Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Curriculum for

M. Tech. (W.R.E.E.)

(Civil Engineering)

Department of

Civil Engineering

Vision:

Excellence in Civil Engineering Education

Mission:

M1: Make competent Civil Engineers with high level of professional, moral and ethical values

M2: Impart highest standards in theoretical as well as practical knowledge and skill set

M3: Establish Center of Excellence in major areas of Civil Engineering to respond to the current and future needs of the industry, higher studies as well as research

Department of Civil Engineering

First Year M. Tech. (FYMT) Water Resource and Environmental Engineering (Civil Engineering) Semester I (Pattern 2018)

Course Code	Course	Course Type	Teaching Scheme		Examination Scheme					Total	Credits
					Formative Assessment			Summative Assessment			
			L	P	ISE		CE	ESE	OR		
					T1	T2					
CVPA11181	Advanced Fluid Mechanics	TH	3	-	20	10	20	50	-	100	3
CVPA11182	Environmental Chemistry and Microbiology	TH	3	-	20	10	20	50	-	100	3
CVPA11183	Program Elective I	TH	3	-	20	10	20	50	-	100	3
CVPA11184	Program Elective II	TH	3	-	20	10	20	50	-	100	3
CVPA11185	Laboratory I	CE-OR	-	4	-	-	50	-	50	100	2
CVPA11186	Laboratory II	CE-OR	-	4	-	-	50	-	50	100	2
CVPA11187	Research Methodology & IPR	CE	2	-	-		50	-	--	50	2
AP1	Audit Course I	-	-	-	-	-	-	-	-	-	-
	Total		**14**	**8**	**80**	**40**	**230**	**200**	**100**	**650**	**18**

Elective I

CVPA11183A Water Resource System Planning
CVPA11183B Dam Engineering
CVPA11183C Remote Sensing and GIS

Elective II

CVPA11184A Advanced Water Treatment
CVPA11184B Environmental Impact Assessment
CVPA11184C Environmental Instrumentation

Audit Courses

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

BOS Chairman Dean Academics Director

Department of Civil Engineering

First Year M. Tech. (FYMT) Water Resource and Environmental Engineering (Civil Engineering) Semester II (Pattern 2018)

Course Code	Course	Course Type	Teaching Scheme		Examination Scheme					Total	Credits
					Formative Assessment			Summative Assessment			
			L	P	ISE		CE	ESE	OR		
					T1	T2					
CVPA12171	Open channel Hydraulics	TH	3	-	20	10	20	50	-	100	3
CVPA12172	Adv. Waste Water Treatment	TH	3	-	20	10	20	50	-	100	3
CVPA12173	Program Elective III	TH	3	-	20	10	20	50	-	100	3
CVPA12174	Program Elective IV	TH	3	-	20	10	20	50	-	100	3
CVPA12175	Laboratory III	CE-OR	-	4	-	-	50	-	50	100	2
CVPA12176	Laboratory IV	CE-OR	-	4	-	-	50	-	50	100	2
CVPA12177	Mini project	CE-OR	-	4	-	-	50	-	50	100	2
AP2	Audit Course II	-	-								
	Total		**12**	**12**	**80**	**40**	**230**	**200**	**150**	**700**	**18**

Elective III

CVPA12173A Hydrology
CVPA12173B Irrigation and Drainage
CVPA12173C FEM to Flow Problems

Elective IV

CVPA12174A Air Pollution and Control
CVPA12174B Industrial Waste Water Treatment
CVPA12174C Solid and Hazardous Waste Management

Audit Courses

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

BOS Chairman Dean Academics Director

SEMESTER - I

First Year - Semester I

Advanced Fluid Mechanics (CVPA11181)

Teaching Scheme
Credits: 3
Lectures:3 hrs./week
Practical: NA
Tutorial : NA

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisite: Fluid Mechanics at UG level including Kinematics, Dynamics, laminar and turbulent flow, differential and integral Calculus

Course Objectives:

- To impart knowledge of kinematics to solve problems of fluid mechanics (other than UG level)
- To introduce students to Navier Stokes equations and their exact solutions and boundary layer theory.
- To introduce students to Reynolds equation of motion and its solution
- To introduce students to problems related to turbulent flow in pipes
- To introduce students to the concept of flow around submerged bodies

Course Outcomes:

By the end of the course,

1. Students should be able to solve problems related to motion of fluid particles using principles of Kinematics.
2. Students should be able to derive equations of motion using principles of dynamics and apply Navier Stokes equations for solving laminar flow problems
3. Students should be to determine boundary layer thickness using various methods
4. Students should be able to apply the basics of turbulent flow in practical problems
5. Students should be able to solve pipe flow problems
6. Students should be able to calculate drag and lift of submerged bodies

Unit I : Kinematics

Revision of concepts in basic Fluid Mechanics such as classification of flows,Equation of continuity for three dimensional flow in Cartesian co-ordinates, types of motion, rotational and irrotational motion, velocity potential, stream function and flow net, methods of drawing flow net, Continuity Equation in polar and cylindrical coordinates, Standard two dimensional flow pattern, source, sink, doublet and their combination

Unit II : Laminar Flow

Navier Stokes' equations, solution of NS equations for flow between parallel plates –a) both plates stationary b) one plate moving , derivation of Hagen Poiseuille's equation using NS equations.

Unit III :Boundary Layer Theory

Introduction to Boundary layer (BL), BL equations, Derivation for development of boundary layer on a flat plate using BL equations, Local and mean drag coefficients, Karman's momentum integral equation, Karman Pohelhausen's solution.

Unit IV : Turbulent Flow

Introduction, Characteristics of turbulent flow, Types of turbulent flow, Prandtl's mixing length theory, velocity distribution in turbulentflow, Reynolds' equation of motion, typical solution, Isotropic and homogeneous turbulence

Unit V : Flow through pipes
Energy losses in pipe flow (major losses and minor losses), Darcy Weisbach Equation, Borda Carnot equation, variation of friction factor for laminar flow and for turbulent flow, Nikuradse's experiments on artificially roughened pipes, resistance to flow in smooth and rough pipes, friction factor for commercial pipes, Moody's diagram, flow through pipes such as simple, compound, series parallel, Dupits equations, Three reservoir and pipe network analysis
Unit VI: Fluid Flow around Submerged Objects
Definitions and expressions for drag, lift, drag coefficient, lift coefficient, types of drag. Drag on sphere, cylinder, flat plate and airfoil, Karman's vortex street, Effect of free surface and compressibility on drag, Development of lift, Lift on cylinder and Aerofoil, Magnus effect, Polar diagram.
Text books
1. SukumarPati, Fluid Mechanics and Hydraulic Machines, Tata McGraw-Hill 2. S. K. Som, Gautam Biswas, Suman Chakraborty, Introduction to fluid Mechanics and fluid machines, McGraw-Hill – 2013 ed. 3. Fluid Mechanics and Machninary, CSP Ojha, R. Berndtsson, P.N.Chandramouli, Oxford University Press
Reference books
1. White, Fluid Mechanics, Mc-Graw Hill 2. Introduction to Fluid Mechanics Edward J. Shaughnessy, Jr. Ira M. Katz, James P. Schaffer Oxford University Press 3. Fluid Mechanic and Machinery B. Ramdurhaiah, New Age International

Environmental Chemistry and Microbiology (CVPA11182)

Teaching Scheme
Credits: 3
Lectures:3 hrs./week
Practical: NA
Tutorial : NA

Examination Scheme
Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisite: Environmental Engineering I & II at UG level

Course Objectives :

- To impart knowledge of various aspects of chemistry & microbiology in environmental engineering.
- To develop understanding of role of micro-organisms and their activities of environmental significance.

Course Outcomes :

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

1) Understand the physical, inorganic and organic chemistry.
2) Understand the process in chemistry for water and waste water.
3) Understand absorption spectroscopy.
4) Understand fundamental of microbial structure and its function.
5) Understand microbial growth rate, nutrient study.
6) Understand bio kinetic coefficients.

Unit I : Basic concept of physical , inorganic and organic chemistry

Periodic table of elements, characteristic of alkali earth metals, transits element , halogen, non metals etc. ionic and covalent bond. Organic compound classification, nomenclature and characteristic of some organic compound alkane, alkenes, alcohol.

Unit II: Process Chemistry for Water and Wastewater Treatment Basic Principles

Thermodynamic equilibrium; Acid Base Equilibrium: Alkalinity and acidity, Buffering in water system; Solubility Equilibrium.
Water stabilization: Corrosion, Oxidation Reduction.
Fundamentals of process kinetics: Reaction rates and order, Reactor design; Fundamentals of surface and colloidal chemistry; Adsorption – physical versus chemical adsorption, factors influencing adsorption, Adsorption isotherms, absorption process.

