

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



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**Department of Civil Engineering**  
**First Year M. Tech. (FYMT) WREE (Civil Engineering)**  
**Semester I (Pattern 2018:R1)**

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 and IPR	CE	2	-	-	-	50	-	-	50	2
CVPA11188	Program Elective III	CE	3	-	-	-	50	-	-	50	3
AP1	Audit Course I	AU	-	-	-	-	-	-	-	-	-
	Total		17	8	80	40	280	200	100	700	21

**Subject Code Elective – I**

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

**Subject Code Elective –III**

CVPA11188A Design of Hydraulic structures  
 CVPA11188B Computational methods in WRE  
 CVPA11188C Wave Mechanics

**Subject Code 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





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**Department of Civil Engineering**

**First Year M. Tech. (FYMT) WREE (Civil Engineering)**

**Semester II (Pattern 2018:R1)**

Course Code	Course	Course Type	Teaching Scheme		Examination Scheme					Total	Credits
					Formative Assessment		Summative Assessment				
			L	P	ISE		CE	ESE	OR		
					T1	T2					
CVPA12181	Open channel Hydraulics	TH	3	-	20	10	20	50	-	100	3
CVPA12182	Adv. Waste Water Treatment	TH	3	-	20	10	20	50	-	100	3
CVPA12183	Program Elective IV	TH	3	-	20	10	20	50	-	100	3
CVPA12184	Program Elective V	TH	3	-	20	10	20	50	-	100	3
CVPA12185	Laboratory III	CE-OR	-	4	-	-	50	-	50	100	2
CVPA12186	Laboratory IV	CE-OR	-	4	-		50	-	50	100	2
CVPA12187	Mini Project	CE-OR	-	4	-	-	50	-	-	50	2
IOEP12188	Open Elective	CE	3	-	-	-	50	-	-	50	3
AP2	Audit Course II	AU	-	-	-	-	-	-	-	-	-
	Total		15	12	80	40	280	200	100	700	21

**Subject Code Elective – IV**

CVPA12183A	Hydrology
CVPA12183B	Irrigation and Drainage
CVPA12183C	FEM to Flow Problems
<b>Subject Code</b>	<b>Open Elective</b>
IOEP12188A	Project Planning and Management
IOEP12188B	Ethical Hacking
IOEP12188C	Product Design Engineering

**Subject Code Elective - V**

CVPA12184A	Air Pollution and Control
CVPA12184B	Industrial Waste Water Treatment
CVPA12184C	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.

  
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**Department of Civil Engineering**

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# 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 able 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 Pohlhausen's solution.

**Unit IV : Turbulent Flow**

Introduction, Characteristics of turbulent flow, Types of turbulent flow, Prandtl's mixing length theory, velocity distribution in turbulent flow, 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 Machinery, 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, transition 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, adsorption 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 projects to 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 and management.
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, criteria for water distribution, Different water distribution policies for different sectors (private, industrial and domestic), Water tariff, tariff regulations and criteria.

**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. Bhawe 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) Assess 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 Scatrometers,- 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 Dreht, 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", Elsevier, 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: OHSAS 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 Assessment By R.R.Barthwal (New Age International 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", UNESCO/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, photocolormeters, 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-II.**

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, spectrophosphorimeter, Raman effect, Raman spectrometer. Nuclear Magnetic Resonance (NMR) spectrometry. Chemical shift principle, working of NMR, FTNMR. Gas analyzers: CO, CO<sub>2</sub>, Hydrocarbons, O<sub>2</sub>, NO<sub>x</sub>

**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 alkalinity 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



**Elective III**

**Design of Hydraulic structures (CVPA21188A)**

**Teaching Scheme**

Credits : 3

Lectures : 3 Hrs/week

**Examination Scheme**

Formative Assessment: 50

Marks

**Prerequisite:**

**Course Objectives:**

- To introduce students to the concept of diversion head works
- To analyse flow below weir
- To impart the knowledge about canal falls along with their design
- To make students aware of different regulation modules and miscellaneous structures along with their design
- To introduce students to cross drainage works along with their designs
- To introduce students to rivers, their behavior and control

**Course Outcomes:**

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

1. Design layout of diversion head works
2. Design of weir on permeable foundations
3. Design canal fall
4. Design canal regulatory modules
5. Design CD works
6. Design river training works

**Unit I : Diversion Head works**

Weir and Barrage, Gravity and non- gravity weirs, layout of a diversion head works and its components, The diversion weirs and its types, afflux and pond level, the under sluices or scouring sluices, the divide wall, fish ladder, head sluices, silt control devices.

