and Shao, “Constitutive Modeling of Soils and Rocks”, John Wiley. 2008
2. C.S. Desai and H. J. Siriwardane, “Constitutive Laws for Engineering Materials with
3. Emphasis on Geologic Materials”, Prentice-Hall, Inc., New Jersey. 1984
4. David M Potts and LidijaZdravkovic, “Finite Element Analysis in Geotechnical Engineering Theory and Application”, Thomas Telford. 1999
5. C.S. Desai, “Mechanics of Materials and Interfaces: The Disturbed State Concept”, CRC Press LLC. 2000
6. A.P.S. Selvadurai, M.J. Boulon, “Mechanics of Geomaterial Interfaces, Elsevier.

Course Outcomes

1. Stress strain models of elasticity of isotropic and anisotropic models.
2. Students can understand theory of plasticity and various yield criteria and flow rule.
3. Students can apply critical state concept to consolidation and triaxial soil behavior.
4. Students can understand the application aspects of elasto plastic models.

GTCP03 SUB SOIL EXPLORATION

L / week	**: 4Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

LIST OF PRACTICALS

1. Field vist
2. Field sampling and transports
3. Determination of Identification tests.
4. Determination of Engineering properties
5. Assessment of Allowable Bearing Pressure of foundations.

Course Outcomes (COs)

1. Evaluate vertical and lateral extent of exploration; identify, select, and plan different stages of subsurface exploration for various civil engineering projects.
2. Discriminate, Classify and analyse different techniques of exploration to be adopted in rocks and soils.
3. Discriminate different types of soil samples, samplers and judge the appropriateness of a sample or sampler for practical cases accounting for the safety and economy.
4. Evaluate different in-situ methods of tests to determine engineering properties of soils and locate Ground water table required for safe and economic design of foundations.
5. Methods of planning, executing, implementing, interpreting, and reporting subsoil investigations based on geophysical methods.

GTCP04 NUMERICAL ANALYSIS LAB

P/ week	**: 4Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

SYLLABUS CONTENTS

1. Develop and Analysis of laboratory tests results using Spread sheets
2. Develop and analysis of Spread sheets for stress distribution, Bearing Capacity and settlements
3. Curve fitting

Course Outcomes (COs)

Student can be

1. Develop and Analysis of laboratory tests results using Spread sheets
2. Develop and analysis of Spread sheets for stress distribution for different loading conditions.
3. Determine Bearing Capacity of given soil sample.
4. Able to determine settlements

GTPE51 STABILITY ANALYSIS OF SLOPES

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

SLOPES Types and causes of slope failures, mechanics of slope failure, failure modes.

UNIT II

STABILITY ANALYSIS Infinite and finite slopes with or without water pressures; concept of factor of safety, pore pressure coefficients, Mass analysis, Wedge methods, friction circle method ; Method of slices, Bishop's method, Janbu's method, Morgenstern and Price, Spencer's method.

UNIT III

STABILITY ANALYSIS IN THE PRESENCE OF SEEPAGE Two dimensional flow – Laplace equation and it's solution, graphical method, determination of phreatic line, flow nets in homogeneous and zoned earth dams under steady seepage and draw-down conditions, seepage control in earth dams, influence of seepage on slope stability stability analysis of dam body during steady seepage.

UNIT IV

STRENGTHENING MEASURES: stabilization of slopes by drainage methods, surface and subsurface drainage, use of synthetic filters, retaining walls, stabilization and strengthening of slopes, shotcreting, rock bolting and rock anchoring.

UNIT V

Instrumentation and monitoring of slopes, slope movements, warning devices, maintenance of slopes

References:

1. Chowdhary R and ChowdharyI , ”Geotechnical Slope Analysis”, CRC Press.
2. Harr M.E.,” Ground Water and Seepage”, McGraw Hill. 1962

Course Outcomes

1. Identifying types and causes of slope failures.
2. Student will be able to check the stability of earthen dams
3. The safety measures to be undertaken to prevent the instability of slopes, earthen dams and embankments.
4. Understand maintenance and monitoring of slopes.

GTPE52 FOUNDATIONS ON WEAK ROCKS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Engineering properties of weak rocks, different rock mass classification systems, relative merits and demerits. Failure criteria for weak rocks, bi-linear Mohr-Coulomb failure criterion, Hoek and Brown criterion and modified Hoek and Brown failure criterion etc.

UNIT II

Effect of structural planes on rock foundations, possible modes of failure of foundations on rocks/ rock masses, determination of in-situ shear strength of rocks and rock masses

UNIT III

Requirements for satisfactory performance of foundations, bearing capacity of foundations on rocks and rock masses, allowable bearing pressure of rock foundations using a nonlinear failure criterion, monotonic and cyclic plate load tests. Pressure-settlement characteristics, effect of layering, anisotropy, heterogeneity andinelasticity

UNIT IV

Shallow foundations, shallow foundations on sloping ground, raft foundations, stilt foundations, foundations for suspension bridges, transmission line towers, framed buildings etc, treatment of foundations - open joints, solution cavities, weak seams

UNIT V

Piles in weak rocks, bearing capacity and settlement of piles, piles in stratified rock masses, field load tests on piles in weak rocks, behaviour of bored / driven piles in soft / weathered rocks.

References

1. Wyllie Duncan C.," Foundations on Rock: Engineering Practice", E&FN Spon, Taylor and Francis.
2. Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: an Introduction to the Principles, 1997. Elsevier, Oxford
3. Singh, B. and Goel, R.K.,"Rock Mass Classification- A Practical Engineering Approach", Elsevier.
4. Ramamurthy, T., "Engineering in Rocks", PHI Learning Pvt. Ltd.
5. Hoek, E., "Practical Rock Engineering", Rock science.

Course Outcome

The students will be able to

1. Understand Rock mass classification and its Engineering properties.
2. Determine engineering properties of in-situ rocks and modes of failure associated.
3. Assess allowable Bearing pressure.
4. Design different types of foundations planned over rock mass.

GTPE53 GEOTECHNICAL EARTHQUAKE ENGINEERING

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

EARTHQUAKE SEISMOLOGY Causes of earthquake, Plate tectonics, Earthquake fault sources, Seismic waves, Elastic rebound theory, Quantification of earthquake, Intensity and magnitudes, Earthquake source models.

UNIT II

EARTHQUAKE GROUND MOTION Seismograph, Characteristics of ground motion, Effect of local site conditions on ground motions, Design earthquake, Design spectra, Development of site specification and code-based design.

UNIT III

GROUND RESPONSE ANALYSIS One-dimensional ground response analysis: Linear approaches, Equivalent linear approximation of non-linear approaches.

UNIT IV

LIQUEFACTION AND LATERAL SPREADING Liquefaction related phenomena, Liquefaction susceptibility: Historical, Geological, Compositional and State criteria. Evaluation of liquefaction by cyclic stress and cyclic strain approaches, Lateral deformation and spreading, Criteria for mapping liquefaction hazard zones.

UNIT V

Seismic design of foundations, Seismic slope stability analysis: Internal stability and weakening instability and Seismic design of retaining walls.

References

1. Steven Kramer, “Geotechnical Earthquake Engineering”, Pearson,2008.
2. Seco e Pinto, P., Seismic behaviour of ground and Geotechnical structure, A. A.
3. Naeim, F., The Seismic Design Handbook, Kluwer Academic Publication, 2ndEdition, 2001.
4. Ferrito, J.M, Seismic design criteria for soil liquefaction, Tech. Report of Naval Facilities service centre, Port Hueneme, 1997.

Course Outcomes

1. Students will know the causes and quantification of earthquake.
2. Student will be exposed to the effect of earthquake and ground motion.
3. Student will be able to understand Ground responseAnalysis and Liquefaction effects.
4. Student will be able to understand the seismic design of foundation

GTOE11 BUSINESS ANALYTICS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT II

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology

UNIT III

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT IV

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT V

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

UNIT VI

Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Reference

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Course Outcomes

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

GTOE12 INDUSTRIAL SAFETY

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive

maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

References

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course Outcomes

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

GTOE13 OPERATIONS RESEARCH

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

UNIT III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

UNIT IV

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT V

Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008.
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010.

Course Outcomes

1. Students should able to apply the dynamic programming to solve problems of discreet and Continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

GTOE14 COST MANAGEMENT OF ENGINEERING PROJECTS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

INTRODUCTION AND OVERVIEW OF THE STRATEGIC COST MANAGEMENT PROCESS

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of CostAccounting A. H. Wheeler publisher.
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Course Outcome

1. Students should able to apply the dynamic programming to solve problems of discreet and Continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

GTOE15 COMPOSITE MATERIALS

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

EARTHQUAKE SEISMOLOGY Causes of earthquake, Plate tectonics, Earthquake fault sources, Seismic waves, Elastic rebound theory, Quantification of earthquake, Intensity and magnitudes, Earthquake source models.

UNIT II

EARTHQUAKE GROUND MOTION Seismograph, Characteristics of ground motion, Effect of local site conditions on ground motions, Design earthquake, Design spectra, Development of site specification and code-based design.

UNIT III

GROUND RESPONSE ANALYSIS One-dimensional ground response analysis: Linear approaches, Equivalent linear approximation of non-linear approaches, Computer code "SHAKE".

UNIT IV

Liquefaction and lateral spreading - Liquefaction related phenomena, Liquefaction susceptibility: Historical, Geological, Compositional and State criteria. Evaluation of liquefaction by cyclic stress and cyclic strain approaches, Lateral deformation and spreading, Criteria for mapping liquefaction hazard zones.

UNIT V

Seismic design of foundations, Seismic slope stability analysis: Internal stability and weakening instability and Seismic design of retaining walls.

Text Books

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West

Germany.

2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References

1. Steven Kramer, “Geotechnical Earthquake Engineering”, Pearson,2008.
2. Seco e Pinto, P., Seismic behaviour of ground and Geotechnical structure, A. A.
3. Naeim, F., The Seismic Design Handbook, Kluwer Academic Publication, 2ndEdition, 2001.
4. Ferrito, J.M, Seismic design criteria for soil liquefaction, Tech. Report of Naval Facilities service centre, Port Hueneme, 1997.

Course Outcome

1. Students should able to apply the dynamic programming to solve problems of discreet and Continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis Student should able to model the real world problem and simulate it.

GTOE16 ENERGY GENERATION FROM ENERGY

L / week	**: 3Hrs**	**Sessional Marks 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I &II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course Outcomes

1. Students should able to apply the dynamic programming to solve problems of discreet and Continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis Student should able to model the real world problem and simulate it.

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Curriculum & Syllabi For Hydraulics & Water Resourse Engineering

(w.e.f 2018-19)

MAY, 2018

PROGRAM OBJECTIVES

1. To learn the principles, processes and design of pressurized and free surface system.

2. To achieve competency in the pipe network design, analysis of channel networks, pressure rise in pipes due to sudden closure of valves, etc.

3. To assess the impact of climate change detection, Land use/Land cover changes on water availability

4. Efficient use of water in irrigation under varying climate change.

5. Impact of climate change on glaciers, consumptive use of surface and ground water, and optimum allocation of water.

6. Evaluation of various hydrologic processes including flow forecasting and the related practical applications.

M. Tech (HYDRAULICS AND WATER RESOURSE ENGINEERING) – I Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Program Core									
HWPC01	Advanced Fluid Mechanics	3	-	-	3	3	40	60	100
HWPC02	Free Surface Flows	3	-	-	3	3	40	60	100
Professional Elective- I Any One from the Following		3	-	-	3	3	40	60	100
HWPE11	Fluvial Hydraulics								
HWPE12	Hydraulic Structures								
HWPE13	Systems Engineering								
HWPE14	Hydraulic Modeling and Experimental techniques								
Professional Elective- II Any One from the Following		3	-	-	3	3	40	60	100
HWPE21	Water Resources System Planning								
HWPE22	Irrigation and Drainage								
HWPE23	Water Power Engineering								
HWPE24	Urban Hydrology								
Program Practicals									
HWCP01	Advanced Fluid Mechanics Lab	-	-	4	4	2	40	60	100
HWCP02	Advanced Hydrology Lab	-	-	4	4	2	40	60	100
Audit Course-I		2	-	-	2	-	100	-	100
PGPA11	English for Research Paper Writing								
PGPA12	Disaster Management								
PGPA13	Sanskrit for Technical Knowledge								
PGPA14	Value Education								
Mandatory Course									
PGMC41	Research Methodology and IPR	2	-	-	2	2	40	60	100
	Total	16	-	8	24	18	380	420	800

M. Tech (HYDRAULICS AND WATER RESOURSE ENGINEERING) – II Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Exam Marks	Total
Program Core									
HWPC03	Advanced Hydrology	3	-	-	3	3	40	60	100
HWPC04	Groundwater Engineering	3	-	-	3	3	40	60	100
Program Elective- III Any One from the following		3	-	-	3	3	40	60	100
HWPE31	Computational Methods in Fluid Mechanics								
HWPE32	Theory and Applications of GIS								
HWPE33	Hydrogeology and Geophysical exploration of groundwater								
HWPE34	Coastal Engineering								
Program Elective- IV Any One from the Following		3	-	-	3	3	40	60	100
HWPE41	Environmental Hydraulics								
HWPE42	Advanced Numerical Analysis								
HWPE43	River Water Management								
HWPE44	Theory of Seepage and groundwater movement								
Program Practicals									
HWCP03	Computational Fluid Dynamics Lab	-	-	4	4	2	40	60	100
HWCP04	Open Chanel Flow Lab	-	-	4	4	2	40	60	100
Audit Course-II		2	-	-	2	-	100	-	100
PGPA21	Constitution Of India								
PGPA22	Pedagogy Studies								
PGPA23	Stress Management By Yoga								
PGPA24	Personality Development Through Life Enlightenment Skills								
Mini Project									
HWMP01	Mini Project with Seminar	-	-	4	4	2	100	-	100
	Total	14	-	12	26	18	440	360	800

M. Tech (HDYDRAULICS AND WATER RESOURSE ENGINEERING) – III Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Program Elective- IV Any One from the following		3	-	-	3	3	40	60	100
HWPE51	Computer Methods in Hydraulics and Hydrology								
HWPE52	Stochastic Hydrology								
HWPE53	Watershed Management and Modeling								
HWPE54	Climate Change and Sustainable Development								
Open Elective Any One from the Following		3	-	-	3	3	40	60	100
HWOE11	Business Analysis								
HWOE12	Industrial Safety								
HWOE13	Operations Research								
HWOE14	Cost Management of Engineering Projects								
HWOE15	Composite Materials								
HWOE16	Energy Generation from Waste								
Dissertation									
HWPD01	Dissertation- Phase-I	-	-	20	20	10	100	-	100
	Total	6	-	20	26	16	180	120	300

M. Tech (HDYDRAULICS AND WATER RESOURSE ENGINEERING) – IV Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Dissertation									
HWPD02	Dissertation- Phase-II	-	-	32	32	16	40	60	100
Total		-	-	32	32	16	40	60	100

HWPC01 ADVANCED FLUID MECHANICS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks: 60**

UNIT I: Kinematics of Flow: Equation of continuity in cartesian, polar and cylindrical coordinates, Standard 2D Flow Patterns: Source, sink, doublet and their combinations, construction of flows by superposition, D'Alembert's paradox

UNIT II: Ideal fluid flow

Simple patterns of 2-dimensional flow - Uniform flow, Source, sink, vortex flow, Superposition of elementary flows – Doublet – Rankine-half body - Rankine oval, flow about a circular cylinder and flow about a rotating cylinder.