Unit III : Absorption spectroscopy

Basic concept and type of chemical analysis of chromium, manganese, copper, arsenic etc. Instrumentation: UV-visible, atomic absorption spectroscopy, flame photometry and mass photometry with reference to working principle, calibration and application.
Environmental Toxicity and its analysis

Unit IV: Microbial cell structure and function

The prokaryotic cell, size, shape and arrangement of bacterial cells; prokaryotic cell membranes, cytoplasmic matrix, the nucleoid, the prokaryotic cell wall, components external of the cell wall, the bacterial endospore.
Microscopic Techniques: The light microscopy, electron microscopy, newer techniques in microscopy, preparation and staining of specimens, simple stains, differential and special stains.

Unit V : Microbial Nutrition

Microbial nutrient requirements, nutritional types of microorganisms, uptake of nutrients by the cell, culture media

Microbial Growth and Control: The growth of bacterial cultures, growth curve, measurement of microbial growth, influence of environmental factors on growth, microbial growth in natural environments

The Diversity of the Microbial World: Microbial taxonomy and phylogeny, Archaea, Bacteria, fungi, slime molds, water molds, algae, protozoa, helminths.

Unit VI : Microbiological and Bio kinetics

Bacteria: classification and characteristics of bacteria, cell morphology, growth rate curve, culture, metabolism – basic metabolic models, microbial growth kinetics; Bio kinetic coefficients, determination of bio kinetic coefficient, application of bio kinetic constant in ASP, Oxidation ponds, UASB.

Text Books :

1. Sawyer C.N., McCarty P.L. and Parkin G.F., Chemistry for Environmental Engineering and Science, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Dara S.S., A Textbook of Environmental Chemistry and Pollution Control, S. Chand and Company Ltd., New Delhi.
3. Manhan, S.E., Environmental Chemistry, Lewis Publishers

Reference books:

1. Pelczar M.J., Chan E.C.S., Krieg N.R., Microbiology, Tata McGraw Hill Education (P) Ltd., New Delhi.
2. E. Gaudy and Gaudy, Environmental Microbiology, Tata McGraw Hill Education (P) Ltd., New Delhi.
3. De A.K., Environmental Chemistry, New Age International (P) Ltd., New Delhi.
4. Khopkar S.M., Environmental Pollution Analysis, New Age International (P) Ltd., New Delhi

Elective I

Water Resources System Planning (CVPA11183A)

Teaching Scheme

Credits: 3
Lectures : 3 hrs./week
Practical: NA
Tutorial : NA

Examination Scheme

Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisite: Hydrology and Ground water engineering, FM-I , FM-II

Course Objectives:

- To impart the necessity and aspects of water resource planning and management.
- To educate students about role of central and state government in water resources planning
- To introduce various water conservation structures.
- To impart the knowledge of reservoir operation and canal irrigation system.
- To make students aware of economics of water resources projectsto expose students to the reality of practicing water resources by virtue of cost benefit analysis.
- To make students aware of miscellaneous systems like basin planning; inter-basin transfer of water and ground water evaluation**.**

Course Outcomes:

By the end of the course,

1. Students would understand the necessity and aspects of water resource planning andmanagement.
2. Students would be able to apply different rules of central and state government in water resources planning
3. Students would be able to select and design a specific water conservation structure as per specific sight.
4. Students would be able to solve problems related to reservoir operation, sediment load and canal irrigation for managing the water resources.
5. Students would be able to plan single and multipurpose projects economically.
6. Students would be able to optimize surface as well as ground water resources and use them effectively by applying the concepts like basin planning, inter-basin transfer of water etc.

Unit I : Water Resources Planning

Objectives of water resource planning and management, Aspects of water resources planning, water resource development; needs, opportunities; social goals. Spatial and temporal characteristics of water resources. Demand for drinking water; irrigation, hydropower; navigational.

Unit II :Role of Central and State Government in water resources planning

Introduction to National and State water laws and policies, water budget, criterions for water distribution, Different water distribution policies for different sectors (private, industrial and domestic), Water tariff, tariff regulations and criterions.

Unit III : Water Conservation Structures

Study of water conservation structures like CCT, MNB/ENB, CNB, Compartment bunding, Terracing,

Recharge shaft, KT Weir, Nala deepening, Farm pond and Forest pond, Percolation tank. One or two Case studies related Jalyukta Shivar Abhiyan of Govt. of Maharashtra.
Unit IV: Management of Water Resources
Characteristics and functions of reservoir; planning region and horizons, reservoir sedimentation; conservation storage; conflict among uses,constraints like non- reversibility.Reservoir operations. Canal irrigation systems(operation, distribution, maintenance), Flood and drought mitigation.
Unit V: Economic Planning
Studies of single and multipurpose projects– multi objective planning models, financial analysis of water resources projects, allocation of cost of multipurpose projects; repayment of cost. Discounting techniques; benefit cost parameters; estimation of benefits and costs; appraisal criteria; social benefit cost analysis.
Unit VI: Miscellaneous systems
Basin planning; inter-basin transfer of water.Ground water evaluation; conjunctive use of surface and ground water.
Text books
1. Bhave P.R., "Water Resources Systems", Narosa Publications, New Delhi. 2. Chaturvedi, M.C.Water Resources System Planning. 3. Biswas, A.K.Water Management System Application
Reference Books
1. National water Laws 2. National Water Policies **3.** Indian Government's rules and regulations for water distribution systems.

Elective I
Dam Engineering (CVPA11183B)

Teaching Scheme

Credits: 3
Lectures: 3hrs./week
Practical: NA
Tutorial : NA

Examination Scheme

Formative Assessment: 50 Marks
Summative Assessment:50 Marks

Prerequisite: Fluid Mechanics at UG level including Kinematics, Dynamics, laminar and turbulent flow, differential and integral Calculus

Course Objectives:

- To introduce students to various aspects of dam engineering like classification of dams, social issues, Displacement and rehabilitation etc.
- To impart the knowledge about assessment of hydropower potential of a dam project and different instruments for safety purposes.
- To equip the students to design the gravity dam
- To equip the students to design the earthen dam
- To equip the students to design spillway.
- To impart the knowledge of general aspects of rock dam fill dam and arch dam

Course Outcomes:

By the end of the course, students would be able to

1) Understand the various aspects of dam engineering like classification of dams, social issues, displacement and rehabilitation etc.
2) Asses the hydropower potential of a dam project and apply different instruments for safety purposes.
3) Design of gravity dam
4) Design of earthen dam
5) Design of spillway.
6) Understand the general aspects of rock dam fill dam and arch dam

Unit I :Introduction to dams

Introduction, Historical development of dams, Different terms related to dams, Selection of site for dam, Factors governing selection of type of dam, Classification of dams based on purpose, materials, size of project, hydraulic action, structural action, Dams and earthquakes, Dams and social issues, Large dams verses small dams, Displacement and rehabilitation, Dams and climate change.

Unit II : Dam Safety and Instrumentation and Hydropower

Introduction, Objectives of dam safety and instrumentation, Selection of Equipments, general working principles of instruments, Introduction to hydropower, Advantages and limitations of hydropower, Assessment of hydropower potential, Definition and different terms related to hydropower ,Features of layout of hydropower plant, Classification of hydropower plants based on storage ,functions, head, plant capacity, location, nature of project

Unit III : Gravity Dams

Forces acting on the gravity dams earthquake force-pseudo static and dynamic response approach, load

classifications, stability analysis, distribution of shear and normal stresses, principle stresses, Stress concentration around openings, foundation treatments, Design of concrete dam. Reservoir operation
Unit IV: Spillways
Spillway-types, components, design principles, Design of different spillways such as Ogee, side channel, siphon. Energy dissipation devices and their design
Unit V : Earthen Dams
Seepage through dam and its foundations, stability analysis for sudden drawdown condition, steady seepage condition, end of constructions, seismic effects, pore pressures, protection of upstream and downstream slopes.
Units VI :Rock fill Dams and Arch Dams
Rock fill Dams: Relevant rocks fill characteristics, general design, principal, method of construction and compaction. **Arch Dams:** General concepts of trail load theory, elastic shell methods, thick cylinder theory.
Text books:
1. Modi, P.N., Irrigation, Water Resources and Water Power Engineering, Standard Book House, NewDelhi, 2nd ed, 1990. 2. Garg S.K., Irrigation Engineering and Hydraulic Structures, Khanna Publishers N.D. 13th ed, 1998. 3. Leliavsky, Serge, Design Textbook in Civil Engineering: Volume Six: Dams, Oxford and IBH Publishing Co. Pvt. Ltd., 1981.
Reference books:
1. Varshney, R.S. Concrete Dams 2. Sherard, J.L ., Earth Dams 3. MurtyChalla, S. Water resources Engineering Principles and Practice, New Age International
I.S. Codes I.S. 8605 – 1977 (Reaffirmed 1998), I.S. 6512-1984 (Reaffirmed 1998), I.S. 457 – 1957 (Reaffirmed, 2005), I.S. 10135 – 1985, I.S. 14591 – 1999, I.S. 11223 – 1985 (Reaffirmed 2004), I.S. 6934 – 1998 (Reaffirmed 2003), I.S. 11155- 1994, I.S. 5186 – 1994, I.S. 10137- 1982 (Reaffirmed 2004), I.S. 4997 – 1968 (Reaffirmed 1995) given by B.I.S. New Delhi.