**Unit II: Theories of seepage and Design of weirs and Barrage**

Failure of hydraulic structures founded on pervious foundations. Bligh's Creep theory for seepage flow, Lane's weighted Creep theory, Khosla's theory and concept of flow nets, Design of vertical drop weir on Bligh's theory, Design of modern weirs and barrages founded on permeable foundations on the basis of Khosla's theory.

**Unit III : Canal Falls**

Definition and location of canal falls, Types of falls, Design of a trapezoidal notch fall, Design of syphon well drop, design of simple vertical drop fall, design of Sarda type fall, design of a straight glacis fall, design of a baffle fall or Inglis fall.

**Unit IV : Regulators Modules And Miscellaneous Canal Structures**

Canal Regulation- Canal regulation works, canal regulators, alignment of the off taking channels, Distributary head regulator and cross regulator, design of cross regulator and head regulator, Canal escapes - types of canal escapes, Metering Flumes – Types of Metering Flumes, Canal Outlets or Modules – Requirements of good Module, types of Modules, Criteria for judging the performance of modules, certain other important definitions



connected with modules, types of non-modular outlets, types of semi modules or Flexible outlets, types of rigid modules, Miscellaneous Canal Structures – Cattle crossings, bed bars.

**Unit V : Cross Drainage Works**

Introduction, types of Cross Drainage Works, selection of suitable type of cross drainage work, various types of aqueducts and siphon aqueducts, design consideration for Cross Drainage Works, determination of maximum flood discharge, Fixing waterway requirements for aqueducts and siphon aqueducts. provision of joints and water bars in R.C.C ducts of aqueducts and super passages.

**Unit VI: Rivers their behavior, training and control**

Importance of rivers and necessity of controlling them, types of rivers and their characteristics, classification of the rivers on the basis of the topography of the river basin, Indian rivers and their classifications, Behavior of rivers, straight reaches, bends, meanders, Control and training of rivers, objective of river training, classification of river training, methods of river training, problems related to the river training.

**Text books:**

1. S. R. Sahasrabudhe, Irrigation Engineering and hydraulic structures, Catson books, Delhi, 3ed.
2. Garg S. K., Irrigation Engineering and Hydraulic Structures, Khanna Publishers N.D. 13th ed, 1998.
3. Dr. P. N. Modi, Irrigation, Water Resources and water power engineering, Publ Standard book house.

**Reference Books :**

1. Grishin M. M., Hydraulic Structures, Vol. 1. & Vol. 2, Mir Publishers, Moscow, 1982.
2. Jasapal Singh, M.S.Achrya, Arun Sharma, Water Management, Himanshu Publication Press
3. Asawa G. L., Irrigation and Water Resources Engineering, New Age International (P) Ltd. Publishers, first ed, 2005



**Elective III**

**Computational methods in WREE (CVPA21188B)**

**Teaching Scheme**

Credits : 3

Lectures : 3 Hrs/week

**Examination Scheme**

Formative Assessment: 50

Marks

**Prerequisite :**

**Course Objectives:**

1. To introduce students to various computational techniques like statistical methods, numerical methods like Finite difference method and Finite element method
2. To introduce students to advanced computational methods like data driven techniques
3. To introduce students a new field of Hydroinformatics
4. To make students aware of various types Hydraulic engineering software and their applications with case studies

**Course Outcomes:**

After successfully completing the course the student will be able to

1. Use spread sheet for analysis of data pertaining to water resources and environmental parameters
2. Model various water resources and environmental parameters using statistical techniques
3. Use numerical methods to solve water resources and environmental engineering problems
4. Understand various data driven techniques and their applications in WREE
5. Explore various options for development of Hydroinformatics
6. Use WREE software like HECRAS and know various other software and their applications in WREE

**Unit I Introduction**

Introduction to computational Techniques, Database design, Spreadsheet, Usefulness in Water Resources Engineering

**Unit II Statistical Techniques**

Presentation of data, Measures of location and dispersion, Probability concepts and distribution, Tests of significance, Correlation and Regression, Selection of Suitable technique, error analysis

**Unit III Numerical Methods**

Finite difference schemes – Method of characteristics – Finite element method

**Unit IV Advanced Techniques**

Genetic algorithm - Artificial Neural Network - Fuzzy logic – Other data driven methods

**Unit IV Hydro informatics**

Introduction – Virtual institute – Web based hydro informatics system Applications

**Unit VI Applications**

Application with case studies, Selection of suitable technique, Different types of hydraulic engineering software - Salient features – Capabilities and Limitations