UNIT III:. Laminar Flow: Derivation of Navier-Stokes equations – exact solutions for flow between parallel plates, Couette flow, flow near a suddenly accelerated plate and an oscillating plate.

UNIT IV: Boundary Layers: Similarity solutions of boundary layer equations, Falkner-Skan Wedge flows, Karman's momentum integral equations, Karman-Puhlhausen approximate solution, separation in boundary layer under adverse pressure gradient, turbulent boundary layer.

UNIT V: Turbulent Flows: Reynolds equations of motion, semi-empirical theories of turbulence, velocity profiles for inner, outer and overlap layers, equilibrium boundary layers.

References:

1. White, F.M., "Fluid Mechanics", McGraw-Hill. 1979
2. Schlichting, H., "Boundary Layer Theory", McGraw-Hill. 1979 Garde, R.J., "Turbulent Flow", Wiley Eastern Limited. 1994
3. Pope, S. B., "Turbulent Flows", Cambridge University Press. 2000
4. Rouse, H., "Advanced Mechanics of Fluids", John Wiley and Sons. 1959
5. Ojha, C.S.P., Berndtsson, R. and Chandaramouli, P.N., "Fluid Mechanics", Oxford University Press. 2010

Course Outcomes (COs)

After completion of the course the student will have:

1. Able to analyze the fluids in motion condition
2. Able to apply the principles of ideal fluid flow and real fluid flow
3. Able to apply the principles of viscous flow of fluids
4. Able to find out different layer of boundary layer and identifying the separation and control
5. Able to analyze the fluids in turbulent flow conditions.

HWPC02 FREE SURFACE FLOWS

L / week : 3Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

UNIT I

INTRODUCTION: Free surface flows, velocity distribution, resistance relationships, specific energy and specific force, normal and critical depths computations, governing equation and computation of gradually varied flows.

UNIT II

HYDRAULIC JUMP: Elements of hydraulic jump, hydraulic jump in variety of situations including contracting and expanding geometries and rise in floor levels, control of hydraulic jump using baffle walls and cross jets.

UNIT III

SUPERCRITICAL FLOWS: Flow past deflecting boundaries, oblique shock waves.

Spatially Varied Flows: Flows past side weirs, De Marchi equations, design of side weirs, flow past bottom racks, trench weirs and waste water gutters.

UNIT IV

AERATED FLOWS: Bulking of flow, mechanism of air entrainments, modelling of aerated flows, development of self-aerated flows, uniform aerated region, aeration over spillway.
Stratified Flows: Thermal stratification in water bodies including reservoirs, modelling of stratified flows.

UNIT V

UNSTEADY FLOWS: St. Venant's equations and their solution using method of characteristics and finite difference schemes; dam break problem, hydraulic flood routing. Channel Transitions: Sub-critical and supercritical.

References:

1. Chow, V.T., “Open Channel Hydraulics”, McGraw Hill. 1959
2. Choudhary, M.H., "Open-Channel Flows", Prentice-Hall. 1994
3. Ranga Raju, K.G., “Flow Through Open Channels, Tata McGraw Hill. 2003
4. Chanson, H., “The Hydraulics of Open Channel Flow: An Introduction”, Elsevier.

   2004 French, R.H., "Open-Channel Hydraulics", McGraw-Hill. 1994
5. Wood, I.R., “Air entrainment in free-surface flows”, A.A. balkema. 1991

Course Outcomes

1. Able to compute flow profile in channel transition

2. Able to apply various principles in unsteady flow conditions

3. Able to formulate and solve the hydraulic flood routing

4. able to apply concepts on aerated flows.

HWPE11 FLUVIAL HYDRAULICS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

The sediment problems, properties of sediments, incipient motion of uniform and non-uniform sediments. Bed forms- mechanics of bed forms, classifications and channel resistance.

UNIT II

Bed load equation, Bed layer characteristics, sediment sampling, measurement and suspended load – sediment concentration, Advection-diffusion equation, suspended sediment concentration profile, Hyper concentration, Field measurements of suspended sediments.

UNIT III

Stable channel design and sediment control – Introduction- variable in channel design and conditions – secondary factors influencing stable channel design- stable channel carrying clear water- Non cohesive material-stable channel carrying sediments-sediment control .

UNIT IV

Bed level variations- continuity equation for sediment – equilibrium depth of scour in long channel contractions- stream bed changes during floods- degradation – aggradations

UNIT V

General mathematical models –silting of reservoirs –local scour- Design of guide bunds and other river training banks.

References:

1. Garde, R.J., “River Morphology”, New International Publishers. 2006

2. Julien, P.Y., “Erosion and Sedimentation”, Cambridge University Press. 1998 3. Jansen, P.P.H., “Principals of River Engineering”, VSSD Publications. 1994

4. Garde, R.J. and Ranga Raju, K.G., "Mechanics of Sediment Transportation and Alluvial Stream Problems", Wiley Eastern Limited. 2006

Course Outcomes

After completion of the course the student will able to

1. Exposure to resistance laws in mobile bed channels/rivers.
   Scour around bridge piers
2. Design of river protection works

HWPE12 HYDRAULIC STRUCTURES

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

HYDRAULIC STRUCTURES – INTRODUCTION- Types of Hydraulic structures – water retaining structures – water conveying structures. Embankment Dams: Types, design considerations, seepage analysis and control, stability analysis, construction techniques.

UNIT II

GRAVITY DAMS: Forces acting on failure of a gravity dam, stress analysis, elementary profile, design of gravity dam, other functional features of a gravity dam.

UNIT III

DAM OUTLET WORKS: Types of outlet structures, ogee spillway, chute spillway, siphon spillway, side channel spillway,.

UNIT IV

TERMINAL STRUCTURES: Hydraulic jump types, stilling basin, roller bucket, ski jump b**asi**n, baffled spillway, drop structure

UNIT V

HYDRAULIC MODELING: Basic principles, dimensional analysis, design of physical models of hydraulic structures.

References:

1. Peterka, A.J, “Hydraulic Design of Stilling Basins and Energy Dissipators”, USBR Engineering Monographs No. 25”. 1984
2. Design of Small Dams", Third Edition, Water Resources Technical Publication – US Bureau of Reclamation. 1987
3. Singh, B., and Varshney, R.S., "Embankment Dam and Engineering", Nem Chand and Brothers. 2004
4. Novak, P. and Nalluri, C., “Hydraulic Structures”, Edition 4, Taylor & Francis. 2007 Creager, Justin and Hinds, “Engineering for Dams”, Vol. I and II, John Wiley.

Course Outcome

1. After completion of the course the student will have the ability toAnalysis and design of various types of hydraulic structures

HWPE13 SYSTEMS ENGINEERING

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Definitions and components of a system, system control, systems modelling and model development. System synthesis. Economic analysis, conflicts and role of optimization in their resolution.

UNIT II:

Unconstrained optimization – classification – univariate method – Hook-Jeeves pattern search method –powell's search method – Indirect search method – Cauchy's steepest descent method – newton' method.Constrained optimization – elimination method, penality and barrier function method, sequential quadratic programming, mixed integer programming.

UNIT III

Integer programming: Introduction – Integer Linear programming – Graphical Representation – Gomory's cutting plane method (mixed integer programming- sequential discreat programming. Geometric programming: unconstraind geometric programming using differential calculus-arithmetic-geometric inequality

UNIT IV

Linear programming: Geometry of linear programming- Linear simultaneous equation – simplex method- revised simplex method- Duality in linear programming. Dynamic programming-Multistage decision process- concept of sub-optimization and principle and optimality-computational procedure in dynamic programming.

UNIT V

Stochastic programming- Introduction – concept or probability theory – stochastic non-linear programming- geometric programming.

References:

1. Aguilera, R.J., "Systems Analysis and Design", Prentice Hall. 1973
2. Ossenbruggen, P. J., "Systems Analysis for Civil Engineering", John Wiley. 1984
3. Neufrille, R., "Systems Analysis for Engineer" , McGraw Hill. 1971
4. Rao, S.S., "Engineering Optimization – Theory and Practice", New Age International (P) Ltd. 1999
5. Hamdy, A.T., "Operations Research – An Introduction", Prentice Hall. 1997

Course Outcome

1. At the completion of the course the students will be able to understand the system behaviors and know how to apply the various simulation and optimization techniques to achieve optimum utilisation of water resources

HWPE14 HYDRAULIC MODELLING AND EXPERIMENTAL TECHNIQUES

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT – I

HYDRAULIC MODELLING

Hydraulic models - Scale effects - Distorted models - movable bed models - Analogy methods - Design and analysis of experiments - errors in experiments.

UNIT - II

EXPERIMENTAL TECHNIQUES AND MEASUREMENTS

Velocity and pressure measuring Instruments - Pitot cylinder, Pitot sphere, - Anaemometers- Pressure transducers.

UNIT - III

Discharge measuring techniques - Classification of methods - Constriction methods, rotometer - Area-velocity method - Dilution methods and techniques - Special techniques and measuring structures.

UNIT - IV

Measurement of two phase flows - measurement of sediment content in water flows - air-water mixture. Test rigs - Wind and water tunnels - Drag balances.

UNIT - V

Flow visualization techniques- Smoke or dye- Line tracers – oil films – china clay – shadowgraph – direct-shadow method – schlieren method – Interferometer – Examples.

Reference Books :

1. Huntley, H.E. Dover (1967),"Dimensional Analysis"
2. B.B.Sharp (1982), "Hydraulic Modeling" Published by Butter Worths.
3. Troskolousky (1960), "Hydrometry" Pergamon Press, London.
4. Addison, H. Chapman and Hall (1940), "Hydraulic Measurements".
5. Bradshaw, P.(1964), "Experimental Fluid Mechanics", Pergamon Press,
6. Ed. Richard, J. Goldstein, "Fluid Mechanics Measurements" published by

   Hemisphere Publishing Corporation (Distributed by Springer-Verlag).

Course Outcomes (Cos)

Learners should be able to

1. Able to design the prototype by analyzing the models and applying latest techniques for good
   efficiency
2. Able to measure the flow in all channels by using latest measurement devices.
3. Able to measure the sediment transport rate in regime flows.

HWPE21 WATER RESOURCES SYSTEMS PLANNING

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

INTRODUCTION: Water resources planning process, multi-objective planning.Evaluation of Water Plans: Basic concepts of engineering economics, welfare economics, economic comparison of alternatives.

UNIT II

WATER PLAN OPTIMIZATION: Plan formulation, objective functions and constraint, analytical optimization, numerical optimization, linear programming, dynamic programming, simulation, planning under uncertainty.

UNIT III

DETERMINISTIC RIVER BASIN MODELING: Stream flow modeling, estimation of reservoir storage requirements – dead storage, active storage for water supply/ irrigation / power generation, flood storage, optimal allocation.

UNIT IV

CONJUNCTIVE USE/GROUNDWATER MANAGEMENT MODELS: LP based conjunctive use modeling, aquifer response models, link - simulation, embedded, matrix response based models, soft modeling.

UNIT V

WATER QUALITY MANAGEMENT MODELS: Basic water quality modeling, objectives of management, control alternatives, optimal plans.

References:

1. Hall, W.A. and Dracup, J.A., "Water Resources Systems Engineering", McGraw Hill Book Company. 1970

2. Loucks, D.P., "Water Resource Systems Planning and Analysis", Prentice Hall. 1981

3. Maass et al., "Design of Water-Resource Systems", Harvard University Press. 1962

4. Vedula S. and Mujumdar, P.P., "Water Resources Systems", Tata McGraw Hill. 2005

Course Outcome

1. Able to use optimum utilisation of surface and subsurface water
2. Able to Rational allocation of reservoir water
3. Able to Exposure to various algorithms to solve linear as well as non-linear problems.

HWPE22 IRRIGATION AND DRAINAGE

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Introduction, objectives of irrigation, type of irrigation and suitability; selection of irrigation method. Irrigation requirement, water balance, soil water relationships, water storage zone, infiltration.

Unit II

Flow of moisture through root zone, soil physical and chemical properties, crop evaporative and drainage requirements, irrigation efficiency and uniformity.

UNIT III

Surface irrigation systems, types of surface systems, basin irrigation, border irrigation, furrow irrigation, field measurement techniques, flow measurement, flumes, weirs, irrigation events, advance, wetting, depletion and recession phases.

UNIT IV

Infiltration, infiltrometer, ponding methods, soil water, tensiometers, neutron probe, time domain reflectometer, evapotranspiration, crop coefficient, leaf area index, FAO guide lines on evapotranspiration estimation.

UNIT V

Drainage principles, need for drainage, steady state equations, Hooghoudt, Kirkham, Dagan and Ernst equations. Salt balance, water and salt balance of the root zone, salt equilibrium equation and leaching requirement, leaching efficiency.