Elective I
Remote Sensing and GIS (CVPA11183C)

Teaching Scheme

Credits: 3
Lectures: 3 hrs./week
Practical: NA
Tutorial : NA

Examination Scheme

Formative Assessment : 50 Marks
Summative Assessment :50 Marks

Prerequisite: Surveying at UG level

Course Objectives:

- To introduce students to Remote Sensing
- To make students aware of methodologies of Aerial Photography And Photogrammetry.
- To impart the knowledge of Remote Sensing Satellites
- To make students aware of procedure for Image Interpretation.
- To introduce students to GIS

Course Outcomes:

By the end of the course, students would be able to:

1. Understand the concept of Remote Sensing
2. Understand the methodologies involved in RS
3. Use of Remote Sensing and GIS software
4. Well conversant with procedure for Image Interpretation , processing and mapping
5. Understand the concept of GIS
6. Understand applications of RS-GIS in water resources engineering

Unit I : Introduction to Remote Sensing and EMR

Introduction of Remote Sensing – Energy sources and Radiation principles, Energy equation, EMR and Spectrum, EMR interaction with Atmosphere scattering, Absorption, EMR interaction with earth surface features reflection, absorption, emission and transmission, Spectral response pattern , vegetation, soil, water bodies- Spectral reflectance. Aerial photography and photogrammetry, height determination contouring - photographic interpretations - stereoscopy – parallax bar- Flight Planning- Photo Interpretation.

Unit II: Data Acquisition and Satellites.

Data acquisition –Procedure, Reflectance and Digital numbers- Intensity- Reference data , Ground truth, Analog to digital conversion, Detector mechanism- Spectro- radiometer-Ideal remote sensing system – Characters of real and successful remote sensing system- Platforms and sensors- orbits types – Resolution. Remote sensing satellites: Land observation satellites, characters and applications, IRS series, LANDSAT series and INSAT series.

Unit III : Types of remote sensing and image interpretation

Introduction- Active, Passive, Optical Remote sensing, sensors and characters. SLAR, SAR Scattrometers,- Altimeter, Characteristics, Image interpretation characters. Introduction to:Image Acquisition And Format, Image Distortion And Rectification, Image Enhancement, Image Classification Image Analysis.

Unit IV: Introduction to GIS

Digital Signal Processor Architectures, hardware units as MAC unit, Barrel shifter, Address generators, pipelining, circular buffering.

Unit V: Data and Processing
Types of geographic data, levels of measurements. Concepts of space and time, Spatial data models, encoding methods of data input – Keyboard, Manual Digitizing and Automatic Digitizing methods, Linking of Spatial and Attribute data to maps, Metadata Spatial data input: Digitization, error identification. Errors: Types, sources, correction. Editing and topology building.
Unit VI: Applications of RS GIS in water resources engineering
Simple-complex query with two or more tables using SQL. Queries using Union, Intersection, Join etc operations. Types of Models, Conceptual Models of WREE, GIS analysis and Interpretation, Over view of Open sources softwares such as ARC – GIS, Q – GIS.
Text books
1. R. Michael Hord, Remote sensing methods & applications, Wily Interscience Publication. 2. Chang, K. T. (2008): Introduction to Geographic Information Systems, Avenue of the Americas, McGraw-Hill, New York 3. Kresse, W. and Danko, D. (2002): Springer Handbook of Geographic Information,Springer Drecht, London 4. Bao, J., Tsui, Y. (2005): Fundamentals of Global Positioning System Receivers, John Wiley Sons, Inc., Hoboken
Reference Books
1. Lilleson J.T.M. &Krefer R.W. Wiley, Remote sensing & image interpretation, New York. 2. Sheford, Photogrammetry 3. Redlands,Environmental Systems Research Institute, Inc. (1998): Understanding GIS: The ARC/INFO Method, ESRI Press. 4. Ahmed, E. L., Rabbany (2002): Introduction to Global Positioning System, ArtechHouse, Boston

Elective II

Advanced Water treatment (CVPA11184A)

Teaching Scheme

Credits: 3
Lectures : 3 hrs./week
Practical: NA
Tutorial : NA

Examination Scheme

Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisite: Environmental Engineering I & II at UG level

Course Objectives:

- To introduce students to design water treatment units.
- To impart the knowledge of advances in treatment & ecofriendly unit.
- To make students aware of different standards of portable water.

Course Outcomes:

By the end of the course, students will able to

1. Understand the unit operation in water treatment.
2. Understand the unit process in water treatment.
3. Design adsorption and softening technique.
4. Design filtration technique in water.
5. Understand ground water treatment.
6. Design membrane process.

Unit I: Introduction to Unit Operations in water treatment.

Physical and chemical quality of surface and sub-surface waters. Components of water supply systems; Water use and demand estimation; Design period, population data and flow rates for water supply systems; Factors affecting water consumption and variation in demand.

Unit II : Unit processes in water treatment

Aeration: Process, Types of aerator, Design of gravity and spray aerator Coagulation: Theory, Design of rapid mixer, Flocculation: Process, Transport of colloids and flocs, Design of slow mixer
Settling: Types of settling, Solids flux analysis, Inclined-settling devices, Design of Clarifier, Coagulation, flocculation and settling in wastewater treatment. Disinfection: Methods and means, Kinetics, Wastewater chlorination. UV disinfection: Source, System components, Estimation of UV dose

Unit III: Adsorption and Softening Technique.

Adsorption: Different Types of Adsorption, factors influencing adsorption, Adsorption Isotherms(including Numerical), Adsorption Kinetics in Batch Reactors, Breakthrough Curve and Design of adsorption column. Chemical Precipitation, Hardness Removal- Lime Soda, ion exchange, zeolite process. (Including numerical).

Unit IV: Filtration Technique

Depth filtration, filter media, filter hydraulics, Analysis of the filtration process, Backwash hydraulics, Rate control patterns and methods, Dual and multimedia filters, Filtration in wastewater treatment

Unit V: Ground water Treatment

Introduction: Definition of groundwater, role of groundwater in hydrological cycle, classification of aquifers, flow and storage characteristics of aquifers, Darcy's law, anisotropy and heterogeneity.
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 Quality: General problem of contamination of groundwater, sources, remedial

and preventive measures, seawater intrusion in coastal aquifers.

Unit VI: Membrane Process

Theory of Membrane separation, mass Transport Characteristics, Cross Flow filtration, Membrane Filtration, Flux and Pressure drop.
Membrane Fouling, Control of Fouling, Pretreatment methods, monitoring of Pretreatment,Langlier Index, Silt Density Index, Chemical cleaning.
Microfiltration principles and applications, Ultra filtration principles and applications, Nano Filtration principles and applications, Reverse Osmosis: Theory and design of modules and applications, Electro dialysis and Ion exchange Theory and design.

Text books

1. Dr. B.C.Punmia, Water Supply Engg., LaxmiPublicaiton
2. S.K. Garge , Water supply Engg., Khanna Publication.
3. Raju, B.S.N., "Water Supply and Wastewater Engineering", Tata McGraw Hill Pvt Ltd., New Delhi.

Reference Books

1. Fair, G.M., Geyer J.C and Okun, Water and Waste water Engineering" Vol II, John Wiley Publications.
2. Weber W.J., "Physico - Chemical Processes for Water Quality Control".
3. Walton, W.C., "Ground Water Resources Evaluation", McGraw Hill. 1970
4. Driscoll, F.G., "Ground Water and Wells", Johnson Division. 1986.
5. Anthony Wachinski, Membrane Processes for water reuse, McGraw-Hill, USA, 2013
6. Baker, R.W., "Membrane technology and applications", 2nd., John Wiley 2004
7. Noble, R.D. and Stern, S.A., "Membrane Separations Technology: Principles and Applications", Elservier, Netherlands, 1995.

Elective II

Environmental Impact Assessment (CVPA11184B)

Teaching Scheme

Credits: 3
Lectures : 3 hrs./week
Practical: NA
Tutorial : NA

Examination Scheme

Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisite: Environmental Engineering I & II at UG level

Course Objectives:

- To introduce students to Environmental impact assessment
- To make students aware of methodologies of EIA.
- To impart the knowledge of Water and air Quality Impact Assessment
- To make students aware of procedure for environmental clearance & structure of EIA document.
- To impart the knowledge of Norms &Standards
- To expose students to Provisions in the EIA notification Procedure for obtaining Environmental clearance for construction projects

Course Outcomes:

By the end of the course, students would be able to

1. Understand the concept of Environmental impact assessment
2. Understand the methodologies involved in EIA
3. Use of Water and air Quality Impact Assessment
4. Well conversant with procedure for environmental clearance & structure of EIA document
5. Implementation of Norms &Standards
6. Well conversant with EIA notification Procedure for obtaining Environmental clearance for construction projects.