**Text Books:**

1. Abbott M.B., Hydroinformatics – Information Technology and the Aquatic Environment, Avebury Technical, Aldershot, 1991.
2. Adeli H. and Hung S., Machine Learning – Neural Networks, Genetic Algorithms and Fuzzy Systems, John Wiley, New York, 1995.
3. Chaudhry M.H., Open Channel Flow, Prentice Hall of India Pvt. Ltd., New Delhi, 1994

**Reference Books:**

1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi.,2001
2. Govindaraju, R. S. and Rao, A. R. (eds.). Artificial Neural Networks in Hydrology, Kluwer Academic Publishers, Dordrecht, 2000.
3. Rajsekaron S. and Pai G.A. Vijayalakshmi, Neural Networks, Fuzzy Logic and Genetic Algorithms-Synthesis and Applications, PHI Learning Pvt. Ltd., New Delhi, 2010



**Elective III**  
**Wave Mechanics (CVPA21188C)**

**Teaching Scheme**

Credits : 3

Lectures : 3 Hrs/week

**Examination Scheme**

Formative Assessment: 50

Marks

Summative Assessment: 00

Marks

**Prerequisite :**

1. Fundamentals of probability.

**Course Objectives:**

1. To introduce students the basics of wave hydrodynamics
2. To study various wave theories
3. To learn wave statistics
4. To study wave propagation
5. To understand coastal processes
6. To understand phenomenon of littoral drift

**Course Outcomes:**

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

1. Understand basics of wave hydrodynamics, wave generation, wave decay, wave forecasting
2. Determine various wave parameters using wave theories
3. Engineers with the ability to carry out the calculation of forces acting on structures due to waves
4. Solve problems related to wave propagation
5. Develop the ability to study and analyze wave statistics
6. Understand and analyze coastal processes
7. Calculate the littoral drift

**Unit I : Introduction to Wave Mechanics**

Introduction, Generation, Decay, Classification, Measurement, Basic hydrodynamic equations, Wave Forecasting: The Significant Wave, Simplified versus Elaborate Technique, Numerical Wave Modelling (introduction only, no mathematical treatment): Phase resolving models, Phase averaging models, Introduction to Wave watch III, SWAN, MIKE

**Unit II : Wave Theories**

Wave theories - Linear wave theory, Bottom boundary condition, Kinematic free surface boundary conditions, Dynamic free surface boundary conditions, Solution to linear water wave problem, wave length, wave celerity, classification of waves, wave particle velocities, water particle acceleration, water particle displacement, Wave energy: potential and kinetic energy.

**Unit III : Wave Propagation**

Wave shoaling, wave refraction, wave diffraction, wave reflection, combined effects using numerical solutions, wave breaking, wave set up and set down, wave runup, radiation stresses.

**Unit IV : Wave Statistics**





Wave statistics: Short term wave statistics, Tucker method, Long term wave statistics- Gumbel distribution, Weibull Distribution, Log Normal Distribution, Wave spectrum analysis, wave spectra and statistics, Theoretical spectra: Pierson-Muskowitz Spectrum, Bretschneider Spectrum, JONSWAP Spectrum, Scott Spectrum, Scott-Wiegel Spectrum.

**Unit V : Coastal Area and Processes**

Overview of Coastal Engineering, The Coastal Area, The Beach and Nearshore System, Dynamic Beach Response to the Sea, page, Causes of Shoreline Erosion, Coastal Protection Methods and Navigation Works.

**Unit VI : Littoral Processes**

Introduction of Littoral process, Littoral Materials, Littoral Wave Conditions, Nearshore Currents, Littoral Transport, Role of Foredunes in Shore Processes, Sediment Budget, Engineering Study of Littoral Processes

**Text books**

1. Dean, R. G., Dalrymple R. A. (1991). "Water Wave mechanics for Engineers and Scientists", World Scientific Sorensen
2. R. M. (1997). "Basic Coastal Engineering", Springer
3. Mani, J.S., (2012), "Coastal Hydrodynamics", PHI Learning Pvt. Ltd, New Delhi

**Reference books**

1. Sarpkaya, T., Issacson, M. (1981). "Mechanics of Wave Induced Forces on Offshore Structures", Van Nostrand Reinhold.
2. Army Corps of Engineers. (2002). "Coastal Engineering Manual", U.S. Army Corps of Engineers, Washington D. C.
3. WMO. (1988), "Guide to Wave Analysis and Forecasting", Pub. NO. 702, World Meteorological Organization, Secretariat of WMO, Geneva



# **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, Monoclonal 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, Muskingum 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, 6<sup>th</sup> 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, 1<sup>st</sup> 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, 2<sup>nd</sup> Edition, 2010.