References:

1. Walker, W.R., and Skogerboe, G.V., "Surface Irrigation Theory and Practice", Prentice Hall, INC. 1987
2. Drainage Principles and Applications, "International Institute for Land Reclamation and Improvement", Wageningen. 1973
3. Michael, A.M., "Irrigation: Theory and Practice", Vikas Publishing House.
4. Asawa, G.L., "Irrigation Engineering", New Age International Publishers.
5. .Majumdar, D.K., "Irrigation Water Management", PHI Learning. 2009 6.Luthin, J.N., "Drainage Engineering", John Wiley. 1966
6. Richard H. Cuenea (1989), "Irrigation System Design (An Engineering Approach)" Published by Prentice Hall Inc

Course Outcomes (CO's)

After completion of course work the students able to

1. Assessment of various soil properties, soil water relationships
2. Measurement of crop water requirements and infiltration
3. Management of salinity problems and leaching process.

HWPE23 WATER POWER ENGINEERING

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT -1

INTRODUCTION

Sources of energy - Development of water power in India - Advantages and disadvantages of hydropower - Estimation of water power potential- Power house components.

UNIT II

ELECTRICAL LOAD CHARACTERISTICS:

Load curve - Load factor - Capacity factor - Utilization factor - Diversity factor - Load duration curves - Firm power and secondary power load prediction.

UNIT -III

HYDROPOWER PLANTS :

Classification of hydel plants - Runoff river, valley dam, and diversion canal plants - Flow duration curves - Storage and pondage - pumped storage plants - Types - Two unit and three unit arrangements - Efficiency of pumped storage plants - Tidal power plants - Basic principle - Components - Modes of generation - Estimation of energy.

UNIT -IV

WATER CONVEYANCE SYSTEM

Intakes - Types - Hydraulic design of intakes and accessories - power canals - Penstocks - Classification - Design criteria - diameter - Anchor blocks - Design criteria - Water hammer - Surge tanks - Channel surges.

UNIT -V

HYDRAULIC TURBINES:

Selection - Setting of turbines - Cavitation in turbines – Design of Francis turbine- Design of Kaplan turbine – Design of pelton wheel – specific speed of turbine – characteristics curves of turbine.

Reference Books :

1. M.M. Dandekar and K.N.Sharma - Water Power Engineering.
2. Emmil Mosonye - Water Power Development, Vol. I & II.

Course Outcomes (Cos)

1. Able to have knowledge about different sources of energy and electrical load on hydro turbines.
2. Able to understand the concepts of low head, high head and head diversion plants
3. Able to design pumped storage power plants
4. Able to use the concepts of water conveyance
5. Able to plan a power house

HWPE24 URBAN HYDROLOGY

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

INTRODUCTION

Urban Hydrology - Need - Highway drainage - Rainfall Characteristics - Point rainfall for Standard Duration - Rainfall and its variability in time and space.

UNIT II

DESIGN STORM PROFILES :

Differences between urban and rural storm profiles - Recommended design procedure - Sensitivity - Storm movement.

UNIT III

FLOOD ESTIMATION :

Planning of field investigations - Measurements; Methods of flood estimation - Regional runoff rainfall model - ORSTOM model - TRRL method - Generalized tropical flood model - Effect of land use - Examples.

UNIT IV

URBAN STORM WATER DRAINAGE:

Design Criteria - Rational method - TRRL hydrograph method - HYDRAON - ILLUDAS (Illinois Urban Drainage Area Simulator) - The Walkingford procedure - The Hydrograph volume method (HVM) - Environmental Protection Agency for Storm Water Management model (SWMM).

UNIT V

PLANNING AND CONTROL MEASURES :

Urban water resources planning - Surface and subsurface drainage - Design of subsurface drains - Erosion Control - Control of Gully erosion - Control of sheet erosion.

REFERENCE BOOK :

"Highway and Urban Hydrology in Tropics" by L.H.Watkins and D. Fiddes, Pentech Publishers (London - plymouth).

Course Outcomes (COs)

After completion of the course the student will have :

1. Able to know about urban rainfall and storm water management in urban areas .
2. Able to design storm water management in urban areas
3. Able to determine the design flood for storm water drainage system.
4. Able to develop urban storm water management models and to suggest suitable erosion control measures.

HWCP01 ADVANCED FLUID MECHANICS LAB

P / week : 4Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

List of Practicals:

1. To study the flow behavior in a pipe bend and to calibrate the pipe bend (i.e., bend or elbow meter) for discharge measurement.
2. To study the boundary layer velocity profile, and to determine the exponent in the power law of velocity distribution, boundary layer thickness and displacement thickness.
3. To study the velocity distribution in a pipe flow and to estimate the energy and momentum correction factors.
4. To study velocity distribution and Reynolds stresses in turbulent flow

Course Outcomes (Cos)

After the completion of course the student must

1. Able to find out surface profiles in forced vortex flow
2. Able to find discharge in elbow meters
3. Able to find energy correction factor , momentum correction factor and hydraulic jump in horizontal and sloping channels.

HWCP02 ADVANCED HYDROLOGY LAB

P / week : 4Hrs **Sessional Marks : 40**

University Exam : 3 Hrs **End Exam Marks : 60**

List of Practicals:

1. Downloading and processing of remote sensing products
2. The hands on experiments in the image processing, GIS platforms
3. Georeferencing of toposheet and creating vector layers(MapInfo/ArcGIS)
4. Creation of attribute tables and layout preparation (MapInfo/ArcGIS)
5. Creation of Digital Elevation Model using Vertical Mapper.
6. GPS Survey and its data transformation into GIS environment.
7. Converting *.tab file to *.shp& vice versa using Universal Translator.
8. Use of D8 pointer algorithm for deriving flow direction, flow accumulation and watershed delineation.

Course Outcomes (Cos)

After the completion of course the student must

1. Able to download the satellite data and it is imported into GIS environment
2. Able to analyse the raster data ,vector data and development of DEM
3. Able to convert GPS data into point data in GIS

HWPC03 ADVANCED HYDROLOGY

L / week	**: 3 Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

INTRODUCTION: Hydrologic system and hydrologic budget, fundamental laws of hydrology; atmospheric water vapour. Hydrologic Inputs: Precipitation and its forms, snowfall and rainfall; measurement techniques and space-time characteristics

UNIT II

HYDROLOGIC ABSTRACTIONS: Infiltration, depression storage, evapotranspiration; measurement techniques, space time characteristics and their modelling.

UNIT III

STREAM FLOW: Measurement techniques, space-time characteristics, rating curves System Approach: Unit Hydrograph IUH, Clark and Nash model.

UNIT IV

MATHEMATICAL MODELLING: Linear and Nonlinear models, Physically based models Hydrological routing, Flood forecasting

UNIT V

ADVANCED METHOD OF FREQUENCY ANALYSIS: Outliers, Time series analysis. Impact of climate change and Land use/Land cover on basin response

References:

1. Chow, V.T., Maidment, D.R. and Mays, W.L., "Applied Hydrology", McGraw Hill. 1988
2. Ojha, C.S.P., Berndtsson, R. and Bhunya, P., “Engineering Hydrology”, Oxford University Press. 2008
3. Wanielista, M., Kersten, R. and Eaglin, R., “Hydrology”, John Wiley. 1997

Course Outcomes (Cos)

After the completion of course the student must

1. To develop basic tools for analysis of hydrologic processes
2. To apply the knowledge of time series models for hydrologic data generation and forecasting.
3. To be familiar with the hydrologic design concepts and methods including estimation of the design flows
4. To assess impact of climate change and Land use/Land cover on water availability

HWPC04 GROUNDWATER ENGINEERING

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

INTRODUCTION

Definition of groundwater, role of groundwater in hydrological cycle, groundwater bearing formations, classification of aquifers, flow and storage characteristics of aquifers, Darcy's law, anisotropy and heterogeneity. Governing Equations for Groundwater Flow: Dupuit-Forchheimer assumptions, general differential equations governing groundwater flows, analytical solutions.

UNIT II

WELLS AND WELL HYDRAULICS

Different types of wells, construction of wells, steady and unsteady state solutions for confined, unconfined and leaky aquifers, effect of boundaries, method of images, pumping test analysis. Groundwater Conservation: Regional groundwater budget; resource assessment; estimation of recharge, Indian practice for artificial recharge

UNIT III

GROUNDWATER QUALITY

General problem of contamination of groundwater, sources, remedial and preventive measures, seawater intrusion in coastal aquifers.

UNIT IV MANAGEMENT OF GROUNDWATER

Concept of basin management – Equation of Hydrologic Equilibrium – Groundwater basin investigations – Data collection and field work – Alternative basin yields – Evaluation of perennial yield – salt balance – basin management by conjunctive use

UNIT IV

GROUNDWATER FLOW MODELLING

Role of groundwater flow models, reference to hydraulic, Hele-Shaw and analog models, introduction to numerical modeling.

References:

1. Todd, D.K., "Groundwater Hydrology", John Wiley. 1959
2. Bear, J., "Hydraulics of Groundwater", McGraw. 1979
3. Bouwer, H., "Groundwater Hydrology", McGraw Hill. 1978
4. Walton, W.C., "Groundwater Resources Evaluation", McGraw Hill. 1970
   Freeze and Cherry, "Groundwater", Prentice Hall. 1979
5. Driscoll, F.G., "Ground Water and Wells", Johnson Division. 1986
6. Raghunath, H. M., "Ground Water", New Age International (P) Limited.

Course Outcomes (Cos)

After the completion of course the student must able to

1. To understand aquifer properties and movement of ground water flow after the completion of the course.
2. Able to exposure towards well design and practical problems of ground water aquifers.
3. Able to find out groundwater quality parameters
4. Able to manage the groundwater resources

HWPE31 COMPUTATIONAL METHODS IN FLUID MECHANICS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Review of numerical techniques like method of characteristics, finite difference method.

Finite element method- Finite element formulation – interpolation function – one dimensional element – two dimensional elements – three dimensional elements.

UNIT II

Causes of transients in pipes, water hammer, rigid water column theory, elastic water column theory, equivalent bulk modulus of elasticity.

UNIT III

Transient open channel flow: Introduction- Examples of transient flow – Governing equation – methods of solution – method of characteristics –Explicit and implicit Finite difference method.

UNIT IV

Numerical solutions for Navier-Stokes, boundary layer and Reynolds equations.

UNIT V

Groundwater modeling, formulation of anisotropic and non homogenous flow of groundwater, finite difference methods for solving groundwater flow problems, regional groundwater flow modelling.

References:

1.Anderson, "Computational Fluid Mechanics and Heat Transfer", McGraw Hill. 1984
2. Chung, T. J., "Finite Element Analysis in Fluid Dynamics", McGraw Hill. 1978
3.Anderson, &Weessner, "Applied Groundwater Modelling", Academic Press. 1992

4.Chaudhary, H. M., "Applied Hydraulic Transient", McGraw Hill. 1976

5. Streeter and Wylie, "Fluid Transients", McGraw Hill. 1976

6. Smith, G.D., "Numerical Solution of Partial Differential Equations-FDM". 1985
7. M. Hanif Chaudhry " Applied Hydraulic transients" third edition, springer publications

Course Outcomes

1. Able to compute the various flow parameters using FDM

2. able to analyse the flow field in a variety of practical situation without going for physical model setup

3. Able to solve the groundwater flow modelling conditions.

HWPE32 THEORY AND APPLICATIONS OF GIS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

INTRODUCTION, Geographical concepts and Terminology, Difference between Image Processing system and GIS, Utility of GIS. Various GIS packages and their salient features, Essentials components of GIS, Data acquisition through scanners and digitizers.

UNIT II

RASTER AND VECTOR DATA: Introduction, Descriptions: Raster and Vector data, Raster Versus Vector, Raster to Vector conversion, Remote Sensing Data in GIS, Topology and Spatial Relationships, Data storage verification and editing.

UNIT III

DATA PRE-PROCESSING, Georeferencing, Data compression and reduction techniques, Run length encoding, Interpolation of data, Database Construction, GIS and the GPS, Data Output Database structure, Hierarchical data, Network systems, Relational database, Database management, Data manipulation and analysis

UNIT IV

SPATIAL AND MATHEMATICAL OPERATIONS IN GIS, Overlay, Query based, Measurement and statistical modelling, Buffers, Spatial Analysis, Statistical Reporting and Graphing Programming languauges in GIS, Virtual GIS, Web GIS

UNIT V

APPLICATION OF GIS IN WATER RESOURCES : Land use/Land cover, Rainfall – Runoff relations and runoff potential indices of watersheds, Flood and Drought impact assessment and monitoring. Watershed management for sustainable development and Watershed characteristics – Reservoir sedimentation, Identification of suitable sites for Ground water & identification of sites for artificial recharge structures, Drainage morphometry, water depth estimation

References:

1. Burrough, P.A. and Mc Donnel, R.A., “Principles of Geographic Information System”, Oxford University Press. 2000.

2. Chrisman, Nicholas R., “Exploring Geographic Information Systems”, John Wiley. 2002

3. Demers, Michael N., “Fundamentals of Geographic Information System”, 2nd Ed. Wiley.

2008

4. Ghosh, S.K. and Chandra, A.M., “Remote Sensing and GIS”, Narosa Publishing House. 2008

5. Lo, C.P. and Young, A.K.W., “Concepts and Techniques of Geographical Information System”, Prentice Hall India. 2002

6. Longley, Paul A, Goodchild, Michael F., Maguire, David J. and Rhind, David W., “Geographic Information Systems and Science”, Wiley. 2001.

Course Outcomes

1. Able to analyse the data both in raster format and vector format

2. Able to evaluate the performance of irrigation systems

3. Able to evaluate groundwater potential using GIS and various applications in water resources engineering.

HWPE33 HYDROGEOLOGY AND GEOPHYSICAL EXPLORATION OF GROUNDWATER

L / week : 3Hrs **Sessional Marks : 40**
University Exam : 3 Hrs **End Exam Marks : 60**

UNIT-I

INTRODUCTION :

Definitions of Hydrogeology – Interdisciplinary subject - Exploration of ground water – Aquifer properties - Porosity, permeability and hydraulic head- Direction and speed of movement of groundwater.

UNIT-II

GROUNDWATER IN DIFFERENT ROCK FORMATIONS

Rock types – Yield of groundwater from Igneous, metamorphic, sedimentary rocks, coastal deposits and glacial deposits - Groundwater indicators – Reservoir indicators – Surface indicators – Boundary indicators

UNIT – III

METHODS OF EXPLORATION- 1

Theory of electrical resistivity - Sounding and profiling - Four electrode system – Wenner and Sclumberger configuration-Cumulative resistivity method – Tagg's master curves. Electrical logging - Spontaneous potential logging - Interpretation from logs.