Unit I:Environmental impact assessment

Environmental impact assessment: Introduction, Concepts and aims, Impact statement, Methods and Processes, Mitigation processes .Prediction and assessment of impact on air, water and noise. Public participation in environment decision making: Environment education and awareness, Environmental economics, Economics of Pollution control, Cost benefit analysis.

Unit II: Methods of EIA

Methods for impact assessment: Background information, interaction matrix methodologies, network methodologies, environmental setting, environmental impact assessment methodology, documentation and selection process, environmental indices and indicators for describing affected environment, Life cycle assessment

Unit III: Water quality Impact Assessment

Water Quality Impact Assessment – attributes, Water Quality Impact Assessment of Water Resources Projects, Data requirements of water quality impact assessment for dams, Impacts of dams on environmental, Case studies.
Prediction and assessment of impact for air environment: Basic information of air quality, identification of type and quantity of air pollutant, existing air quality and air quality standards, impact prediction and assessment, mitigation

Unit IV: EIA for various industries.
Categorization of Industries for seeking environmental clearance from concerned authorities, procedure for environmental clearance, procedure for conducting environmental impact assessment report, Rapid and Comprehensive EIA, general structure of EIA document, Environmental management plan, post environmental monitoring
Unit V : Norms and Standards
Norms & Standards: OHSHAS 18001 & its significance, ISO 14000 & its significance, other acts in ESE and case studies, Feasibility Studies and Management issues. Related Issues: Principles of sustainable development and implications of finite biosphere and complexities for engineering design and decision-making, Design of controlled environments to enhance health and protection of natural resources for sustainable development, Resource problems and design with ecology and economics.
Unit VI: Provisions of EIA
Latest EIA notification by Ministry of Environment and Forest (Govt. of India): Provisions in the EIA notification, Procedure for public hearing, post environmental monitoring, Procedure for obtaining Environmental clearance for construction projects.
Text books
1. Canter R.L., Environmental Impact Assessment, McGraw Hill International edition, 1997. 2. Peter Watten (Eds.) - `Environmental Impact Assessment Theory and Practice', Unwin Hyman, London (1988). 3. Environmental Impact Assesment By R.RBarthwal (New Age Intenational Publishers)
Reference Books
1. John G. Rau and David C. Woolen (Eds.) `Environmental Impact Analysis Hand Book', McGraw Hill, (1980). 2. Meyers A. Robert (Eds.) Encyclopedia of Environmental Analysis and Remediation Vol. 1-8, John Wiley & Sons, 1998. 3. Encyclopedia of Industrial Safety and Health, 1999 4. UNESCO "Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development",WNESCO/UNEP, Paris

Elective II

Environmental Instrumentation (CVPA11184C)

Teaching Scheme

Credits: 3
Lectures : 3 hrs./week
Practical: NA
Tutorial : NA

Examination Scheme

Formative Assessment : 50 Marks
Summative Assessment : 50 Marks

Prerequisite: Environmental Engineering I & II at UG level

Course Objectives:

- To study various instrumentation technique for environmental analysis.

Course Outcomes:

By the end of the course, student will able to

1. Understand instrumental analysis technique.
2. Understand spectrometry type I
3. Understand spectrometry type II
4. Understand spectrometry type III
5. Understand Separative Methods
6. Understand radioactive instrumentation.

Unit I : Introduction to Chemical Instrumental Analysis

Introduction to Chemical Instrumental Analysis, advantages over classical methods, classification, various units used in chemical analysis. Introduction to Electro analytical methods, potentiometry, voltametry, coulometry

Unit II : Spectrometric Methods-I

Laws of Photometry, UV-visible instrument component, photocolorimeters, single and double beam instruments, various types of UV-visible spectrophotometers. Atomic absorption spectrophotometer: Principle, working, hollow cathode lamp, atomizer, back-ground correction.

Unit III : Spectrometric Methods-ll.

IR spectroscopy: Principle, IR sources, IR detectors, dispersive and Fourier Transform IR spectroscopy. Atomic Emission Spectroscopy: Principle, types, Flame photometer, DC arc and AC arc excitation, plasma excitation.

Unit IV: Spectrometric Methods-III and Miscellaneous Instruments

Fluorimeters and Phosphorimeters: Principle, spectrofluorimeters, spectrophosporimeter, Raman effect, Raman spectrometer. Nuclear Magnetic Resonance (NMR) spectrometry. Chemical shift principle, working of NMR, FTNMR. Gas analyzers: CO, CO2, Hydrocarbons, O2, NOX

Unit V: Separative Methods

Mass Spectrometer(MS): Principle, ionisation methods, mass analyzer types magnetic deflection type time of flight, quadrupole, double focusing, detectors for MS.T.E.

Unit VI: Radioactive Instrumentation
X-ray spectrometry: Instrumentation for X-ray spectrometry, X-ray diffractometer: Bragg's law, Auger emission spectroscopy, Electron spectroscopy for chemical analysis(ESCA) .B. Radiation detectors: Ionisation chamber, Geiger-Muller counter, proportional counter, scintillation counters.
Text books
1. Instrumental Methods of Analysis, Willard, Merritt, Dean, Settle, CBS Publishers & Distributors
Reference Books
1. Instrumental Methods of Chemical Analysis, Galen W. Ewing, McGraw-Hill Book Company, Fifth edition 2. Introduction to Instrumental Analysis, Robert D. Braun, McGraw-Hill Book Company. 3. Principles of Instrumental Analysis, Skoog, Holler, Nieman, Saunders College Publishing, 1998

Advanced Fluid Mechanics Lab (CVPA11185)

Teaching Scheme

Credits: 2
Laboratory Work: 4 hrs./week
Practical: NA
Tutorial : NA

Examination Scheme

Formative Assessment: 50 Marks
Summative Assessment: 50 Marks

Prerequisite: FM I and FM II at UG level

Course Objectives

- To give exposure to practical problems related to Fluid Mechanics
- To introduce students the concepts of drag and lift practically
- To introduce students to the concept of boundary layer growth practically
- To impart knowledge about pipe flow, major losses and pipe networks
- To introduce three reservoir problem practically
- To impart knowledge about kinematical solution of flow problem using flow net

Course Outcomes

After completing the lab practice students would be able to

1. Understand practical problems related to Fluid Mechanics
2. Measure drag and lift practically
3. Measure boundary layer growth practically
4. Solve pipe flow problems
5. Solve three reservoir problem practically
6. Solve fluid flow problem using flow net

List of Exercises

1 Visit reports of minimum two site visits, exploring the field aspects for various subjects.
2 Flow past circular cylinder using wind tunnel.
3 Flow past air foil
4 Growth of a boundary layer along a flat plate using wind tunnel
5 Flow through pipes
6 Flow through parallel pipes
7 Experiment on three reservoir problem
8 Experiment on pipe network
9 Electrical analogy for flow below weir
10 Drawing of flow net using graphical method
11 Virtual lab
12 Virtual lab

Environmental Chemistry and Microbiology Lab (CVPA11186)

Teaching Scheme

Credits: 2
Practical: 4 hrs./week
Tutorial : NA

Examination Scheme

Formative Assessment: 50 Marks
Summative Assessment: 50 Marks

Prerequisite: Environmental Engineering I & II.

Course Objectives

- To understand different methods for water analysis.
- To understand different instruments in environmental engineering**.**

Course Outcomes

After completing the lab practice students would be able to

1. Measure types of solids
2. Measure conductivity of waste water sample.
3. Measure hardness and alkanity of water sample.
4. Measure Manganese **or** Iron
5. Study various sample collection methods and standardization of chemicals.
6. Solve one assignment on microbiology

List of Exercises

1 Determination of Solids (TS, TDS, TSS).
2 Electrical Conductivity.
3 Determination of pH & Alkalinity.
4 Determination of Hardness.
5 Determination of Manganese **or** Iron.
6 Sample collection methods and standardization of chemicals.
7. One assignment on microbiology
8. One assignment on environmental instrumentation.

List of Books :

1. Sawyer C.N., McCarty P.L. and Parkin G.F., Chemistry for Environmental Engineering and Science, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Dara S.S., A Textbook of Environmental Chemistry and Pollution Control, S. Chand and Company Ltd., New Delhi.
3. Waste Water Engineering Metcalf Eddy McGraw Hill Publications

Research Methodology & IPR (CVPA11187)

Teaching Scheme
Credits: 2
Lecture: 2hrs./week
Practical: NA
Tutorial : NA

Examination Scheme
Formative Assessment: 50 Marks
Summative Assessment: NA

Prerequisite: Basis statistical tools

Course Objectives :

- To introduce to the concept of research and research problem
- To understand research ethics
- Get introduced to the concept of Intellectual property rights
- To understand developments in IPR

Course Outcomes : The students will be able to:

1. Define research and formulate a research problem
2. Write a research proposal to a suitable funding agency
3. Define concept of Intellectual property rights.
4. Select Patents/ Designs/ Trademarks/ Copyright and analyze them through case studies.

