Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Syllabus for

F.Y. M. TECH

(WATER RESOURCE AND ENVIRONMENTAL ENGINEERING)

Department of Civil Engineering

2020- Pattern

VISION:

- Excellence in Electronics & Telecommunication Engineering Education

MISSION:

- Provide excellent blend of theory and practical knowledge. sustainable development of society
- Establish centre of excellence in post graduate studies and research.
- Prepare engineering professionals with highest ethical values and a sense of responsible citizenship.

MTECH -CIVIL ENGINEERING -WREE

First Year M. Tech. (FYMT) - Semester I (Pattern 2020)

Course Code	Course		Teaching Scheme		Examination Scheme					Total	Credits
			L	P	CIE	ISE	SCE	ESE	TW /OR		
CVPA11201	Water Resources System Planning	TH	3	-	20	30	20	30	-	100	3
CVPA11202	Advanced Water Treatment	TH	3	-	20	30	20	30	-	100	3
CVPA11203	Irrigation and Drainage	TH	3	-	20	30	20	30	-	100	3
CVPA11204	Program Elective I	TH	3	-	20	30	20	30	-	100	3
CVPA11205	Program Elective II	TH	3	-	20	30	20	30	-	100	3
IOEP11206	Open Elective I	CE	2	-	-	-	-	-	50	50	2
CVPA11207	Research Methodology	CE	2	-	-	-	-	-	50	50	2
CVPA11208	Laboratory I	CE-OR	-	4	-	-		-	50	50	2
AP 1	Audit Course I	-	-	-	-	-		-	-	-	-
	Total		19	4	100	150	100	150	150	650	21

* Laboratory I (CVPA11208) will be based on courses namely Water Resources System Planning, Advanced Water Treatment and Irrigation and Drainage.

Subject Code	**Program Elective I**		**Subject Code**	**Program Elective II**
CVPA11204A	Air Pollution and Control		CVPA11205A	Solid and Hazardous Waste Management
CVPA11204B	Environmental Impact Assessment		CVPA11205B	Environmental Chemistry & Microbiology
CVPA11204C	Environmental instrumentation		CVPA11205C	Remote sensing and GIS
Subject Code	**Open Elective I**			
IOEP11206A	Soft Computing Techniques			
IOEP11206B	Ethical Hacking			
IOEP11206C	Product design Engineering			

Audit course -I	
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 schemes

BOS Chairman **Dean Academics** **Director**

MTECH -CIVIL ENGINEERING -WREE

First Year M. Tech. (FYMT) - Semester II (Pattern 2020)

Course Code	Course		Teaching Scheme		Examination Scheme					Total	Credits
			L	P	CIE	ISE	SCE	ESE	TW /OR		
CVPA12201	Open Channel Hydraulics	TH	3	-	20	30	20	30	-	100	3
CVPA12202	Advance Waste Water Treatment	TH	3	-	20	30	20	30	-	100	3
CVPA12203	Industrial Waste Water Treatment	TH	3	-	20	30	20	30	-	100	3
CVPA12204	Program Elective IV	TH	3	-	20	30	20	30	-	100	3
CVPA12205	Program Elective V	TH	3	-	20	30	20	30	-	100	3
IOEP12206	Open Elective II	CE	2	-	-	-	-	-	50	50	2
CVPA12207	Intellectual Property Rights	CE	2	-	-	-	-	-	50	50	2
CVPA12208	Laboratory II	CE-	-	4	-	-	-	-	50	50	2
AP 2	Audit Course II	-	-	-	-	-					
	Total		19	4	100	150	100	150	150	650	21

* Laboratory II (CVPA12208) will be based on courses namely Open channel hydraulics, Advanced Waste Water Treatment and Industrial Waste Water Treatment

Subject Code	**Program Elective IV**		**Subject Code**	**Program Elective V**
CVPA12204A	Hydrology		CVPA12205A	Design of Hydraulic Structures
CVPA12204B	Advance Fluid Mechanics		CVPA12205B	Dam Engineering
CVPA12204C	FEM to Flow Problems		CVPA12205C	Wave Mechanics
Subject Code	**Open Elective II**			
IOEP12206A	Project Planning and Management			
IOEP12206B	Blockchain Technologies			
IOEP12206C	Data Science for Engineers			

Audit course -I	
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 schemes

BOS Chairman **Dean Academics** **Director**

SEMESTER - I

F.Y.M TECH WREE - SEMESTER I

Water Resources System Planning (CVPA11201)	
Teaching Scheme	**Examination scheme**
Credits :3	**CIE:20**
Lectures :3 hrs/ week	**ISE: 30**
	SCE:20
	ESE:30
	PR/OR/TW: NA

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

Course Objectives:

1. To impart the necessity and aspects of water resource planning and management.
2. To educate students about role of central and state government in water resources planning
3. To introduce various water conservation structures.
4. To impart the knowledge of reservoir operation and canal irrigation system.
5. 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.
6. To make students aware of miscellaneous systems like basin planning; inter-basin transfer of water and ground water evaluation.