UNIT – IV

METHODS OF EXPLORATION - 2

Types of waves- elastic constants – Refraction method of measurement – its interpretation - Reflection method of measurement – its interpretation.Soil temperature survey – Magnetic survey – Gravity survey.

UNIT – V

METHODS OF EXPLORATION- 3

Application of Remote sensing method to delineate groundwater potential zones- thematic maps – Assessment of status of groundwater development.Radioactive logging , Induction logging, sonic logging- interpretation from logs.Drilling time, factors influencing and use of drilling time, applications of drill stem test data, wire line formation test.

Reference Books:

1. Raghunath H M (1998) “Groundwater” New Age International Publishers
2. Davis S.N. and Dewiest R.I.M. (1967) ”Hydrogeology” – John Wiley sons.
3. Griffith,D.H and King R.F (1966) “Applied geophysics for Engineers and geologists” Pergamen Press.
4. Todd,D.K. (1980) “Groundwater Hydrology” John Wiley and sons, New York.
5. R.Kirsch (edited by) “ Groundwater Geophysics- A tool for hydrogeology” 2nd edition, Springer Publications.

Course Outcomes (COs)

After completion of the course the student will have :

1. Able to identify different types of aquifers
2. Able to find out yield of well in different aquifers
3. Able to conduct geophysical exploration studies on groundwater identification studies
4. Applying different logging techniques in groundwater and remote sensing and gis

HWPE34 COASTAL ENGINEERING

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT -I

COASTAL ZONE PROCESS:

General, Sediment properties; measurement and sampling techniques - fundamental principles of movement - bad load and suspended load transport.

UNIT -II

Role of coastal sedimentation process - Long shore drift - Beach Evaluation Models - General sediment transport models - On-shore and off-shore sediment transport.

UNIT -III

Beach nourishment - Coast and Bed Morphology - Regime of the Coast and Sea Beach - Sand features - Features of Estuaries - Coastal and Beach features.

UNIT –IV

COASTAL PROTECTION

Identification of the problem - Restoration of the Beach - Groynes and Rivetments - Off-shore Breakwaters, Bays and Artificial Headlands - Beach replenishment.

UNIT -V

DESIGN PRINCIPLES OF COASTAL AND HARBOUR STRUCTURES :

Break water - types - Waves, Jelties and Piers; Docks - different types.

Reference Books :

1. "Coastal Hydraulics" (2nd Edn) By A.M. Muir Wood and CA Fleming, John Wiley and Sons (Newyork).
2. "Coastal Engineering" (Vol. 1 & 2) by Richard L. Silvister, Elsvier Scientific Publishing Company.

Course Outcomes (Cos)

1. Able to know Explain the properties, measurement and principles of sediment transport.
2. Able to evaluate the different sediment transport models
3. Able to describe the different features of coast and beach
4. Able to apply the knowledge of design principles of coastal and harbor structures

HWPE41 ENVIRONMENTAL HYDRAULICS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Introduction and scope, review of basic principles of engineering fluid mechanics, continuity, momentum, and energy equations, steady flow through pipes- hydraulic gradient and total energy line, basics of open channel flow; Ground water, well hydraulics, well design and constructions,

UNIT II

Parallel, compound and equivalent pipes, head losses in pipes, design of pressurized conduits,

UNIT III

Various forms of mixing in the environment, modeling of the mixing process:

advection dispersion equation, Various forms of advection dispersion eq. and its solution.

UNIT IV

Special cases of mixing, density stratified flow, tide, etc.

UNIT V

Mass transfer in gas-liquid and liquid -liquid system with special emphasis on aeration, Project presentation

References:

1. Roberson, J.A., Cassidy, J.J., Chaudhry, M.H. “Hydraulic Engineering”, 2nd Edition, Wiley. 1998
2. Chadwick, A., Morfett, J., Borthwick, M. “Hydraulics in Civil and Environmental Engineering”, 5th Edition, CRC Press. 2004
3. Lee, C. C., Lin, S.D. “Handbook of Environmental Engineering Calculations”, McGraw Hill. 2007
4. Schnoor, J.L., Environmental Modeling: Fate of Chemicals in Water, Air and Soil, John Wiley & Sons, New York. 1996.

Course Outcome

1. The students will be able to gain a basic knowledge of advection-dispersion processes in the environment.

2. Able to gain the skills to take up research activities in solving environmental problems involving fluid motions.

HWPE42 ADVANCED NUMERICAL ANALYSIS

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

Introduction to digital computers & Programming an overview; Errors-Polynomial approximations and interpolations-Numerical differentiation & Integration.

UNIT II

Evaluation of single and multiple integrals, Newton's method, variational and weightened residual methods.

UNIT III

Matrices –Linear equations, Eigenvalues and Eigenvectors-nonlinear equations,

UNIT IV

Harmonic and biharmonic equations - solutions, convergence, completeness & stability.

UNIT V

Initial and boundary value problems of finite difference method, Implicit & Explicit scheme.

References

1.Jain M.K, SRK Iyenge and RK Jain."Numerical Methods for Scientific & Engg. Computation".

2.Mathews J. H "Numerical Methods for Mathematics, Science and Engineering".

3.Gerld C.F and PO Wheatley "Applied Numerical Analysis".

4. Gupta S.C and V. K. Kapoor "Fundamentals of Applied Statistic", Sultan Chand & Sons.

5. Johnson R.A " Probability and Statistics for Mngineers.

Course outcomes:

1.able to determine different variables using different numerical techniques.

HWPE43 RIVER WATER MANAGEMENT

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT -1

INTRODUCTION

Planning and analysis of Water Resources Systems –Probability concepts and methods.

UNIT -II

WATER RESOURCES PLANNING UNDER UNCERTAINITY

Distributions of random events - Stochastic process and time series - Planning with uncertainity - analysing systems with dynamic uncertainty.

UNIT -111

DETERMINISTIC RIVER BASIN MODELLING:

Food control alternatives - Hydro power production - Withdrawals and Diversions - Model synthesis -Expansion of water resources systems.

UNIT -IV

SYNTHETIC STREAM FLOW GENERATION:

Statistical streamflow generation models - Multisite models - Multiseasonal models - Model selection and parameter estimation - Stream flow generation from precipitation data.

UNIT -V

STOCHASTIC RIVER BASIN PLANNING MODELS

Reservoir operation - Single reservoir design and operation - Multiple - Site River Basin Planning Models.

Reference Books :

1. “Water Resources System Planning and Analysis” by Daniel P.Loucks, Jerry R.

   Stedinger and Douglass A. Haith (Published by Prentice - Hall Inc.)

Course outcomes:

1. Able to plane water resources projects with different uncertainties

2. Able to design the river basing modelling

3. Able to design the stochastic river basin planning models

HWPE43 THEORY OF SEEPAGE AND GROUNDWATER MOVEMENT

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

MOVEMENT OF GROUNDWATER

Darcy's flow - Range of validity of Darcy's law - permeability coefficient – laboratory and field methods of measurement - General hydrodynamic equation.

UNIT II

STEADY STATE FLOWS

Bboundary conditions – flow nets – construction and analysis of flow nets – flow nets for anisotropic soils.

UNIT III

UNCONFINED FLOWS

Dupuit's theory of unconfined flow – basic considerations- Two-dimensional flow on a horizontal impervious boundary - Free surface subjected Infiltration and Evaporation - groundwater flow with an inclined lower impervious boundary – Pavlosky's solutions.

UNIT IV
CONFORMAL TRANSFORMATIONS AND MAPPING TECHNIQUES

Geometrical representation of $w = f(z)$ and $z = f(w)$, application of the mapping function $z = w^2$ - Reciprocal function $w = 1/z$ - Velocity hodograph – impervious boundary – boundary of reservoir – surface of seepage –free surface– flow characteristics at singular points of flow domain – example of velocity hodograph.

UNIT V
RECHARGE OF GROUNDWATER

Concept of recharge – methods- waste water recharge for reuse – Artificial recharge for energy purposes.

References :

1. Groundwater and Seepage : M.E. Harr ,Mc Graw Hill pubs.
2. Ground water Hydrology : D.K. Todd, John Wiley & Sons

Course Outcomes (Cos)

1. Able to know about movement of groundwater
2. Able to apply the boundary conditions and flow net analysis of groundwater
3. Able to apply the principles of unconfined flow and infiltration flow of groundwater
4. Able to apply conformation transformation of mapping of groundwater
5. Able to analyze different subsurface investigations and artificial recharge techniques

HWCP03 Computational Fluid Dynamics

P / week	**: 4Hrs**	**Sessional Marks**	**: 40**
University Exam	**: 3 Hrs**	**End Exam Marks**	**: 60**

List of Practicals

Exposure to software's such as ANSYS, FLUENT, creation of Geometry, Mesh, description of boundary condition and solution of flow problems in 1D, 2D and 3D. typical examples should include flow around sphere, cylinders, bridge piers etc.

Course Outcomes:

1. Able to find out boundary flow condition solution flow in 1D, 2D and 3D flows using software ANSYS, FLUENT

HWCP04 OPEN CHANNEL FLOW

P / week	**: 4 Hrs**	**Sessional Marks**	**: 40**
University Exam	**: 3 Hrs**	**End Exam Marks**	**: 60**

List of Practicals:

1. To calibrate a broad-crested weir and study the pressure distribution at the upstream end of the weir.
2. To study the characteristics of a hydraulic jump.
3. To study the velocity distribution downstream of an expansion (with and without splitter plates) in a channel.
4. To obtain pressure distribution over spillway profile
5. To study energy dissipation using baffle blocks
6. To study air entrainment in open channel flow
7. To study the velocity distribution in an open channel and to estimate the energy and momentum correction factors.

Course outcomes:

1. Able to find out pressure distributions of the weir

2. Able to determine velocity distribution and pressure distribution in channels

3. Able to find out kinetic energy correction factor , momentum correction factor on horizontal and sloping channels.

HWPE51 COMPUTER METHODS IN HYDRAULICS AND HYDROLOGY

L / week	**: 3Hrs**	**Sessional Marks**	**: 40**
University Exam	**: 3 Hrs**	**End Exam Marks**	**: 60**

UNIT I

BASIC: Introduction to computer programming and computation with Matlab.

UNIT II

OPEN CHANNEL FLOW: Estimation of normal and critical depth; uniform flow computations; computation of water surface profile (WSP) - gradually varied flow estimation using standard step and direct step methods, WSP in presence of hydraulic structures; unsteady flow - Saint-Venant equation, kinematic wave routing, diffusion routing, overland flow; steady and unsteady modelling using HEC-RAS.

UNIT III

GROUNDWATER HYDROLOGY: Solving groundwater flow equation - saturated and unsaturated flow, Richards' equation, Green-Ampt infiltration model; introduction to MODFLOW.

UNIT IV

SURFACE WATER HYDROLOGY: Estimation of Unit hydrographs; lumped and distributed flow routing; hydrologic statistics - parameter estimation, time series analysis, frequency analysis, geostatistics; hydrologic modelling using HEC-HMS/SWAT.

UNIT V

CLOSED CONDUIT FLOW: Steady and unsteady state modeling; pipe network analysis; introduction to EPANET. Application of soft computing methods and GIS in Hydraulic and Hydrologic modeling.

References:

1. Chow V.T., Maidment D.R. and Mays L.W. (1988), Applied Hydrology, McGraw-Hill. 1988

2. Todd D.K. and Mays L.W. (2008), Groundwater Hydrology, 3rd Edition, John Wiley & Sons. 2008

3. Chaudhry M.H. (2007), Open-Channel Flow, 2nd Edition, Springer, 2007
Pratap R. (2010), Getting started with Matlab, Oxford. 2010

4. P.K. Swamee and Sharma A.K. (2008), Design of water supply pipe networks, John Wiley & Sons. 2008

Course Outcomes (Cos)

After the completion of course the student must able to

1.Apply the computational knowledge in the field of water resources systems

HWPE52 STOCHASTIC HYDROLOGY

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT - I

STOCHASTIC PROCESSES :

Description - Classification - Stationarity - Persistance - Tests - Time series - Classification - Components - Trend - Cyclic and Stochastic Components - Methods of Investigation.

UNIT - II

AUTOCORRELATION ANALYSIS

Autocorrelation coefficients - Correlogram - Moving Average and Auto-regressive processes (First order and second order).

UNIT - III

SPECTRAL ANALYSIS

Line spectrum- continuous spectrum-Spectral density function for an Independent process – Spectrum of a moving average process-Spectrum of an autoregressive process.

UNIT - IV

SYNTHETIC FLOW GENERATION MODELS

Classification - Single site annual models - First order and second order AR models – Seasonal Models – Thomas-Fiering and Rosener and yevjevich models.

UNIT - V

GENERATION OF RANDOM NUMBERS

Uniformly distributed random numbers - Normal random numbers - Random numbers of other distributions.

Reference Books :

1) H.M.Raghunath, “Hydrology”.

2) R.S.Varshney, “Engineering Hydrology”.

3) Mutreja, “Applied Hydrology”.

4) P.Jayarami Reddy, “Stochastic Hydrology”.

5) V.Yevjevich, “Stochastic Processes in Hydrology”.

Course Outcomes (Cos)

1. Able to analyze the uncertainty in data by using stochastic hydrology
2. Able to find statistical analysis of hydrological data by auto regression analysis
3. Able to find out synthetic generation model and generation of random numbers

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HWPE53 WATERSHED MANAGEMENT AND MODELLING

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT -I

WATERSHEDMANAGEMENT-I:

Basin characteristics - Classification of effective watershed management methods - Factors affecting integrated watershed management - Watershed inventory.

UNIT -II

WATERSHED MANAGEMENT II :

Problem definition and scope - Consultation process - Developing workable management options - Evaluation of constraints and criteria - Simple assessment methods.

WATERSHED MODELLING I :

Runoff components- correlation coefficient, linear regression- least square's method, coefficient of determination, t-and F-test; Types of model- black box, parametric and physically based;cuvillinear relations, multi-linear regression model.

UNIT -III

WATERSHED MODELLING II :API & wetness performance, calibration, validation, errors, coefficient of efficiency and other tests, graphical methods. Simple parametric models- Curve Number Method, its modification, variable source area models; quasi- physically based models; a simple physically based model.