Unit I : Introduction to Research and Research problem

Meaning of research, types of research, process of research, Objectives of research, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, defining a research problem (Real life example or case study). Literature Review: objectives, Significance, sources (Review of journal paper/s).
Research hypotheses, Qualities of a good Hypothesis, Null Hypothesis & Alternative Hypothesis. Hypothesis Testing -Logic & Importance.

Unit II: Report, Research proposal and funding agencies

Need of effective documentation, types of reports, report structure, Format of research proposal, Individual research proposal, Institutional research proposal, Funding for the proposal, Different funding agencies. Plagiarism and its implications. Research briefing, presentation styles, elements of effective presentation, writing of research paper, presenting and publishing paper.

Unit III : Introduction to IPR and Patenting

Introduction and the need for intellectual property right (IPR), IPR in India – Genesis and Development, IPR in abroad, Some important examples of IPR. Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development, patenting under PCT, patent license, patentable and non-patentable inventions. Drafting of a patent, Filing of a patent.

Unit IV: Patent Rights and Development

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. International cooperation on Intellectual Property. Administration of Patent System. New developments in IPR; IPR of Biological Systems, Traditional knowledge Case Studies, understanding of IPR issues in cyber world

Text books:

1. Dr. C. R. Kothari, Research Methodology: Methods and Trends', New Age International
    a. Publishers.
2. Wayne Goddard and Stuart Melville, Research Methodology: An Introduction'
3. Ranjit Kumar, Research Methodology: A Step by Step Guide for Beginners'
4. Prabuddha Ganguly, "Intellectual Property Rights", Tata Mc-Graw Hill.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley "Intellectual Property in New"

Reference books:

1. Deepak Chawla and Neena Sondhi, Research Methodology**:** concepts and cases, Vikas Publishing House Pvt. Ltd. (ISBN 978-81-259-5205-3)
2. Louis Cohen, Manion, Morrison , Research Methods in Education, Routledge(Taylor & Francis Group) /Cambridge University Press India Pvt. Ltd.-ISBN-978-0-415-58336-7
3. Sekaran Uma and Roger Bougie, Research Methods for Business, Wiley, India.
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007

SEMESTER - II

First Year - Semester II

Open Channel Hydraulics (CVPA12181)

Teaching Scheme

Credits: 3
Lectures: 3 hrs./week
Practical: NA
Tutorial : NA

Examination Scheme

Formative Assessment: 50 Marks
Summative Assessment: 50 Marks

Prerequisite: Fluid Mechanics at UG level including Kinematics, Dynamics, laminar and turbulent flow, differential and integral Calculus

Course Objectives:

- To introduce students to the basics of uniform flow and critical flow
- To impart the knowledge of hydraulic jump formation and control
- To equip the students to compute the GVF by analyzing various GVF profiles.
- To impart the knowledge of spatially varied flow.
- To introduce students to the fundamentals of unsteady flow
- To impart knowledge about flood routing

Course Outcomes:

By the end of the course, students would be able to

1. Understand the various aspects of uniform flow. .
2. Do the computations of GVF and RVF.
3. Compute the GVSF using various methods like Chow's methods, standard step method and finite difference method.
4. Solve differential Equation of spatially varied flow
5. Analyze complex problems of unsteady flow like dam break problem.
6. Route the flood (Hydraulic and Hydrologic flood routing)

Unit I: Uniform flow

Uniform flow formulae and design of channels, efficient sections, Introduction to critical flow and specific energy and specific force

Unit II --Hydraulic Jump

Relation between sequent depth of hydraulic jump in rectangular channel, Energy loss in jump in rectangular channels, Types of jump**,** Formations of jump in expanding and contracting channel, jump control, jump on sloping floors

Unit III: Gradually Varied Steady Flow

Dynamic equation for Gradually varied steady flow in open channels, surface profiles in GVF analysis, different method of computations, Chow's methods, standard step method

Unit IV: Spatially Varied Flow

Differential Equation of spatially varied flow, profile computation, SVF with lateral inflow, SVF with lateral outflow, flow over side weir, bottom racks

Unit V: Unsteady Flow
Gradually varied unsteady flow: Continuity equation, dynamic equation, Monoclinal rising waves, dynamic equation for uniformly progressive flow, wave profile of uniformly progressive flow, wave propagation, Rapidly varied unsteady flow: Uniformly progressive flow, positive surge, negative surge, dam break problem
Unit VI: Flood Routing
Hydraulic and Hydrologic flood routing, Reservoir and channel routing, Differential form of Momentum Equation, Muskinghum method, Finite difference scheme
Text Books :
1. Flow in open channel- K. Subramanya, Tata Mc-Graw Hill. **2.** Flow through Open Channel-K.G.Ranga Raju, Tata Mc-Graw Hill. **3.** .Flow through open channels-Rajesh Srivastava—Oxford
Reference Books 1. Open Channel Hydraulics – Ven Te Chow, Mc-Graw Hill. 2. Open Channel flow– Madan Mohan Das, PHI learning private limited 3. The hydraulic of Open channel flow – Hubert Chanson, Arnold Publications UK

Advanced Waste Water Treatment (CVPA12182)

Teaching Scheme
Credits: 3
Lectures:3hrs./week
Practical: NA
Tutorial : NA

Examination Scheme
Formative Assessment: 50 Marks
Summative Assessment: 50 Marks

Prerequisite: Environmental Engineering I & II at UG level

Course Objectives:

- To introduce students to design waste water treatment units.
- To impart the knowledge of low cost treatment & ecofriendly unit.
- To make students aware of different standards for the disposal of water and its various consequences..

Course Outcomes:

At the end of the course student would able to,

1. Understand unit operation in waste water.
2. Understand suspended and attach growth process.
3. Understand method for removal of biological nutrients.
4. Design anaerobic reactors.
5. Understand working constructed wet land system.
6. Understand method of disposal of waste water

Unit I:Unit operation in waste water

Preliminary, Primary, Secondary and Tertiary unit operation. Working of all units used in waste water treatment process. Flow diagram for treatment of waste water. Waste water quality and quantity estimation

Unit II: Suspended growth and attach growth process

Suspended growth process: Modeling aerobic growth of heterotrophs in complete-mix and plug flow reactor with and without recycle Suspended growth reactors: Process design, performance and operating parameters of activated sludge process (conventional and sequential batch reactor), aerated lagoon, facultative waste stabilization pond, membrane bioreactor.

Attached growth process: Concept of biofilm modeling, Eckenfelder model for performance of packed tower with and without recirculation Attached growth reactor: Process design, performance and operating parameters of rotating biological contactor, submerged attached growth (packed, fluidized and expanded bed) reactor.

Unit III: Biological nutrient removal

Biological nutrient removal: Biological nitrogen and phosphorous removal, Kinetics of nitrification and denitrification, Process design, performance and operating parameters of ASP, SBR and RBC for carbon oxidation – nitrification and denitrification

Unit IV :**Anaerobic reactors**

Anaerobic reactors: Process design, performance and operating parameters of upflow anaerobic sludge blanket, filter, and sequential batch Sludge processing: Sludge mass-volume relationship, Process

fundamentals of Thickening, Stabilization, Conditioning, and Dewatering

Sludge processing units: Process design, performance and operating parameters of gravity thickener, dissolved air flotation tank, digester, belt filter press and drying bed

Unit V :**Constructed wetland:**

Potential applications, Purification mechanisms, Process design, performance and operating parameters of Free water surface and subsurface systems, Sludge treatment constructed wetland

Aquatic treatment: Process design, performance and operating parameters of Water hyacinth system

Unit VI Wastewater disposal :

Stream and Effluent standards, Wastewater reclamation and reuse Land treatment systems: Water quality considerations, Processes, Removal mechanisms, Process design, performance and operating parameters for slow rate, rapid infiltration and overland flow systems

Text books

1. Peavy H, S, Rowe D, R, and Tchobanoglous G, *"Environmental Engineering",* McGraw-Hill Book Company, international edition 1985.
2. Metcalf and Eddy *"Wastewater Engineering Treatment and Reuse",* Tata McGraw Hill Publication, 6th Reprint. 2003.
3. Karia, G, L, and Christian R, A, *"Wastewater treatment",* PHI learning private limited, 2008.