**Elective IV**

**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 IV**

**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, assessment water charges, conjunctive use of surface and groundwater, multi-crop irrigation 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 disadvantages of 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 IV**

**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 interpolation functions
- 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 V**

**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 V**

**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 Wesley. 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 Stoughton.1988



**Elective V**

**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, 1<sup>st</sup> 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, 1<sup>st</sup> 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, 1<sup>st</sup> 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
  10. 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.





<b>Open Elective</b> <b>Project Planning and Management (IOEP12188A)</b>	
<b>Teaching Scheme</b> <b>Credits : 3</b> <b>Lectures : 3Hrs/week</b>	<b>Examination Scheme</b> Formative Assessment: 50 Marks
<b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To impart knowledge of project life cycle.</li><li>2. To introduce students to Project Identification Process, Project Initiation</li><li>3. To understand studies related to Pre-Feasibility Study and Project feasibility Studies.</li><li>4. To construct CPM, PERT network for a project.</li><li>5. To introduce students to Steps in Risk Management, Risk Identification, Risk Analysis and Reducing Risks</li><li>6. To introduce students to process of project Performance Measurement, Evaluation and closeout.</li></ol>	
<b>Course Outcomes:</b> <p>Upon the completion of the course, students will be able to</p> <ol style="list-style-type: none"><li>1. Understand phases of project life cycle</li><li>2. Understand the Project Identification Process, Project Initiation.</li><li>3. Understand Pre-Feasibility Study and Project feasibility Studies of a project.</li><li>4. Construct CPM, PERT network for a project.</li><li>5. Understand the concept of Risk Management</li><li>6. Understand the process of project Performance Measurement, Evaluation and closeout.</li></ol>	
<b>Unit I: Basics of Project Management (PM)</b>	
Introduction, Need, Project Management Knowledge Areas and Processes, Concept of Organizational Structure and types, The Project Life Cycle (preferably with case study), Essentials PM.	
<b>Unit-II: Project Identification and Selection</b>	
Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point. Case study is preferred	
<b>Unit -III: Project Planning</b>	
Introduction, Need for Project Planning, Work Breakdown Structure (WBS), LOB, CPM and PERT, Network Cost System, Resource Allocation, Scheduling, Project Cost Estimate and Budgets.	
<b>Unit -IV: Project Risk Management and Quality Management</b>	
Introduction, Risk, Risk Management, Role of Risk Management in Overall Project Management, Steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks. Introduction to Quality, Quality Concepts, Value, Engineering. Case study is preferred.	
<b>Unit V: Project Performance Measurement, Evaluation and closeout</b>	
Introduction, Performance Measurement, Productivity, Project Performance Evaluation, Benefits and Challenges of Performance Measurement and Evaluation, Controlling the Projects. Project Close-out, Steps for Closing the Project, Project Termination, and Project Follow-up. Case study is preferred	
<b>Unit VI - Operation Research in Management</b>	
Introduction, Operation Research as tool for Decision Support System, Overview of OR Research Techniques, Formulation of Linear Programming Problem, Linear Programming Models, Assumptions of Linear Programming, Graphical Method and Simplex method for solving LP problem.	
<b>Students are encouraged to register for On-line course in the relevant above course approved by authority.</b>	



**Text books:**

1. Operations Research by Premkumar Gupta and D.S. Hira, S. Chand Publications (2014)
2. Project Management – K Nagrajan – New age International Ltd.
3. Project Management – Ahuja H.N. – John Wiley, New York.



**Open Elective**

**Ethical Hacking (IOEP12188B)**

**Teaching Scheme**

**Credits : 3**

**Lectures : 3 Hrs/week**

**Examination Scheme**

**Formative Assessment : 50 Marks**

**Summative Assessment : NA**

**Course Objectives :**

- 1 Understand basics of network security and hacking
- 2 Aware of legal perspective of cybercrime including Indian IT ACT 2008
- 3 Learn techniques of gathering network information
- 4 Identify security tools including, but not limited to intrusion detection and firewall software
- 5 Learn to perform different kind of attacks
- 6 Understand functioning of various protocols

**Course Outcomes :**

After completion of the course, student will be able to

1. Use basics knowledge of network security and hacking
2. Understand and use the IT Laws as and when required
3. Gather required information to perform a attack
4. Use various tools and methods for Vulnerability Assessment
5. Perform different attacks on Dummy scenario
6. Analyze the use of protocols studied

**Unit I : Introduction to Network and security**

**Basics of Computer Networks:** OSI Model, TCP/IP Model, Network topology (Physical & logical), Network Hardware Components: Connectors, Repeaters, hubs, NICs, Bridges and Switches.