UNIT -1V

SOIL CONSERVATION:

Soil loss estimation - Universal soil loss equation; soil erosion principles - Gulley erosion - Design of permanent gully control structures - Stream bank erosion - Erosivity and erodability, Engineering measures to control erosion - Terracing, bunding, vegitated waterways. Wind erosion and control practices.

UNIT –V

ARTIFICIAL GROUNDWATER RECHARGE TECHNIQUES AND WATER HARVESTING TECHNIQUES:

Artificial recharge - Considerations - Methods - Induced Infiltration - Water Spreading - Flooding - Artificial recharge basins and distches - Natural channel modifications - Recharge pits and shafts - Recharge wells. Farm ponds- Percolation tanks.

Reference Books :

1. Prof. R.Suresh, "Watershed Hydrology" Standard Publishers.
2. Isobel W. Heathiote."Integrated Watershed Management - Principles & Practices".
3. Schwab, G.O. & Others, "Soil and Water Conservation Engg."
4. Prof.R.Suresh, "Soil and Water Conservation Engg.",

   (Standard Publishers).
5. Wayne A. Pettyjohu, "Introduction to Artificial Ground Water Recahrge" Scientific

   Publishers, Jodhpur.
6. Murthy J.V.S., "Wastershed Management".

Course outcomes:

1. Able to use watershed management methods and optimization techniques

3. Able to apply soil conservation equation and principles

4. Able to use water harvesting techniques and artificial recharge techniques

HWPE54 CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT

L / week	**: 3Hrs**	**Sessional Marks : 40**
University Exam	**: 3 Hrs**	**End Exam Marks : 60**

UNIT I

EARTH'S CLIMATE SYSTEM: Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes – The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation –The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.

UNIT II

OBSERVED CHANGES AND ITS CAUSES: Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC –Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.

UNIT III

IMPACTS OF CLIMATE CHANGE: Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions– Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

UNIT IV

CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES: Adaptation Strategy/Options in various sectors – Water – Agriculture –- Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS)- Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

UNIT V

CLEAN TECHNOLOGY AND ENERGY: Clean Development Mechanism –Carbon Trading- examples of future Clean Technology – Biodiesel – Natural Compost – Eco-Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydropower – Mitigation Efforts in India and Adaptation funding.

Course outcomes:

At the end of the course the students will able to

1. Identify factors influencing the global climate systems
2. Assess impacts of climate change on global, regional and local scales
3. Develop strategies for adaptation and mitigation measures
4. Identify clean technologies for sustainable development

References:

1. Anil Markandya , Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002

2. Heal, G. M., Interpreting Sustainability, in Sustainability: Dynamics and Uncertainty, Kluwer Academic Publ., 1998

3. Jepma, C.J., and Munasinghe, M., Climate Change Policy – Facts, Issues and Analysis, Cambridge University Press, 1998

4. Munasinghe, M., Sustainable Energy Development: Issues and Policy in Energy, Environment and Economy: Asian Perspective, Kleindorfor P. R. et. al (ed.), Edward Elgar, 1996

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

PGMC 41 RESEARCH METHODOLOGY AND IPR

Instruction Hours/week : 2(L) **Credits : 2**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT II

Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT V

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition , “Research Methodology: A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall , “Industrial Design”, McGraw Hill, 1992.
6. Niebel , “Product Design”, McGraw Hill, 1974.
7. Asimov , “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New
9. Technological Age”, 2016.
10. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes:

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understand that when IPR would take such important place in growth of individuals & Nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

OPEN ELECTIVES

HWOE 11 BUSINESS ANALYTICS

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT I

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT II

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics technology.

UNIT III

Organization Structures of Business analytics, Team management, Management Issues, designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear optimization.

UNIT IV

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT V

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

References:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Course outcomes:

At the end of the course, students will demonstrate

1. The knowledge of data analytics.
2. The ability of think critically in making decisions based on data and deep analytics.
3. The ability to use technical skills in predicative and prescriptive Modeling to support business decision-making.
4. The ability to translate data into clear, actionable insights.

HWOE 12 INDUSTRIAL SAFETY

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination: 60**

UNIT I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in achine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

References:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course outcomes:

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

1. understand the preventive steps for industrial safety
2. apply the corrosion prevention methods
3. find the causes and tracking of faults in machine tools and equipment
4. understand the periodic and preventive maintenance of mechanical and electrical equipment

HWOE 13 OPERATIONS RESEARCH

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT II

Formulation of a LPP - Graphical solution revised simplex method- duality theory - dual Simplex method - sensitivity analysis - parametric programming

UNIT III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

UNIT IV

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Course Outcomes:

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

1. apply the dynamic programming to solve problems of discreet and continuous variables.
2. apply the concept of non-linear programming
3. carry out sensitivity analysis
4. model the real world problem and simulate it.

HWOE 14 COST MANAGEMENT OF ENGINEERING PROJECTS

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT I

Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT II

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents, Project team: Role of each member. Importance Project site: Data required with significance.

UNIT III

Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning,

UNIT IV

Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT V

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Course outcomes:

At the end of the course, students will be able to
1. understand the cost concepts in decision - making
2. commission, execute and manage Engineering projects
3. apply the quality management techniques in the execution of projects
4. apply the quantitative techniques for cost management of projects

HWOE 15 COMPOSITE MATERIALS

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT–I:

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II:

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III:

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V:

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

References:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials – K.K.Chawla.
5. Composite Materials Science and Applications – Deborah D.L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Course outcomes:

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

1. demonstrate the characteristics of composite materials and composite performance
2. understand the use of fibres as reinforcement
3. understand the manufacturing process of metal and polymer matrix composites
4. demonstrate the failure criteria

HWOE 16 ENERGY GENERATION FROM WASTES

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, design, construction and operation - Operation of all the above biomass combustors.

UNIT V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion biomass

gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course outcomes :

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

1.demonstrate the energy generation from wastes

2. understand the biomass pyrolysis and gasification

3. design, construct and operate biomass combustors

4. develop bio-energy system

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Curriculum & Syllabi for Structural Engineering

(w.e.f 2018-19)

MAY, 2018

PROGRAMME OBJECTIVES

1. To make students learn and Understand different problems Associated with Structural, geotechnical and hydraulics structures.
2. To develop analysis and design procedure for various types of structures.

PROGRAM OUTCOMES (POS):

After completion of the program graduates will be able to

1. Apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude.
2. Identify, formulate and solve engineering problems in the domain of structural engineering field.
3. Use different software tools for Analysis and Design structural engineering domain.
   Design and conduct experiments, analyse and interpret data, for development of simulation experiments.
4. Function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.

M. Tech (STRUCTRAL ENGINEERING) – I Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Program Core									
SEPC01	Advanced Structural Analysis	3	-	-	3	3	40	60	100
SEPC02	Advanced Solid Mechanics	3	-	-	3	3	40	60	100
Program Elective- I Any One from the Following		3	-	-	3	3	40	60	100
SEPE11	Theory of Thin Plates and Shells								
SEPE12	Theory and Applications of Cement Composites								
SEPE13	Theory of Structural Stability								
Program Elective- II Any One from the following		3	-	-	3	3	40	60	100
SEPE21	Analytical and Numerical Methods for Structural Engineering								
SEPE22	Structural Health Monitoring								
SEPE23	Structural Optimization								
Program Practicals									
SECP01	Structural Design Lab	-	-	4	4	2	40	60	100
SECP02	Advanced Solid Mechanics Lab	-	-	4	4	2	40	60	100
Audit Course-I		2	-	-	2	-	100	-	100
PGPA11	English for Research Paper Writing								
PGPA12	Disaster Management								
PGPA13	Sanskrit for Technical Knowledge								
PGPA14	Value Education								
Mandatory Course									
PGPC41	Research Methodology and IPR	2	-	-	2	2	40	60	100
	Total	16	-	8	24	18	380	420	800

M. Tech (STRUCTRAL ENGINEERING) – II Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Program Core									
SEPC03	FEM in Structural Engineering	3	-	-	3	3	40	60	100
SEPC04	Structural Dynamics	3	-	-	3	3	40	60	100
Program Elective- III Any One from the following		3	-	-	3	3	40	60	100
SEPE31	Advanced Steel Design								
SEPE32	Design of Formwork								
SEPE33	Design of High Rise Structures								
SEPE34	Design of Masonry Structures								
Program Elective- IV Any One from the following		3	-	-	3	3	40	60	100
SEPE41	Design of Advanced Concrete Structures								
SEPE42	Advanced Design of Foundations								
SEPE43	Soil Structure Interaction								
SEPE44	Design of Industrial Structure								
SEPE45	--								
Program Practicals									
SECP03	Core Lab III Model Testing Lab	-	-	4	4	2	40	60	100
SECP04	Core Lab IV Numerical Analysis Lab	-	-	4	4	2	40	60	100
Audit Course-II		2	-	-	2	-	100	-	100
PGPA21	Constitution Of India								
PGPA22	Pedagogy Studies								
PGPA23	Stress Management By Yoga								
PGPA24	Personality Development Through Life Enlightenment Skills								
Mini Project									
SEMP01	Mini Project with Seminar	-	-	4	4	2	100	-	100
	Total	14	-	12	26	18	440	360	800

M. Tech (STRUCTRAL ENGINEERING) – III Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Program Elective- IV Any One from the following		3	-	-	3	3	40	60	100
SEPE51	Design of Pre-stressed Concrete Structures								
SEPE52	Analysis of Laminated Composite Plates								
SEPE53	Fracture Mechanics of Concrete Structures								
SEPE54	Design of Plates and Shells								
SEPE55	--								
Open Elective Any One from the Following		3	-	-	3	3	40	60	100
SEOE11	Business Analytics								
SEOE12	Industrial Safety								
SEOE13	Operations Research								
SEOE14	Cost Management of Engineering Projects								
SEOE15	Composite Materials								
SEOE16	Energy Generation from Waste								
Dissertation									
SEPD01	Dissertation- Phase-I	-	-	20	20	10	100		100
	Total	6	-	20	26	16	180	120	300

M. Tech (STRUCTRAL ENGINEERING) – IV Semester

Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
Dissertation									
SEPD02	Dissertation- Phase-II	-	-	32	32	16	40	60	100
Total		-	-	32	32	16	40	60	100

SEPC01 ADVANCED STRUCTURAL ANALYSIS

L / week : 3Hrs Sessional Marks : 40

University Exam : 3 Hrs End Exam Marks : 60

UNIT-I

INFLUENCE COEFFICIENTS: Physical Significance, Effects of Settlements, Temperature Change and Lack of Fit, Member Approach and Structure Approach.

UNIT-II

STIFFNESS METHOD APPLIED TO LARGE FRAMES: Local Coordinates and Global Coordinates.

STIFFNESS MATRIX ASSEMBLY OF STRUCTURES: Stiffness Matrix in Global Co ordinates, Boundary Conditions, Solution of Stiffness Matrix Equations, Calculation of Reactions and Member Forces.

UNIT-III

APPLICATIONS TO SIMPLE PROBLEMS: Beams, Plane Trusses, Plane Rigid Jointed Frames and Grids by Structure Approach and Member Approach.

UNIT-IV

BOUNDARY VALUE PROBLEMS (BVP): Approximate Solution of Boundary Value Problems, Modified GalerkinMethod for One-Dimensional BVP, Matrix Formulation ofthe Modified GalerkinMethod.

UNIT-V

LINEAR ELEMENT: Shape Functions, Solution for Poisson's Equation, General OneDimensional Equilibrium Problem.

References:

1. Matrix Analysis of Framed Structures, Weaver and Gere.
2. The Finite Element Method, Lewis P. E. and WardJ. P., Addison-Wesley Publication Co.
3. Computer Methods in Structural Analysis, MeekJ. L., E and FN, Span Publication.
4. The Finite Element Method, Desai and Able, CBS Publication.

Course outcomes: At the end of the course, students will be able to

1. Analysis the structures due to the effects of settlements and temperature changes.
2. Analyze the skeleton structures using stiffness analysis code.
3. Use direct stiffness method understanding its limitations

SEPC02 ADVANCED SOLID MECHANICS

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

UNIT-I

INTRODUCTION TO ELASTICITY: Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity.

STRAIN AND STRESS FIELD: Elementary Concept of Strain, Stain at a Point, Principal Strains and Principal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic and Deviatoric Components.

UNIT-II

EQUATIONS OF ELASTICITY: Equations of Equilibrium, Stress- Strain relations, Strain Displacement and Compatibility Relations, Boundary Value Problems, Co-axiality of the Principal Directions.

UNIT-III

TWO-DIMENSIONAL PROBLEMS OF ELASTICITY: Plane Stress and Plane Strain Problems, Airy's stress Function, Two-Dimensional Problems in Polar Coordinates.

UNOT-IV

TORSION OF PRISMATIC BARS: Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, Torsion of Thin Tubes.

UNIT-V

PLASTIC DEFORMATION: Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.

References:

Theory of Elasticity, Timoshenko S. andGoodierJ. N., McGraw Hill, 1961.
Elasticity,SaddM.H.,Elsevier,2005.
Engineering Solid Mechanics, RagabA.R., BayoumiS.E., CRC Press,1999.
Computational Elasticity, AmeenM., Narosa,2005.
Solid Mechanics, KazimiS. M. A., Tata McGraw Hill,1994.
Advanced Mechanics of Solids, SrinathL.S., Tata McGraw Hill,2000.

Course outcomes: At the end of the course, students will be able to

1. Solve simple problems of elasticity and plasticity understanding the basic concepts.
2. Apply numerical methods to solve continuum problems.

3. Study the two-dimensional problems of Elasticity.

4. Solving the tensional problem of prismatic beam.

5. Solve the problems of plasticity understanding the basic concepts.

SEPC03 FINITE ELEMENT METHOD IN STRUCTURAL ENGINEERING

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

INTRODUCTION: History and Applications. Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, Nodal Equilibrium equations.

UNIT-II

BEAM ELEMENTS: Assembly of Global Stiffness Matrix, Element Strain and Stress. Flexure Element, Element Stiffness Matrix, Element Load Vector.

UNIT-III

METHOD OF WEIGHTED RESIDUALS: Galerkin Finite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications.

UNIT-IV

Types: Triangular Elements, Rectangular Elements, Three-Dimensional Elements, Isoparametric Formulation, Axi-Symmetric Elements, Numerical Integration, Gaussian Quadrature.