Reference books

1. Droste, Ronald L *"Theory and Practice of Water and Wastewater Treatment",* John Wiley & Sons Publication, 1st Edition, 1997.
2. Crites Ron and Tchobanoglous George, "*Small and Decentralized Wastewater Management Systems*", McGraw-Hill Book Company, International edition, 1998.
3. Sincero A, P and Sincero G, A, *"Environmental Engineering A Design approach",* PHI learning private limited, 2004.
4. Quasim, S. R., "Wastewater treatment plants planning, design and operation", CRC Press, 2nd Edition, 2010.

Elective III

Hydrology (CVPA12183A)

Teaching Scheme

Credits: 3
Lectures: 3 hrs./week
Practical: NA
Tutorial : NA

Examination Scheme

Formative Assessment: 50 Marks
Summative Assessment: 50 Marks

Prerequisite: Hydrology, FM I, FM II at UG level and basic statistics.

Course Objectives:

- To introduce students to rainfall runoff processes and their modeling techniques.
- To impart the knowledge of various stochastic processes to analyze and forecast hydrologic variables
- To equip the students to estimate and forecast the flood by various methods
- To introduce students to concept of Ground Water and well hydraulics.
- To impart the knowledge of various attributes of ground water like exploration, well construction & design, pumping equipment, quality and pollution of ground water.
- To expose the students to various ways of ground water conservation

Course Outcomes:

By the end of the course, students would be able to

1. Understand the rainfall runoff processes and their modeling techniques.
2. Apply various Stochastic processes to analyze and forecast hydrologic variables
3. Estimate and forecast the flood by various methods
4. Understand the concept of Ground Water and well hydraulics
5. Deal with various attributes of ground water like exploration, well construction & design, pumping equipment, quality and pollution of ground water.
6. Know various ways of ground water conservation

Unit I : Hydrological Parameters

Hydrologic Cycle, Precipitation, Evaporation, Infiltration, Interception and Depression, run off, Rainfall runoff models-SWM, Tanks, CLS models.

Unit II : Hydrograph Analysis

Unit hydrograph theory, S curve, Synthetic unit hydrograph ,IUH

Unit III : Stochastic processes and Flood Analysis

Stochastic processes-classification, time series & it's components, various statistical distributions like binomial, Poisson, normal, log-normal, Beta B, gamma, Extreme value distribution; Type I (for largest value (Gumbel), Extreme value distribution; Type III (for smallest value (Weibull), Pearson type I, II and III, Chi square test, plotting position, flood frequency analysis

Unit IV: Ground Water Hydrology
Definition of Ground Water, aquifers, vertical distribution of subsurface water, Darcy's Law-it's range of validity, DupuitForchheimer assumption, application of Darcy's law to simple flow systems governing differential equation for confined and unconfined aquifers, fully & partially penetrating wells, interference of wells, pumping test with steady & unsteady flow, method of image.
Unit V: Ground Water Development
Ground water Exploration, well types, well construction & design, screens, perforations & gravel packs, pumping equipment, quality of ground water, pollution of groundwater
Unit VI : Ground Water Conservation
Ground water budget, seepage from surface water artificial recharge, Porous media models, Analog models, Electric analog models, Digital computer models.
Text books :
1. K. Subramanya,Engineering Hydrology, Tata Mc-Graw Hill. 2. H.M. Raghunath, Hydrology, Wiley Eastern, New Delhi. 3. Jaya Rami Reddy, A text book of Hydrology, University Science Press
Reference books :
1. LinsleyKolhar&Paulhas, Applied Hydrology, Mc-Graw Hill 2. S.K. Garg., Water Resource & Hydrology 3. Jaya Rami Reddy, Stochastic Hydrology, Laxmi Pub., New Delhi. 4. V.T. Chow, Applied Hydrology, McGraw-Hill Book Company.

Elective III

Irrigation and Drainage Engineering (CVPA12183B)

Teaching Scheme

Credits: 3
Lectures: 3hrs./week
Practical: NA
Tutorial : NA

Examination Scheme

Formative Assessment: 50 Marks
Summative Assessment: 50 Marks

Prerequisite: Fluid Mechanics at UG level including Kinematics, Dynamics, laminar and turbulent flow, differential and integral Calculus

Course Objectives:

- To introduce students to various aspects of Irrigation and methods.
- To impart the knowledge of Soil Water and Crop Relationship
- To equip the students to design the lift and drip irrigation schemes.
- To expose the students to design the Sprinkler irrigation scheme
- To impart the knowledge of effects of water logging, salinity and its remedial measures.
- To equip the students to design the drainage system the irrigated land

Course Outcomes:

By the end of the course, students would be able to

1. Understand the various aspects of Irrigation and methods. .
2. Understand Soil Water and Crop Relationship
3. Design the lift and drip irrigation schemes.
4. Design the Sprinkler irrigation scheme.
5. Understand effects of water logging, salinity and its remedial measures.
6. To design the drainage system the irrigated land

Unit I : Irrigation Practices

Definition, Necessity of irrigation, Benefits of Irrigation, ill effects of irrigation. Types of irrigation systems. Classification of Irrigation methods, Factors affecting the choice of irrigation methods, quality of irrigation water. Surface and Subsurface irrigation methods, sprinkler irrigation, Micro irrigation (theory only)

Unit II : Soil Water-Crop Relationship

Soil classification, soil moisture and crop water Relationship, Determination of soil moisture, factors governing consumptive use of water, estimation of consumptive use and frequency of irrigation, irrigation efficiencies for economical use of water, assessmentwatercharges,conjunctiveuseofsurfaceandgroundwater,multi-cropirrigation scheduling

Unit III : Lift Irrigation and Drip Irrigation

Lift Irrigation: General concepts, advantages, disadvantages, elements of lift Irrigation schemes, design considerations involved in intake well, jackwell, rising main, distribution systems, concept of cost economics.

Drip Irrigation:

Definition and functions,types of drip Irrigation systems, components of Drip Irrigation systems.

Design and installation of drip Irrigation systems,advantages and disadvantagesof Drip Irrigation systems, operations and maintenance of Drip assembly.

Unit IV: Sprinkler Irrigation

Sprinkler Irrigation:

Definition and introduction of Sprinkler Irrigation,, advantages and disadvantages of Sprinkler Irrigation, components of sprinkler Irrigation systems (Pumping set, desilting basin and debris screen, main and lateral pipe lines , sprinkler heads, perforated pipes, take off volves and flow control valves, fertilizer applicators), types of sprinklers, design of considerations sprinkler Irrigation systems(preparation of inventory of basic data, criteria for system layout, selection of sprinkler and its spacing, discharge capacity of the pump hydraulic design of sprinkler head, main and lateral pipe sizes)

Unit V: Salt Affected Land And Their Reclamation:

Salt accumulation in soil water, classification of salts affecting the soils and their characteristics, reclamation of saline and alkaline soils, leaching and salinity control. Water and wind erosion, design of various types of soil conservation measures.

Unit VI: Drainage Of Irrigated Land

Need and purpose of drainage water logging of agricultural lands and its reclamation, steady state and transient designs of surface and sub-surface drainage systems, drainage by wells. Soil Erosion and conservation.

Text books:

1. Irrigation Engineering and hydraulic structures – S.R.Sahasrabudhe- Catson books, Delhi, 2014-3ed.
2. Irrigation Engineering - S. K. Garg. .
3. Irrigation, Water Resources and water power engineering- Dr. P. N. ModiPubl Standard book house.

Reference books:

1. Irrigation, Michael, B.A.M., Vikas Publishing House Pvt. Ltd. New Delhi, 1990
2. Theory & design of irrigation structures Vol.I, II, III Varshney Gupta and Gupta Nemchand and brothers publication
3. Water Management – Jasapal Singh, M.S.Achrya, Arun Sharma – Himanshu Publication Press

Elective III

Finite Element Method to Flow Problems (CVPA12183C)

Teaching Scheme

Credits: 3
Lectures: 3hrs./week
Practical: NA
Tutorial : NA

Examination Scheme

Formative Assessment: 50 Marks
Summative Assessment: 50 Marks

Prerequisite: Fluid Mechanics at UG level including Kinematics, Dynamics, laminar and turbulent flow, differential and integral Calculus

Course Objectives:

- To introduce students to various aspects of Finite elements.
- To impart the knowledge of Finite elements and their interpolationfunctions
- To equip the students to design one dimensional Finite elements and their analysis
- To expose the students to design the two dimensional Finite elements
- To impart the knowledge of different computer implementations of FEM.
- To introduce the students to various applications of FEM

Course Outcomes:

By the end of the course, students would be able to

1. Understand the various aspects of Finite elements.
2. Understand different Finite elements and their interpolation functions
3. Design and analyze one dimensional Finite elements
4. Design two dimensional Finite elements.
5. Understand benefits of different computer implementations of FEM.
6. Understand the practical / real time applications of FEM.

Unit I: Introduction of Finite element method

History and general introduction of FEM, Merits and demerits of FEM, Different approaches used in FEM – Direct approach, variational approach, energy approach, weighted residual approach.