**Basics of Computer Networks Security:** Essential Terminology, Elements of Information Security, Types of Hackers, Steps for Ethical hacking, Types of Attacks.

**Unit II : Legal Perspective**

The Indian IT Act, Challenges to Indian law, Cybercrime scenario in India, 2008 amendments to Indian IT Act, Intellectual property in the cyberspace.

**Unit III : Information Gathering Techniques**

Active information gathering, passive information gathering, Trace route, Interacting with DNS Servers, SNMP and SMTP attacks.

**Unit IV : Port Scanning and Vulnerability Assessment**

**Target Enumeration and Port Scanning Techniques:** Scanning for Open Ports and Services, Types of Port Scanning, Firewall/IDS Evading Techniques

**Vulnerability Assessment:** Vulnerability Scanners and How Do They Work, Pros and Cons of a Vulnerability Scanner, Vulnerability Assessment with Nmap, Nessus

**Unit V : Network Sniffing**

Introduction, Types of Sniffing, ARP Protocol Basics, ARP Attacks, Denial of Service Attacks, Man in the Middle Attacks.

**Unit VI : Remote Exploitation**

Understanding Network Protocols: TCP,UDP,ICMP, Server Protocols: FTP,HTTP,SMTP

**Text Books :**

- |   |   |
|---|---|
| 1 | Rafay baloch, "Ethical hacking and Penetration Testing guide", CRC press, 2015, |
|---|---|



		ISBN: 13: 978-1-4822-3162-5 (eBook - PDF)
	<b>2</b>	Nina Godbole, SunitBelapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", WILEY Publications, 2015, ISBN:978-81-265-2179-1
<b>Reference Books :</b>		
	<b>1</b>	Behrouz Fourzon, " Data Communication and Computer Networks", Pearson Education,5 <sup>th</sup> edition ISBN : 978-0070634145
	<b>2</b>	Andrew S. Tanenbaum, " <i>Computer Networks</i> ", International Economy Edition, 5 <sup>th</sup> edition ISBN: 10: 9332518742



<b>Open Elective</b>		
<b>Product Design Engineering (IOEP12188C)</b>		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>
Credits : 3 Lectures : 3 Hrs/week		Formative Assessment: 50 Marks
<b>Course objectives:</b> <ol style="list-style-type: none"><li>1. To understand basic techniques for particular phases of product development</li><li>2. Make and manage design teams for product development in a company.</li></ol>		
<b>Course Outcomes:</b> <p>Upon completion of this course, the student will be able to:</p> <ol style="list-style-type: none"><li>1. Describe an engineering design and development process</li><li>2. Employ engineering, scientific, and mathematical principles to execute a design from concept to finished product</li><li>3. Create 3D solid models of mechanical components from the perspective of aesthetic, ergonomic and functional requirement using CAD software</li><li>4. Work collaboratively on a team.</li><li>5. Create new product based on mechanical design engineering.</li><li>6. Investigate contemporary issues and their impact on provided solution.</li></ol>		
<b>Unit 1 – Introduction to Product Design</b>		
Characteristics of Successful Product Development, Innovative Thinking, Challenges to Product Development, Product Development Process, Concept Development, Economics – Cost Vs Performance, Design Considerations		
<b>Unit 2 – Product Development Process</b>		
Product development process- Identification of customer needs- customer requirements, product development process flows. Product specifications and concept generation, concept selection, concept screening, concept testing, reverse engineering, product architecture		
<b>Unit 3 –Product Design Tools</b>		
Creativity and Problem Solving –Creativity methods-Theory of Inventive Problem Solving (TRIZ), Product function tree, Life cycle analysis, Quality Function Deployment, Competing Product Analysis, SWOT analysis, Failure Mode Effect Analysis.		
<b>Unit 4 – Design for Manufacture and Assembly</b>		
Design for assembly, design for disassembly, design for environment, design for graphics and packaging		
<b>Unit 5 – Rapid Prototyping</b>		
Understanding Prototypes, Principles of Prototyping, Prototyping Technologies, Planning for Prototypes		



**Unit-6: Product Testing and Validation**

Time value of Money, Analytical technique, Product and Process, Evaluation of component, subassembly, assembly, Reliability Goals, Computer simulations and Bench test results, Comprehensive test plans and reports.

**Text Books:**

1. Product Design-Techniques in Reverse Engineering and New Product Development, Kevin Otto, Kristion Wood, Pearson Education, ISBN 978-81-7758-821-7.
2. Karl T.U. And Steven D.E., Product Design and Development, McGraw Hill, Ed 2000.

**Reference Books :**

1. Dieter GE, Engineering Design-Material and Processing Approach, McGraw Hill, Ed 2000