UNIT-V

APPLICATION TO SOLID MECHANICS: Plane Stress, CST Element, Plane Strain Rectangular Element, Isoparametric Formulation of the Plane Quadrilateral Element, Axi- Symmetric Stress Analysis, Strain and Stress Computations.

COMPUTER IMPLEMENTATION of FEM procedure, Pre-Processing, Solution, Post-Processing, Use of Commercial FEA Software (Practice Only).

Reference Books:

1. Finite Element Analysis, Seshu P., Prentice-Hall of India,2005.
2. Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley J., New York, 1995. Fundamentals of Finite Element Analysis, Hutton David, Mc-Graw Hill, 2004.
3. Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 1995. Finite Element Method, Zienkiewicz O.C. & Taylor R.L. Vol. I, II & III, Elsevier, 2000.
4. Finite Element Methods in Engineering, Belegundu A.D., Chandrupatla, T.R., Prentice Hall India, 1991.

Course Outcomes: At the end of the course, students will be able to

1. Use Finite Element Method for structural analysis.
2. Execute the Finite Element Program/ Software.
3. Solve continuum problems using finite element analysis.
4. Develop the FEM software.

SEPC04: STRUCTURAL DYNAMICS

L/week : 3Hrs Sessional Marks : 40

University Exam : 3 Hrs End Exam Marks: 60

UNIT - I

RESPONSE OF SIMPLE – SINGLE DEGREE OF FREEDOM SYSTEM

Definition of DOF – Idealization of structure as SDOF system – Formulation of equations of motion for various SDOF systems – Free vibration of un-damped systems – Determination of natural frequency - Free vibration of viscously damped systems – Determination of Damping in structures.

UNIT - II

RESPONSE OF SINGLE DEGREE OF FREEDOM SYSTEMS- FORCED VIBRATIONS

Forced vibration of systems – Steady state response to harmonic forces – Duhamel's integral- Numerical Evaluation – Response to support motion – Transmissibility – Construction of response Spectrum.

UNIT - III

ANALYSIS OF MULTI-DEGREE OF FREEDOM SYSTEMS

Formal Derivations — Formulation of equation of motion - Evaluation of natural frequencies and modes — Free vibration of undamped systems — Forced vibration of damped systems.

UNIT — IV

APPROXIMATE METHODS OF COMPUTING NATURAL FREQUENCIES

Rayleigh's method – Dunkerley's method – Methods of iteration – Stodola – Vainello Method –Rayleigh – Ritz method.

UNIT — V

DYNAMIC ANALYSIS OF CONTNUOUS SYSTEM

Vibration of flexural beams — Equation of motion — Free vibrations of Uniform Beams - Natural frequencies and Mode Shapes of Beams with different Support Conditions - Orthogonality Condition between Normal Modes.

References :

1. Dynamics of Structures, Clough R.W, and Penzien J, McGraw Hill.
2. Structural Dynamics and Introduction to Earthquake Engineering, Chopra A K, Prentice Hall.
3. Vibrations of Structures – Application in Civil Engg Design, Smith J. W.Chapman and Hall.
4. Dynamics of Structures, Humar J L, Prentice Hall.
5. Structural Dynamics - Theory and Computation, Paz Mario, CBS Publication.

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Course Outcomes:

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

Analyze the dynamic response of single degree freedom system usinging fundamental theory and equation of motion.

Analyze dynamic response of Multi-degree of freedom system with lumped parameters.

Apply approximate methods to obtain fundamental natural frequency of structures.

Analyze dynamics response of Multi degree of freedom system with distributed mass.

SEPE11 THEORY OF THIN PLATES AND SHELLS

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

INTRODUCTION: Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions.

UNIT-II

STATIC ANALYSIS OF PLATES: Governing Equation for a Rectangular Plate, Navier Solution for Simply- Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions.

UNIT-III

CIRCULAR PLATES: Analysis under Axi- Symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates.

UNIT-IV

STATIC ANALYSIS OF SHELLS: MEMBRANE THEORY OF SHELLS - Cylindrical, Conical and Spherical Shells,

UNIT-V

SHELLS OF REVOLUTION: WITH BENDING R**ESISTANCE** - Cylindrical and Conical Shells, Application to Pipes and Pressure Vessels.

References:

1. Theory of Plates and Shells, Timoshenko S. and KriegerW., McGraw Hill.
2. Stresses in Plates and Shells, UguralAnsel C., McGraw Hill.
3. Thin Elastic Shells, KrausH., John Wiley and Sons.
4. Theory of Plates, Chandra shekhar K., Universities Press.
5. Design and Construction of Concrete Shells, Ramaswamy G.S.

Course Outcomes: At the end of the course, students will be able to

1. Use analytical methods for the solution of thin plates and shells.
2. Use analytical methods for the solution of shells.
3. Apply the numerical techniques and tools for the complex problems in thin plates.
4. Apply the numerical techniques and tools for the complex problems in shells.

SEPE12 THEORY AND APPLICATIONS OF CEMENT COMPOSITES

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Content:

UNIT-I

INTRODUCTION: Classification and Characteristics of Composite Materials- Basic Terminology, Advantages. Stress-Strain Relations- Orthotropic and Anisotropic Materials, Engineering Constants for Orthotropic Materials, Restrictions on Elastic Constants, Plane Stress Problem, Biaxial Strength, Theories for an Orthotropic Lamina.

UNIT-II

MECHANICAL BEHAVIOUR: Mechanics of Materials Approach to Stiffness- Determination of Relations between Elastic Constants, Elasticity Approach to Stiffness- Bounding Techniques of Elasticity, Exact Solutions - Elasticity Solutions with Continuity, Halpin, Tsai Equations, Comparison of approaches to Stiffness.

UNIT-III

CEMENT COMPOSITES: Types of Cement Composites, Terminology, Constituent Materials and their Properties, Construction Techniques for Fibre Reinforced Concrete - Ferro cement, SIFCON, Polymer Concretes, Preparation of Reinforcement, Casting and Curing.

MECHANICAL PROPERTIES OF CEMENT COMPOSITES: Behaviour of Ferro cement, Fibre Reinforced Concrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion.

UNIT-IV

APPLICATION OF CEMENT COMPOSITES: FRC and Ferro cement- Housing, Water Storage, Boats and Miscellaneous Structures. Composite Materials- Orthotropic and Anisotropic behaviour, Constitutive relationship, Elastic Constants.

UNIT-V

ANALYSIS AND DESIGN OF CEMENT COMPOSITE STRUCTURAL ELEMENTS - Ferro cement, SIFCON and Fibre Reinforced Concrete.

Reference Books:

1. Mechanics of Composite Materials, Jones R. M,, 2nd Ed., Taylor and Francis,BSP Books, 1998. Ferro cement – Theory and Applications, Pama R. P., IFIC, 1980.
2. New Concrete Materials, Swamy R.N., 1stEd., Blackie, Academic and Professional, Chapman & Hall, 1983.

Course Outcomes: At the end of the course, students will be able to

1. Formulate constitutive behaviour of composite materials – Ferrocement, SIFCON and Fibre Reinforced Concrete - by understanding their strain- stress behaviour.
2. Classify the materials as per orthotropic and anisotropic behaviour.
3. Estimate strain constants using theories applicable to composite materials.
4. Analyse and design structural elements made of cement composites.

SEPE13 THEORY OF STRUCTURAL STABILITY

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

CRITERIA FOR DESIGN OF STRUCTURES: Stability, Strength, and Stiffness, Classical Concept of Stability of Discrete and Continuous Systems, Linear and nonlinear behaviour.

UNIT-II

STABILITY OF COLUMNS: Axial and Flexural Buckling, Lateral Bracing of Columns, Combined Axial, Flexural and Torsion Buckling.

UNIT-III

STABILITY OF FRAMES: Member Buckling versus Global Buckling, Slenderness Ratio of Frame Members.

UNIT-IV

STABILITY OF BEAMS: lateral torsion buckling.

UNIT-V

STABILITY OF PLATES: Axial, flexural, buckling, shear, flexural, buckling, buckling under combined loads. Introduction to Inelastic Buckling and Dynamic Stability.

Reference Books:

1. Theory of elastic stability, Timoshenko and Gere, Tata Mc Graw Hill,1981
2. Principles of Structural Stability Theory, Alexander Chajes, Prentice Hall, New Jersey.
3. Structural Stability of columns and plates, Iyengar, N. G. R., Eastern west press Pvt. Ltd. Strength of Metal Structures,Bleich F. Bucking, Tata McGraw Hill, New York.

Course Outcomes: At the end of the course, students will be able to

1. Use stability criteria and concepts for analysing discrete and continuous systems,
2. Determine stability of beams and plates
3. Determine stability of columns and frames
4. Determine stability of plates.

SEPE21 ANALYTICAL AND NUMERICAL METHODS FOR STRUCTURAL ENGINEERING

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

FUNDAMENTALS OF NUMERICAL METHODS: Error Analysis, Polynomial Approximations and Interpolations, **Curve Fitting;** Interpolation and extrapolation. Solution of nonlinear algebraic and transcendental equations

UNIT-II

ELEMENTS OF MATRIX ALGEBRA: Solution of Systems of Linear Equations, Eigen Value Problems.

UNIT-III

NUMERICAL DIFFERENTIATION & INTEGRATION: Solution of Ordinary and Partial Differential Equations.

UNIT-IV

FINITE DIFFERENCE SCHEME: Implicit & Explicit scheme.

UNIT-V

COMPUTER ALGORITHMS: Numerical Solutions for Different Structural Problems, Fuzzy Logic and Neural Network.

Reference Books:

1. An Introduction to Numerical Analysis, AtkinsonK.E., J. Wiley and Sons, 1989.
2. Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, (Shaum Series), 1988.
3. Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 1998.

Course Outcomes: At the end of the course, students will be able to

1. Analyse the error analysis, polynomial approximations & curve fittings.
2. Write solutions of systems of linear equations & given value problems.
3. Solve ordinary and partial differential equations in structural mechanics using numerical methods.
4. Write a program to solve a mathematical problem.

SEPE22 STRUCTURAL HEALTH MONITORING

L / L / week : 3Hrs Sessional Marks : 40

University Exam : 3 Hrs End Exam Marks : 60

Syllabus Contents:

UNIT-I

STRUCTURAL HEALTH: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.

UNIT-II

STRUCTURAL HEALTH MONITORING: Concepts, Various Measures, Structural Safety in Alteration.

STRUCTURAL AUDIT: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.

UNIT-III

STATIC FIELD TESTING: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.

UNIT-IV

DYNAMIC FIELD TESTING: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.

UNIT-V

INTRODUCTION TO REPAIRS AND REHABILITATIONS OF STRUCTURES: Case Studies (Site Visits), piezo– electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.

Reference Books:

1. Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006.

2. Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.

3. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006.

4. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2007.

Course Outcomes: At the end of the course, students will be able to

1. Diagnosis the distress in the structure understanding the causes and factors.

2. Assess the health of structure using static field methods.

3. Assess the health of structure using dynamic field tests.

4. Suggest repairs and rehabilitation measures of the structure.

SECP01 STRUCTURAL DESIGN LAB

P / week	: 4Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

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Syllabus Content:

Design and detailed drawing of complete G+ 3 structures by individual student using latest relevant IS codes.

Course Outcomes: At the end of the course, students will be able to

1. Design and Detail all the Structural Components of Frame Buildings.
2. Design and Detail complete Multi-Storey Frame Buildings.

SECP02 ADVANCED SOLID MECHANICS LAB

P / week	: 4Hrs	Sessional Marks	: 40
University Exam	: 3 Hrs	End Exam Marks	: 60

. **List of Experiments/Assignments:**

Study of stress-strain curve of high strength concrete, Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.

Effect of cyclic loading on steel.

Non-Destructive testing of existing concrete members.

Behaviour of Beams under flexure, Shear and Torsion.

Reference Books:

1. Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012. Concrete Technology, Shetty M. S., S. Chand and Co., 2006.

Course Outcomes: At the end of the course, students will be able to

1. Design high grade concrete and study the parameters affecting its performance.
2. Conduct Non Destructive Tests on existing concrete structures.
3. Apply engineering principles to understand behaviour of structural/ elements.

SEPE31 ADVANCED STEEL DESIGN

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

PROPERTIES OF STEEL: Mechanical Properties, Hysteresis, Ductility.

HOT ROLLED SECTIONS: compactness and non-compactness, slenderness, residual stresses.

UNIT-II

DESIGN OF STEEL STRUCTURES: Inelastic Bending Curvature, Plastic Moments, Design Criteria Stability, Strength, Drift.

STABILITY OF BEAMS: Local Buckling of Compression Flange &Web, Lateral Torsional Buckling.

UNIT-III

STABILITY OF COLUMNS: Slenderness Ratio, Local Buckling of Flanges and Web, Bracing of Column about Weak Axis.

METHOD OF DESIGNS: Allowable Stress Design, Plastic Design, Load and Resistance Factor Design;

UNIT-IV

STRENGTH CRITERIA: Beams - Flexure, Shear, Torsion, Columns - Moment Magnification Factor, Effective Length, PM Interaction, Biaxial Bending, Joint Panel Zones.

DRIFT CRITERIA: P Effect, Deformation Based Design;

UNIT-V

CONNECTIONS: Welded, Bolted, Location Beam Column, Column Foundation, Splices.

Reference Books

1. Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi.
2. Design of Steel Structures - Arya A. S., Ajmani J. L., Nemchand and Bros., Roorkee.
3. The Steel Skeleton- Vol. II, Plastic Behaviour and Design - Baker J. F., Horne M. R., Heyman J., ELBS.
4. Plastic Methods of Structural Analysis, Neal B. G., Chapman and Hall London. IS 800: 2007 – General Construction in Steel - Code of Practice, BIS, 2007.
5. SP – 6 - Handbook ofStructural Steel Detailing, BIS,198

Course Outcomes: At the end of the course, students will be able to

1. Design steel structures/ components by different design processes.
2. Analyze and design beams and columns for stability and strength, and drift. Design welded and bolted connections.

SEPE32 DESIGN OF FORMWORK

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Content:

UNIT-I

INTRODUCTION: Requirements and Selection of Formwork.

FORMWORK MATERIALS- Timber, Plywood, Steel, Aluminium, Plastic, and Accessories. Horizontal and Vertical Formwork Supports.