Unit II: Finite elements and interpolation functions

Interpolations functions : one-independent, two-independent, three-independent spatial variables, One dimensional elements (Line, Quadratic, cubic, Lagrangian and higher order elements), Two dimensional elements (Triangular all 4 types of elements, rectangular and isoparametric elements), Three dimensional elements (tetrahedral all 4 types, serendipity elements)

Unit III: One dimensional Finite element analysis

One dimensional flow through porous media, one dimensional ideal flow through pipes (Inviscid flow), applications of flow network analysis and electrical network analysis, element matrices for one dimensional FE.

Unit IV: Two dimensional Finite element analysis

Two dimensional ideal flow through pipes (seepage flow), Finite element solution of partial differential equation by weighted residual method, FEM formulation based on variation principle, Finite element solution of Stokes flow equations.

Unit V: Computer implementation of FEM

Use of symmetry and anti-symmetry conditions in reducing a problem, static condensation, Sfeap, applications of boundary conditions
Unit VI: Applications Of Fem In Water Flow Problems
Applications Of Fem In Water Flow Problems: In Pipe Flows, Open Channel Flows, Ground Water Flow, Applications Of Fem In Hydrology (Case Studies / Actual Problems)
Text books
1. Bhate K.J., Finite element procedure, Prentice Hall of India, ed;2001, New Delhi 2. Reddy J.N., An introduction to the finite element method, Mcgraw Hill 3. Desai.Y.M, Eldeo T.I, Shah A.H., Finite element method with applications in engineering, Pearson Pub.
Reference books
1. Bear J., Dynamics of fluid in porous media, Elsevier, New York 2. Bear J., Hydraulics of Groundwater , McGraw Hill, New York 3. Connors J.J., Brebbia C.A, Finite element techniques for fluid flow, Butterworth, London

Elective IV

Air Pollution and control (CVPA12184A)

Teaching Scheme

Credits: 3
Lectures: 3hrs./week
Practical: NA
Tutorial : NA

Examination Scheme

Formative Assessment: 50 Marks
Summative Assessment: 50 Marks

Prerequisite: Environmental Engineering I & APC (Elective) at UG level and

Course Objectives:

- Student would understand the concept of meteorology and its parameter.
- Controlling technics for gaseous and particulate matter.
- Vehicle emission controlling technique.

Couse Outcomes:

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

1. Introduce the student to the air pollution, quality and standards.
2. Give a knowhow of meteorological parameters and their effects.
3. Make the student aware of the indoor air pollution, sources, causes and effects.
4. Impart the knowledge particulate matter control technology of air pollution.
5. Impart the knowledge of gaseous pollution control.
6. Impart the knowledge of vehicle pollution.

Unit I: Meteorology & Dispersion of pollutants in the atmosphere

Physics of atmosphere, Solar radiation, Wind circulation, Lapse rate, Inversion, Stability conditions, Pasquil stability model, maximum mixing depth, Wind rose, Plume behavior, Heat island effect, Greenhouse effect, Rain drop formation, Visibility, Photochemical reaction Eddy diffusion model, the Gaussian dispersion model, point source, Line source,maximum ground level concentration, Determination of stack height, sampling time corrections, Effects of inversion trap

Unit II: Indoor Air Pollution

Indoor air pollution sources, indoor pollutant levels, monitoring instruments; indoor pollution control strategies: source control, control equipment and ventilation; energy conservation and indoor air pollution; effects of indoor air population; risk analysis; models for predicting source emission rates and their impact on indoor air environments

Unit III: Air Pollution Particulate matter

Control of Particulate Pollutants: Properties of particulate pollution - Particle size distribution - Control mechanism - Dust removal equipment - Design and operation of settling chambers, cyclones, wet dust scrubbers, fabric filters & ESP.

Unit IV Control of Gaseous Pollutants

Process and equipment for the removal by chemical methods - Design and operation of absorption and adsorption equipment - Combustion and condensation equipment

Unit V: Air Pollution Modeling

Chemistry of air Pollutants - Atmospheric reactions, sinks for air pollution –Transport of air Pollutants – Meteorological settling for dispersal of air pollutants vertical structure of temperature and stability, atmosphere, transport and diffusion of stack emission –atmospheric characteristics significant to transport and diffusion of stack emission – stack plume characteristics, Maximum Mixing Depths –

Plume rise – Types of dispersion models
Unit VI: Motor Vehicle Emissions
Automobile Source Emission of pollutants from automobiles, Reduction of emissions by different methods, Alternative fuels and their utilizations Strategy for effective control of air pollution in India. Air pollution control act
Text books
1. Rao, M. N. and Rao, H. V. N., Air pollution, Tata McGraw-Hill Publishing Co; Ltd, New Delhi, 1993. 2. Nevers, N. D., Air Pollution Control Engineering, McGraw-Hill International Ed., 1993. 3. Pandey V., Noise Pollution, Meerut Publishers, 1995.
Reference books
1. Wark, K. and Warner, C.F., Air Pollution, Its Origin and Control, Harper and Row, New York,1981. 2. Wayne T. D., Air Pollution Engineering Manual, John Wiley & Sons, 2000. 3. Rao, C. S., Environmental Pollution Control Engineering, New Age Int. Pubs, 1991, Reprint, 2005. 4. Barratt, R., Atmospheric Dispersion Modeling, Earthscan Publication Ltd, 2003. 5. Rau J. G. and Wooten D. C., Environmental Impact Analysis: Handbook, McGraw Hill Publications, 1985. Khare, M. and Sharma P., Modeling the Vehicular Exhausts Emission, WIT press, UK, 2002.

Elective IV

Industrial waste water treatment (CVPA12184B)

Teaching Scheme

Credits: 3
Lectures: 3hrs./week
Practical: NA
Tutorial : NA

Examination Scheme

Formative Assessment: 50 Marks
Summative Assessment: 50 Marks

Prerequisite: Environmental Engineering I and II

Course Objectives:

- To introduce students to sources, composition, and properties of industrial wastes
- To impart the knowledge of industrial Wastewater Treatment
- To make students aware of Advanced Industrial Wastewater Treatment Methods
- To introduce students to Common Effluent Treatment Plants and able to design the same
- To make students aware of Manufacturing process and sources of effluent from the process of different industries.
- To impart the knowledge of different methods of treatment & disposal of effluent for the different industries and its design

Course Outcomes:

By the end of course , students would be able

1. To identify key sources, typical quantities generated, composition, and properties of industrial wastes
2. To understand the working of industrial Wastewater Treatment
3. To understand the concept of Advanced Industrial Wastewater Treatment Methods
4. To understand the working principal of CETP and able to design the same.
5. To understand the Manufacturing process and sources of effluent from the process of different industries.
6. To understand the Characteristic, composition, methods of treatment & disposal of effluent and its design

Unit I: Sources of Pollution :

Physical, Chemical, Organic and Biological properties of Industrial Wastes – Differences between industrial and municipal waste waters –Effects of industrial effluents on sewers and treatment plants. Water pollution control act, organizational set up of central and state boards for water pollution control, socio-economic aspects of water pollution control

Unit II: Waste Water Treatment :

Wastewater Treatment:, Waste minimization - Equalization - Neutralization – Oil separation – Flotation – Precipitation – Heavy metal Removal – adsorption – Aerobic and Anaerobic biological Treatment – Sequencing batch reactors – High Rate reactors

Unit III: Advanced Treatment Methods :

Nitrification and De-nitrification – Phosphorous removal – Heavy metal removal – Membrane Separation Process – Air Stripping and Absorption Processes

Unit IV: CETP'S

Common Effluent Treatment Plants (CETPs): Common Effluent Treatment Plants (CETPs): Location, Need, Design, Operation & Maintenance Problems and Economical aspects

Unit V: Manufacturing process & treatment methods for I.W.W.
Manufacturing process and sources of effluent from the process of industries like chemical, fertilizer, petroleum, petro -chemical, paper, sugar, distillery, textile, tannery food processing, dairy and steel manufacturing.
Unit VI: Characteristics and composition of effluent and different methods of treatment & disposal of effluent for the following industries
Steel, Petroleum Refineries, Tanneries, Atomic Energy Plants and other Mineral Processing Industries. Complete design of wastewater treatment plant of any industry listed above with all components, details, drawings and cost estimation.
Text books
1 Waste Water Engineering Metcalf Eddy McGraw Hill Publications. 2 N.L. Nemerow, Liquid waste of Industry, Addison Wesely. 1996 3 Industrial Waste Treatment Rao & Datta, PHI Publication.
Reference books
1.W. Wesley Eckenfelder Jr., Industrial Waste Water Pollution Control. 2.Arceivala, S. J., Wastewater Treatment for Pollution Control, McGraw-Hill, 1998.21 3.Frank Woodard, Industrial waste treatment Handbook, Butterworth Heinemann, New Delhi, 2001. 4.Callegly, Forster and Stafferd, Treatment of Industrial Effluent, Hodder and Stonghton.1988

Elective IV

Solid and Hazardous Waste Management (CVPA12184C)

Teaching Scheme

Credits: 3
Lectures: 3hrs./week
Practical: NA
Tutorial : NA

Examination Scheme

Formative Assessment: 50 Marks
Summative Assessment: 50 Marks

Prerequisite: Environmental Engineering I & II

Course Objectives:

- To provide knowledge on functional elements of MSWM.
- To impart students with the skill of design and operation of MSWM
- To impart basics of biomedical waste management system

Course Outcomes: Student will able to

1. Understand importance of solid waste management.
2. Understand solid waste generation and transfer of solid waste system.
3. Understand waste processing techniques and 3 R principle.
4. Understand study composting system.
5. Understand study biological waste disposal system.
6. Understand study hazardous waste disposal system

Unit I: Solid Waste, Solid Waste Management & Indian Scenario

Solid Waste: Sources, Types, Composition, Quantities, Physical, Chemical and Biological properties. Solid Waste Management: Objectives, Functional elements, Environmental impact of mismanagement, Factors affecting. Indian Scenario: Present scenario and measures to improve system for different functional elements of solid waste management system, Legislative provisions.

Unit II: Solid Waste Generation Rate & Transfer Station

Solid Waste Generation Rate: Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Collection components, Types of collection systems.
Transfer station: Meaning, Types, Capacity, Location and Viability. Waste – Collection system design, Transportation of solid waste: Means and methods, Routing of vehicles

Unit III: Waste Processing Techniques & Material Recovery and Recycling

Waste Processing Techniques: Purpose, Mechanical volume and size reduction, component separation techniques. Material Recovery and Recycling: Objectives, Recycling program elements, Commonly recycled materials and processes Energy recovery from solid waste: Parameters affecting, Fundamentals of thermal processing, Biomethanation, Pyrolysis, Incineration, Refuse derived fuels, Planning and design of incineration facility, Energy recovery

Unit IV: Composting of Solid Waste & Landfills

Benefits, Processes, Stages, Technologies, Factors affecting, Properties of compost. Vermicomposting Site selection, Types, Principle, Processes, Land filling methods, Leachate and landfill gas management, Design of a landfill facility

Unit V: Biomedical Waste

Generation, identification, storage, collection, transport, treatment, common treatment and disposal, occupational hazards and safety measures. Biomedical waste legislation in India.

Unit VI: Hazardous waste treatment technologies

Details related to hazardous waste, basel convention in detail with basil agreement. Following rules and sign for handling hazardous waste. Hazardous waste landfills: site selection, design and operation-remediation of hazardous waste disposal sites. sampling and characterization of solid wastes; tclp tests and leachate studies

Text books

1. Bhide. A.D. And Sundaresan. B.B, *"Solid Waste Management",* Indian National Scientific Documentation Centre, 1st Edition, 1983.
2. CPHEEO, "Manual on Municipal Solid waste management", Central Public Health and
3. Environmental Engineering Organization, Government of India, New Delhi, 2000
4. George Tchobanoglous, "Integrated Solid Waste Management", Tata McGraw-Hill Publishing
5. Company Limited, 1st Edition, 1993

Reference books

1. Vesilind, Worrell, and Reinhart, "Solid Waste Engineering", Cengage Learning India Pvt. Ltd.,
2. G. Masters, "Introduction to Environmental Engineering and Science", Pearson Education, 2004
3. Peavy, Rowe and Tchobanoglous, "Environmental Engineering", Tata McGraw-Hill Publishing
4. Company Limited, 1st Edition, 1985.
5. Waste Water Engineering Metcalf Eddy McGraw Hill Publications

Open Channel Hydraulics lab (CVPA12185)

Teaching Scheme

Credits: 2
Lectures: NA
Practical: 4 hrs./week
Tutorial : NA

Examination Scheme

Formative Assessment: 50 Marks
Summative Assessment: 50 Marks

Prerequisite: FM I and FM II at UG level

Course Objectives

- To give exposure to practical problems related to Open channel flow
- To introduce students the concepts hydraulic jump on horizontal and sloping channel
- To introduce students to the concept Uniform flow, specific energy and velocity distribution in open channel
- To give exposure to latest fluid flow software
- To introduce calibration of discharge measuring device
- To impart knowledge about flood routing and GVF analysis

Course Outcomes

After completing the lab practice students would be able to

1. Understand practical problems related to Open channel flow
2. determine energy loss from hydraulic jump on horizontal and sloping channel
3. Analyze open channel flow problems
4. Use latest fluid flow software like HEC-RAS, MATLAB
5. Do calibration of discharge measuring device like venturi flume
6. Calculate the water levels after flood routing

The lab work will consist of --
i) Visit reports of minimum two site visits, exploring the field aspects for various subjects
ii) The laboratory work report of following experiments.....

1. Characteristics of Hydraulic Jump in horizontal channel
2. Characteristics of Hydraulic Jump in sloping channel
3. Velocity distribution in open channel flow using pitot tube or current meter
4. Assignment on open channel flow simulation software such as HEC RAS /MIKE-21
5. Numerical simulation of 1-D open channel flow using MATLAB
6. Study of uniform flow formulae
7. Study of specific energy diagram
8. Calibration of venture flume
9. Assignment on flood routing

Assignment on GVF analysis

Advanced Waste Water Treatment Lab. (CVPA12186)

Teaching Scheme

Credits: 2
Lectures: NA
Practical: 4 hrs./week
Tutorial : NA
Prerequisite: Environmental Engineering I & II.

Examination Scheme

Formative Assessment:50 Marks
Summative Assessment:50 Marks

Course Objectives

- To understand different methods for waste water analysis.
- To understand different waste water treatment process**.**

Course Outcomes

After completing the lab practice students would be able to

1. Understand determination of D.O.
2. Understand determination of BOD
3. Understand determination of C.O.D.
4. Understand determination of nitrate.
5. Understand different secondary process.
6. Understand different tertiary treatment process.

List of Exercises

1. Determination of Dissolved Oxygen.
2. Determination of Biochemical Oxygen Demand.
3. Determination of Chemical Oxygen Demand.
4. Determination of phosphate.
5. Determination of Nitrite.
6. Assignment on design on Secondary Treatment (Aerobic/Anaerobic) in excel spread sheet.
7. Assignment on design on Tertiary Treatment (any one) in excel spread sheet.

List of Books :

1. Sawyer C.N., McCarty P.L. and Parkin G.F., Chemistry for Environmental Engineering and Science, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Dara S.S., A Textbook of Environmental Chemistry and Pollution Control, S. Chand and Company Ltd., New Delhi

Mini Project (CVPA12187)

Teaching Scheme
Credits : 2
Lecture: NA
Practical : 4 hrs./week
Tutorial : NA

Examination Scheme
Formative Assessment: 50 Marks
Summative Assessment: 50 Marks

Course Objectives:

- To enable the students to apply fundamental knowledge for understanding state of the art information about any topic relevant to curriculum
- To enhance communication skills of the students

Course Outcomes: By the end of the course, the students would be able to

1. Demonstrate a solution to the problem selected.
2. Demonstrate an ability to present and defend their research work to a panel of experts

Seminar/Mini Project shall be on any topic of student's own choice approved by the faculty. The continuous evaluation will be based on the continuous work of the student to achieve set objectives, technical contents of the topic to assess understanding of the student about the same. Students should prepare a power point presentation for its delivery in 15 minutes. The student should submit duly certified spiral bound report having the following contents.

- Introduction
- Literature Survey
- Theoretical contents/fundamental topics
- Relevance to the present national and global scenario (if relevant)
- Merits and Demerits
- Field Applications / case studies / Experimental work / software application / Benefit cost/ feasibility studies
- Conclusions
- References

A. Report shall be typed on A4 size paper with line spacing 1.5 on one side of paper.
Left Margin : - 25 mm
Right Margin : - 25 mm
Top Margin : - 25 mm
Bottom Margin : - 25 mm
B. Size of Letters
Chapter Number: - 12 font size in Capital Bold Letters- Times New Roman
Chapter Name: - 12 Font size in Capital Bold Letters- Times New Roman
Main Titles (1.1, 3.4 etc):- 12 Font size in Bold Letters- Sentence case. Times New Roman
Sub Titles (1.1.4, 2.5.3 etc):- 12 Font size in Bold Letters-Sentence case. Times New Roman
All other matter: - 12 Font size sentence case. Times New Roman
C. No blank sheet be left in the report
D. Figure name: - 12 Font size in sentence case-Below the figure.
E. Table title -12 Font size in sentence case-Above the table.
Continuous Evaluation: Will be monitored by the respective guides.
Summative Assessment: An oral presentation of the mini project will be held at the end of semester.