UNIT-II

FORMWORK DESIGN: Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams.

UNIT-III

FORMWORK DESIGN FOR SPECIAL STRUCTURES: Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.

UNIT-IV

FLYING FORMWORK: Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork Management Issues –Pre- and Post-Award.

UNIT-V

FORMWORK FAILURES: Causes and Case studies in Formwork Failure, Formwork Issues in Multi-Story Building Construction.

Reference Books:

1. Formwork for Concrete Structures, Peurify, Mc Graw Hill India, 2015.
2. Formwork for Concrete Structures, Kumar NeerajJha, Tata McGraw Hill Education, 2012.
   IS 14687: 1999, False workfor Concrete Structures - Guidelines, BIS.

Course Outcomes: At the end of the course, students will be able to

1. Select proper formwork, accessories and material.
2. Design the form work for Beams, Slabs, columns, Walls and Foundations.
3. Design the form work for Special Structures.
4. Understand the working of flying formwork.
5. Judge the formwork failures through case studies.

SEPE33 DESIGN OF HIGH RISE STRUCTURES

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Content:

UNIT-I

DESIGN OF TRANSMISSION/ TV TOWER, MAST AND TRESTLES: Configuration, bracing system, analysis and design for vertical transverse and longitudinal loads.

UNIT-II

ANALYSIS AND DESIGN OF RC AND STEEL CHIMNEY, Foundation design for varied soil strata.

UNIT-III

TALL BUILDINGS: Structural Concept, Configurations, various systems, Wind and Seismic loads,

UNIT-IV

Dynamic approach, structural design considerations and IS code provisions. Firefighting design provisions.

UNIT-V

APPLICATION of software in analysis and design.

Reference Books:

1. Structural Design of Multi-storeyed Buildings, Varyani U. H., 2nd Ed., SouthAsian Publishers, New Delhi, 2002.
2. Structural Analysis and Design of Tall Buildings, Taranath B. S., Mc Graw Hill, 1988.
3. Illustrated Design of Reinforced ConcreteBuildings(GF+3storeyed), Shah V. L. &Karve S. R., Structures Publications, Pune, 2013.
4. Design of Multi Storeyed Buildings, Vol. 1 & 2, CPWD Publications, 1976.
   Tall Building Structures, Smith Byran S. and Coull Alex, Wiley India. 1991.
   High Rise Building Structures, Wolfgang Schueller, Wiley., 1971.
5. Tall Chimneys, Manohar S. N., Tata Mc Graw Hill Publishing Company, New Delhi

Course Outcomes: At the end of the course, students will be able to

1. Analyse, design and detail Transmission/ TV tower, Mast and Trestles with different loading conditions.
2. Analyse, design and detail the RC and Steel Chimney.
3. Analyse. design and detail the tall buildings subjected to different loading conditions using relevant codes.

4. Analysis and design of dynamic approach OF STRUCTURAL DESIGN USING is Code provisions.

SEPE41 DESIGN OF ADVANCED CONCRETE STRUCTURES

L / week : 3Hrs Sessional Marks : 40
University Exam : 3 Hrs End Exam Marks : 60

Syllabus Contents

UNIT – I

ESTIMATION OF CRACK WIDTH AND REDISTRIBUTION OF MOMENTS IN REINFORCED CONCRETE BEAMS :

Factors affecting crack width in beams - Calculation of crack width - Empirical Method - Estimation of crack width in beams by IS 456 - Shrinkage and thermal cracking - Redistribution of moments in a fixed beam and a two-span continuous beam - Advantage and disadvantages of moment redistribution.

UNIT – II

DESIGN OF RIBBED (VOIDED) SLABS & GRID FLOORS :

Analysis of the ribbed slabs for moment and shears - Design for shear - Deflections - Arrangement of reinforcements.

Analysis of grid floors by Timoshenko's plate theory, stiffness matrix method - Equating joint deflections - Detailing of steel.

UNIT – III

DESIGN OF PLAIN CONCRETE WALLS :

Braced and unbraced walls - Eccentricities of vertical loads - Empirical design method (walls carrying axial load) - Design of wall for In-plane horizontal forces.

DESIGN OF SHEAR WALLS :

Steps of designing deep beams by IS 456 - Detailing of deep beams.

UNIT – IV

EARTH QUAKE FORCES AND STRUCTURAL RESPONSE :

Earthquake magnitude and intensity - Determination of design forces - Torsion in buildings - Ductile detailing of beams - Columns and frame members with axial force and moment.

DESIGN OF SHEAR WALLS :

Classification of shear walls - Loads in shear walls - Design of rectangular and flanged shear walls - Moment of resistance of rectangular shear walls

REFERENCES :

1) P.C.Varghese, "Advanced Reinforced Concrete Design", Prentice-Hall of India, Private Ltd., New Delhi.

2) P.C.Varghese, "Limit State Design of Reinforce Concrete", Prentice-Hall of India, Private Ltd., New Delhi.

3) Krishna Raju, "Advanced Reinforced Concrete Design - SI Units" CBS, New Delhi, 1986.

4) Blume, J.A., Newmark, N.M. and Corning, L.M. "Design of Multi-Storey Reinforced Concrete Buildings for Earth Quake Motion", Portland Cement Association, Chicogo, 1961.

5) Pankaj Agarwal, "Earthquake Resistant Structures", Prentice-Hall of India, Private Ltd., New Delhi.

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Course Outcomes: At the end of the course, students will be able to

1. Model the loads and findings the material properties.
2. Design deep beams and corbels
3. Design of shear walls using IS, ACI & Errocode.
4. Analyse the special structures by understanding their behaviour in torsional buckling.

5. Design and prepare detail structural drawings for execution citing relevant IS codes.

SEPE42 ADVANCED DESIGN OF FOUNDATIONS

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

PLANNING OF SOIL EXPLORATION for Different Projects, Methods of Subsurface Exploration, Methods of Borings along with Various Penetration Tests.

UNIT-II

SHALLOW FOUNDATIONS, Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations using Field Test Data, Pressure - Settlement Characteristics from Constitutive Laws.

PILE FOUNDATIONS, Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behaviour of Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of Piles.

UNIT-III

WELL FOUNDATION, IS and IRC Code Provisions, Elastic Theory and Ultimate Resistance Methods.

UNIT-IV

TUNNELS and Arching in Soils, Pressure Computations around Tunnels.

OPEN CUTS, Sheeting and Bracing Systems in Shallow and Deep Open Cuts in Different Soil Types.

UNIT-V

COFFER DAMS, Various Types, Analysis and Design, Foundations under uplifting loads, Soil-structure interaction

Reference Books:

1. Design of foundation system, N.P. Kurian, Narosa Publishing House
2. Foundation Analysis and Design, J. E. Bowles, Tata McGraw Hill New York
3. Analysis and Design of Substructures, Sawmi Saran, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.

Course Outcomes: At the end of the course, students will be able to

1. Decide the suitability of soil strata for different projects.
2. Design shallow foundations deciding the bearing capacityof soil.
3. Analyze and design the pile foundation.
4. Understand analysis methods for well foundation.

SEPE43 SOIL STRUCTURE INTERACTION

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil Structure Interaction.

UNIT-II

Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method. Relaxation and Interaction for the Evaluation of Soil Structure Interaction for Different Types of

Structure under various Conditions of Loading and Subsoil Characteristics.

UNIT-III

Preparation of Comprehensive Design Oriented Computer Programs for Specific Problems, Interaction Problems based on Theory of Sub Grade Reaction Such as Beams, Footings, Rafts Etc.

UNIT-IV

Analysis of Different Types of Frame Structures Founded on Stratified Natural Deposits with Linear and Non-Linear Stress-Strain Characteristics.

UNIT-V

Determination of Pile Capacities and Negative Skin Friction, Action of Group of Piles Considering Stress-Strain Characteristics of Real Soils, Anchor Piles and Determination of Pullout Resistance

Reference Books:

1. Analytical and Computer Methods in Foundation, Bowels J.E.,McGraw Hill Book Co., New York, 1974.

2. Numerical Methods in Geotechnical Engineering, Desai C.S. and Christian J.T., McGraw Hill Book Co., New York.

3. Soil Structure Interaction - The real behaviour of structures, Institution of Structural Engineers. Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg. Vol-17,

4. Elsevier Scientific Publishing Company.

5. Elastic Analysis of Soil-Foundation Interaction, Selvadurai A.P.S., Elsevier Scientific Publishing Company.

6. Analysis & Design of substructures, Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd. Design of Foundation System- Principles & Practices, Kurian N. P., Narosa Publishing

Course Outcomes: At the end of the course, students will be able to

1. Understand soil structure interaction concept and complexities involved.

2. Evaluate soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics.

3. Prepare comprehensive design oriented computer programs for interaction problems based on theory of sub grade reaction such as beams, footings, rafts etc.

4. Analyze different types of frame structure founded on stratified natural deposits with linear and non-linear stress-strain characteristics.

5. Evaluate action of group of piles considering stress-strain characteristics of real soils.

SECP03: MODEL TESTING LAB

L/week	: 4Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks: 60

Concrete:

Properties and testing of fresh and hardened concrete

Concrete Mix Design

Non-Destructive Testing of Concrete

Reinforced Concrete:

Under- reinforced and over-reinforced beams

Column

Steel:

Testing of steel beams under static loading including measurement of strains (Using electric resistance strain gauges)

Course Outcomes:

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

1. Plan the test set-up for model testing

2. Understand the behavior of structural components.

SECP04 NUMERICAL ANALYSIS LAB

P / week	: 4Hrs	Sessional Marks	: 40
University Exam	: 3 Hrs	End Exam Marks	: 60

Syllabus Contents:

Find the Roots of Non-Linear Equation Using Bisection Method.
Find the Roots of Non-Linear Equation Using Newton's Method.
Curve Fitting by Least Square Approximations.

Solve the System of Linear Equations Using Gauss - Elimination Method.

Solve the System of Linear Equations Using Gauss - Seidal Iteration Method. Solve the System of Linear Equations Using Gauss - Jorden Method.

Integrate numerically using Trapezoidal Rule.
Integrate numerically using Simpson's Rules.

Numerical Solution of Ordinary Differential Equations By Euler's Method.

Numerical Solution of Ordinary Differential Equations ByRunge- Kutta Method.

Course Outcomes: At the end of the course, students will be able to

1. Find Roots of non-linear equations by Bisection method and Newton's method.
2. Do curve fitting by least square approximations
3. Solve the system of Linear Equations using Gauss - Elimination/ Gauss - Seidal Iteration/ Gauss - Jorden Method
4. To Integrate Numerically Using Trapezoidal and Simpson's Rules
5. To Find Numerical Solution of Ordinary Differential Equations by Euler's Method, Runge- Kutta Method

SEPP01 MINI PROJECT

Syllabus Contents:

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.

Continuous assessment of Mini Project at Mid Semester and End Semester will be monitored by the departmental committee.

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

1. Identify structural engineering problems reviewing available literature.
2. Study different techniques used to analyze complex structural systems.
3. Work on the solutions given and present solution by using his/her technique applying engineering principles.

SEPE51 DESIGN OF PRESTRESSED CONCRETE STRUCTURES

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents

UNIT-I

INTRODUCTION TO PRESTRESSED CONCRETE: types of prestressing, systems and devices, materials, losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, code provision.

UNIT-II

STATICALLY DETERMINATE PSC BEAMS: design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions.

TRANSMISSION OF PRESTRESS in pretensioned members; Anchorage zone stresses for post tensioned members.

UNIT-III

STATICALLY INDETERMINATE STRUCTURES - Analysis and design - continuous beams and frames, choice of cable profile, linear transformation and concordancy.

UNIT-IV

COMPOSITE CONSTRUCTION with precast PSC beams and cast in-situ RC slab - Analysis and design, creep and shrinkage effects. Partial prestressing - principles, analysis and design concepts, crack-width calculations. Analysis and design of pre stressed concrete pipes

References:

1. Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 1955.
2. Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 1981.
3. Limited State Design of Prestressed Concrete, GuyanY., Applied Science Publishers, 1972.
4. IS: 1343- Code of Practice for Prestressed Concrete
5. IRC: 112

Course outcomes: At the end of the course, students will be able to

1. Find out losses in the prestressed concrete. Understand the basic aspects of prestressed concrete fundamentals, including pre and post-tensioning processes.
2. Analyse prestressed concrete deck slab and beam/ girders.
3. Design prestressed concrete deck slab and beam/ girders.
4. 4. Design of end blocks for prestressed members.

SEPE52 Analytical and Finite Element Analysis of Laminated Composite Plates

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

Introduction: Displacement Field Approximations for Classical Laminated Plate Theory (CLPT) and First Order Shear Deformation Theory (FSDT), Analytical Solutions for Bending of Rectangular Laminated Plates using CLPT.

UNIT-II

Governing Equations. Navier Solutions of Cross-Ply and Angle-Ply Laminated Simply-Supported Plates, Determination of Stresses. Levy Solutions for Plates with Other Boundary Conditions, Analytical Solutions for Bending of Rectangular Laminated Plates Using FSDT.

UNIT-III

Finite Element Solutions for Bending of Rectangular Laminated Plates using CLPT.

UNIT-IV

Introduction to Finite Element Method, Rectangular Elements, Formation of Stiffness Matrix, Formation of Load Vector, Numerical Integration, Post Computation of Stresses.

Finite Element Solutions for Bending of Rectangular Laminated Plates using FSDT.
Finite Element Model, C^0Element Formulation, Post Computation of Stresses.

UNIT-V

Analysis of Rectangular Composite Plates using Analytical Methods.

References:

Mechanics of Laminated Composites Plates and Shells, Reddy J. N., CRC Press.

.

Course outcomes: At the end of the course, students will be able to

1. Analyse the rectangular composite plates using the analytical methods.
2. Analyse the composite plates using advanced finite element method.
3. Develop the computer programs for the analysis of composite plates.

SEPE53 FRACTURE MECHANICS OF CONCRETE STRUCTURES

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

INTRODUCTION: Basic Fracture Mechanics, Crack in a Structure, Mechanisms of Fracture and Crack Growth, Cleavage Fracture, Ductile Fracture, Fatigue Cracking.

UNIT-II

FRACTURE MECHANISM:

UNIT-III

STRESS AT CRACK TIP: Stress at Crack Tip, Linear Elastic Fracture Mechanics, Griffith's Criteria, Stress Intensity Factors, Crack Tip Plastic Zone, Erwin's Plastic Zone Correction, R curves, Compliance, J Integral, Concept of CTOD and CMD.

UNIT-IV

MATERIAL MODELS: General Concepts, Crack Models, Band Models, Models based on Continuum Damage Mechanics, Applications to High Strength Concrete, Fibre Reinforced Concrete.

UNIT-V

Environment assisted Cracking, Service Failure Analysis, Crack Concepts and Numerical Modelling.

Reference Books:

1. Fracture Mechanics, Suri C. T. and Jin Z.H., 1st Edition, Elsevier Academic Press, 2012.
2. Elementary Engineering Fracture Mechanics, BroekDavid, 3rd Rev. Ed. Springer, 1982.
3. Fracture Mechanics of Concrete Structures – Theory and Applications, Elfgreen L., RILEM Report, Chapman and Hall, 1989.
4. Fracture Mechanics – Applications to Concrete, Victor, Li C., Bazant Z. P., ACI SP 118, ACI Detroit, 1989.

.

Course outcomes: At the end of the course, students will be able to

1. Identify and classify cracking of concrete structures based on fracture mechanics.
2. Implement stress intensity factor for notched members
3. Apply fracture mechanics models to high strength concrete and FRC structures.
4. Compute J-integral for various sections understanding the concepts of LEFM.

SEPE34 DESIGN OF MASONRY STRUCTURES

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

INTRODUCTION: Historical Perspective, Masonry Materials, Masonry Design Approaches, Overview of Load Conditions, Compression Behaviour of Masonry, Masonry Wall Configurations, Distribution of Lateral Forces.

UNIT-II

FLEXURAL STRENGTH of Reinforced Masonry Members: In plane and Out-of-plane Loading.

UNIT-III

INTERACTIONS: Structural Wall, Columns and Pilasters, Retaining Wall, Pier and Foundation.

SHEAR STRENGTH and Ductility of Reinforced Masonry Members.

UNIT-IV

PRESTRESSED MASONRY - Stability of Walls, Coupling of Masonry Walls, Openings, Columns, Beams.

UNIT-V

ELASTIC AND INELASTIC ANALYSIS, Modelling Techniques, Static Push Over Analysis and use of Capacity Design Spectra.

Reference Books:

1. Design of Reinforced Masonry Structures, Narendra Taly, ICC, 2nd Edn,
2. Masonry Structures: Behavior and Design, Hamid Ahmad A. and Drysdale Robert G., 1994.
3. Mechanics of Masonry Structures, Editor: Maurizio Angelillo, 2014.
4. Earthquake-resistant Design of Masonry Buildings,Toma evi Miha, Imperial College Press, 1999.

. **Course outcomes :**At the end of the course, students will be able to

1. Understand the masonry design approaches.
2. Analyse Reinforced Masonry Members.
3. Determine interactions between members.
4. Determine shear strength and ductility of Reinforced Masonry members.
5. Check the stability of walls
6. Perform elastic and Inelastic analysis of masonry walls.

SEPE44 DESIGN OF INDUSTRIAL STRUCTURES

L / week	: 3Hrs	Sessional Marks : 40
University Exam	: 3 Hrs	End Exam Marks : 60

Syllabus Contents:

UNIT-I

Chimneys – Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation.

UNIT-II

Water Tanks – Design of rectangular riveted steel water tank – Tee covers – Plates – Stays –

Longitudinal and transverse beams –Design of staging – Base plates – Foundation and anchor bolts.

UNIT-III

Design of pressed steel water tank – Design of stays – Joints – Design of hemispherical bottom water tank – side plates – Bottom plates – joints – Ring girder –Design of staging and foundation.

Reference Books:

1. Design of Steel Structure, Punmia B. C., Jain Ashok Kr., Jain Arun Kr., 2nd Ed., Lakshmi Publishers, 1998.
2. Design of Steel Structures, Ram Chandra, 12th Ed., Standard Publishers, 2009. Design of Steel Structures, Subramaniyam.

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

1. Design Steel Gantry Girders.
2. Design Steel Portal, Gable Frames.
3. Design Steel Bunkers and Silos.
4. Design Chimneys and Water Tanks.

SEPE54 DESIGN OF PLATES AND SHELLS

L / week : 3Hrs Sessional Marks : 40

University Exam : 3 Hrs End Exam Marks : 60

Syllabus Contents:

Prismatic folded Plate
Systems Shell
Equations

Approximate Solutions

Analysis and Design of Cylindrical Shells

Approximate Design methods for Doubly Curved Shells.

.

Reference Books:

1. Theory of Plates and Shells, Timoshenko and Woinowsky-Krieger S., Tata Mc Graw Hill Edition, 2010.

2. Design and Construction of Concrete Shell Roofs, Ramaswamy G. S., 1st Edition, 2005. Design of Reinforced Concrete Shells & Folded Plate, Varghese P. C., 1st Edition, PHI. Design of Plate and Shell Structures, Jawad Maan H., Springer Science.

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

1. Analyse and design prismatic folded plate systems.
2. Analyse and design shells using approximate solutions
3. Analyse and Design Cylindrical Shells
4. Design Doubly Curved Shells using Approximate Solutions.

SEPD01 DISSERTATION I

Lectures: 3hrs/week

Mid Semester Evaluation weight age - 30%

End Semester Evaluation weight age - 70%

Syllabus Contents:

Dissertation-I will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individuals contribution.

Continuous assessment of Dissertation – I and Dissertation – II at Mid Semester and End Semester will be monitored by the departmental committee.

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

1. Identify structural engineering problems reviewing available literature. Identify appropriate techniques to analyze complex structural systems.
2. Apply engineering and management principles through efficient handling of project

SEPD02 DISSERTATION II

Lectures: 3hrs/week

Syllabus Contents:

Dissertation – II will be extension of the to work on the topic identified in Dissertation – I.

Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be pre submission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.

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

Solve complex structural problems by applying appropriate techniques and tools.

Exhibit good communication skill to the engineering community and society.

Demonstrate professional ethics and work culture.

PGMC 41 RESEARCH METHODOLOGY AND IPR

Instruction Hours/week : 2(L) **Credits : 2**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT II

Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT V

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

11. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
12. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
13. Ranjit Kumar, 2nd Edition , “Research Methodology: A Step by Step Guide for beginners”
14. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
15. Mayall , “Industrial Design”, McGraw Hill, 1992.
16. Niebel , “Product Design”, McGraw Hill, 1974.
17. Asimov , “Introduction to Design”, Prentice Hall, 1962.
18. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New
19. Technological Age”, 2016.
20. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes:

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understand that when IPR would take such important place in growth of individuals & Nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

OPEN ELECTIVES

SEOE 11 BUSINESS ANALYTICS

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT I

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT II

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics technology.

UNIT III

Organization Structures of Business analytics, Team management, Management Issues, designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear optimization.

UNIT IV

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT V

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

References:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Course outcomes:

At the end of the course, students will demonstrate

1. The knowledge of data analytics.
2. The ability of think critically in making decisions based on data and deep analytics.
3. The ability to use technical skills in predicative and prescriptive Modeling to support business decision-making.
4. The ability to translate data into clear, actionable insights.

SEOE 12 INDUSTRIAL SAFETY

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination: 60**

UNIT I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in achine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

References:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course outcomes:

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

1. understand the preventive steps for industrial safety
2. apply the corrosion prevention methods
3. find the causes and tracking of faults in machine tools and equipment
4. understand the periodic and preventive maintenance of mechanical and electrical equipment

SEOE 13 OPERATIONS RESEARCH

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT II

Formulation of a LPP - Graphical solution revised simplex method- duality theory - dual Simplex method - sensitivity analysis - parametric programming

UNIT III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

UNIT IV

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Course Outcomes:

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

1. apply the dynamic programming to solve problems of discreet and continuous variables.
2. apply the concept of non-linear programming
3. carry out sensitivity analysis
4. model the real world problem and simulate it.

SEOE 14 COST MANAGEMENT OF ENGINEERING PROJECTS

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT I

Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT II

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents, Project team: Role of each member. Importance Project site: Data required with significance.

UNIT III

Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning,

UNIT IV

Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT V

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Course outcomes:

At the end of the course, students will be able to
1. understand the cost concepts in decision - making
2. commission, execute and manage Engineering projects
3. apply the quality management techniques in the execution of projects
4. apply the quantitative techniques for cost management of projects

SEOE 15 COMPOSITE MATERIALS

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT–I:

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II:

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III:

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V:

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

References:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials – K.K.Chawla.
5. Composite Materials Science and Applications – Deborah D.L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Course outcomes:

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

1. demonstrate the characteristics of composite materials and composite performance
2. understand the use of fibres as reinforcement
3. understand the manufacturing process of metal and polymer matrix composites
4. demonstrate the failure criteria

SEOE 16 ENERGY GENERATION FROM WASTES

Instruction Hours/week : 3(L) **Credits : 3**

Sessional Marks : 40 **Semester-end Examination : 60**

UNIT I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, design, construction and operation - Operation of all the above biomass combustors.

UNIT V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion biomass

gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course outcomes :

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

1.demonstrate the energy generation from wastes

2. understand the biomass pyrolysis and gasification

3. design, construct and operate biomass combustors

4. develop bio-energy system

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

M.Tech Degree Program (CBCS)

Syllabi of the AUDIT COURSES

Common to all specializations

(w.e.f 2018-19)

MAY, 2018

AUDIT COURSES

PGPA11 ENGLISH FOR RESEARCH PAPER WRITING

Instruction Hours/week : 2(L) **Credits : -**

Sessional Marks : 100 **Semester-end Examination : -**

UNIT I

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT II

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT III

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature

UNIT IV

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

References :

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Course outcomes :

At the end of the course, students will be able to
1. understand how to improve writing skills and level of readability
2. learn about what to write in each section
3. understand the skills needed when writing a Title

PGPA12 DISASTER MANAGEMENT

Instruction Hours/week : 2(L) **Credits : -**

Sessional Marks : 100 **Semester-end Examination : -**

UNIT I

Introduction

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; natural and Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT II

Repercussions Of Disasters And Hazards

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Manmade disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III

Disaster Preparedness And Management Preparedness

Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT IV

Risk Assessment Disaster Risk

Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT V

Disaster Mitigation Meaning

Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

References:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

Course outcomes :

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

1. demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. develop the standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

PGPA 13 SANSKRIT FOR TECHNICAL KNOWLEDGE

Instruction Hours/week : 2(L) **Credits : -**

Sessional Marks : 100 **Semester-end Examination : -**

UNIT I

Alphabets in Sanskrit, Past/Present/Future Tense

UNIT II

Simple Sentences Order

UNIT III

Introduction of roots

UNIT IV

Technical information about Sanskrit Literature

UNIT V

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

References:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Outcomes:

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

1. understand basic Sanskrit language
2. understand the Ancient Sanskrit literature about science & technology
3. help to develop logic, being a logical language

PGPA14 VALUE EDUCATION

Instruction Hours/week : 2(L) **Credits : -**

Sessional Marks : 100 **Semester-end Examination : -**

UNIT I

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

UNIT II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature ,Discipline

UNIT III

Personality - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness, Avoid fault Thinking. Free from anger, Dignity of labour.

UNIT IV

Behavior Development, Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT V

Character and Competence, Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence ,Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

References:

1 Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes:

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

1.acquire the knowledge of self-development

2.learn the importance of Human values

3.develop the overall personality

PGPA 21 CONSTITUTION OF INDIA

Instruction Hours/week : 2(L) **Credits : -**

Sessional Marks : 100 **Semester-end Examination : -**

Course Objectives:

Students will be able to:

1. understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I

History and philosophy of the Indian Constitution

History -Drafting Committee, (Composition & Working) - Preamble - Salient Features

UNIT II

Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT III

Organs of Governance: Parliament – Composition - Qualifications and Disqualifications - Powers and Functions, Executive President – Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions

UNIT IV

Local Administration:

District's Administration Head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT V

Election Commission: Election Commission: Role and Functioning - Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

At the end of the course, students will be able to discuss

1. the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. the passage of the Hindu Code Bill of 1956.

PGPA 22 PEDAGOGY STUDIES

Instruction Hours/week : 2(L) **Credits : -**

Sessional Marks : 100 **Semester-end Examination : -**

UNIT I

Introduction and Methodology:

Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching.

UNIT II

Thematic overview:

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT III

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT V

Research gaps and future directions:

Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

References:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign. 7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

At the end of the course, students will be able to understand

1. the pedagogical practices being used by teachers in formal and informal classrooms in developing countries.
2. the evidence on the effectiveness of these pedagogical practices
3. learns how teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.

PGPA 23 STRESS MANAGEMENT BY YOGA

Instruction Hours/week : 2(L) **Credits : -**

Sessional Marks : 100 **Semester-end Examination : -**

UNIT I

Definitions of Eight parts of yog. (Ashtanga)

UNIT II

Yam - Ahinsa, satya, astheya, bramhacharya and aparigraha

UNIT III

Niyam - Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT IV

Asan - Various yog poses and their benefits for mind & body

UNIT V

Pranayam - Regularization of breathing techniques and its effects-Types of pranayam 8

References:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur

2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Course Outcomes:

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

1. develop healthy mind in a healthy body thus improving social health also

2. improve efficiency

PGPA 24 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Instruction Hours/week : 2(L) **Credits : -**

Sessional Marks : 100 **Semester-end Examination : -**

UNIT I

Neetisatakam-Holistic development of personality

Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) - Verses- 26,28,63,65 (virtue)

UNIT II

Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)

UNIT III

Approach to day to day work and duties.

Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47,48- Chapter 3-Verses 13, 21, 27, 35 - Chapter 6-Verses 5,13,17, 23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT IV

Statements of basic knowledge.

Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68 - Chapter 12 -Verses 13, 14, 15, 16,17, 18

UNIT V

Personality of Role model. Shrimad BhagwadGeeta: Chapter2-Verses 17 - Chapter 3-Verses 36,37,42 Chapter 4 - Verses 18, 38,39 - Chapter18 – Verses 37,38,63.

References :

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata 2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes :

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

1. develop personality and achieve the highest goal in life

2. lead the nation and mankind to peace and prosperity

3. Help in developing versatile personality.