Course Outcomes:

Upon completion of this course, students will be able to –

1. Understand the necessity and aspects of water resource planning and management.
2. Apply different rules of central and state government in water resources planning
3. Design a specific water conservation structure as per specific sight.
4. Solve problems related to reservoir operation, sediment load and canal irrigation for managing the water resources.
5. Plan and Design single and multipurpose projects economically.
6. 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 (6 Hrs)

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.

Unit II: Role of Central and State Government in water resources planning (6 Hrs)

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

Unit III: Water Conservation Structures (6 Hrs)

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 (6 Hrs)

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 (6 Hrs)

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 **(6 Hrs)**
Basin planning; inter-basin transfer of water, Ground water evaluation; conjunctive use of surface and ground water.
Text books: 1. Bhave P.R., "Water Resources Systems", Narosa Publications, New Delhi. 2. Chaturvedi, M.C.Water Resources System Planning. **3.** Biswas, A.K.Water Management System Application
Reference Books: 1. National water Laws 2. National Water Policies 3. Indian Government's rules and regulations for water distribution systems

Advance Water Treatment (CVPA11202)	
Teaching Scheme	**Examination scheme**
Credits :3	**CIE:20**
Lectures :3hrs / week	**ISE: 30**
	SCE:20
	ESE:30
	PR/OR/ TW:NA

Prerequisite: Environmental Engineering I & II at UG level

Course Objectives:

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

Course Outcomes:

Upon completion of this course, students will be able to –

1. Analyze the water demand, quality and distribution of water..
2. Understand the unit operation in water treatment.
3. Design of aeration, sedimentation process in water treatment.
4. Design filtration technique and disinfection process in water treatment.
5. Understand adsorption and ion exchange process in water treatment.
6. Understand the concept of advance water treatment process.

Unit I: Water demand, quality of water, water intake structure and distribution of water. (6 Hrs)

Introduction to water demand, factor affecting demand, rate of variation, methods of population forecasting. Characteristics of water such physical, chemical and biological. Methods used in water distribution and supply scheme, selection of pipe diameter, material of pipe, power calculation of pump, pumping station design. Types of water intake structure only introduction.

Unit II: Unit operation in water treatment. (6 Hrs)

Various unit operation such as gas transfer aeration, its types and design of cascade aerator, desorption of gas, ficks law, henry's law, theory and types of mixing chamber, sedimentation, flocculation, screening, carbonation, de carbonation operations. Ion and metal removal operation chemistry in water treatment.

Unit III: Unit process I. (Physico-chemical type) (6 Hrs)

Screening process, types of screen chamber, aeration process and its types, sedimentation process such as plain and coagulation type, design of clariflocculator, mixing chamber design.

Unit IV: Unit process II. ((Physico-chemical type) (6 Hrs)

Filtration process, design of sand filter, operational problems, filtration hydraulics, duel media filter. Disinfection process, types of chlorination, UV radiations, iodine, bromine treatment

Unit V: Unit process III. ((Physico-chemical type) (6 Hrs)

Adsorption process different types of adsorbent, factors influencing adsorption, adsorption isotherms (including Numerical), adsorption kinetics breakthrough curve and design of adsorption column. Water softening process such as lime soda, zeolite, ion exchange design.

Unit VI: Advanced water treatment process. (6 Hrs)

Membrane process, theory and types of member, operation problems in membrane operation. Desalination process, its types. Removal of color, odor, fluoride, iron and manganese from the water. Electro dialysis process. SCADA system in WTP.

Text books:

1. Dr. B.C.Punmia, Water Supply Engg., Laxmi Publicaiton
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

Irrigation and Drainage (CVPA11203)	
Teaching Scheme	**Examination scheme**
Credits :3	**CIE:20**
Lectures :3hrs/ week	**ISE:30**
	SCE:20
	ESE:30
	PR/OR/TW:NA

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

Course Objectives:

1. To impart the knowledge of Soil Water and Crop Relationship
2. To introduce students to various aspects of Irrigation and its methods.
3. To equip the students to Measure irrigation water flowing in canals and pipes
4. To expose the students to design the Sprinkler irrigation scheme
5. To impart the knowledge of effects of water logging, salinity and its remedial measures.
6. To equip the students to design the surface and subsurface drainage system the irrigated land

Course Outcomes:

Upon completion of this course, students will be able to –

1. Establish relationship between soil water and crop
2. Design an irrigation water conveyance in the form of a channel or pipe and understand water application methods
3. Measure irrigation water flowing in canals and pipes
4. Design a sprinkler and drip irrigation system
5. Establish relation between soil properties and drainage and understand drainage system components
6. Design surface and subsurface drainage system

Unit I: Soil Water-Crop Relationship (6 Hrs)

Introduction, water resources in India, irrigation potential, irrigation definition, benefits, disadvantages, types of irrigation projects, surface irrigation systems, pressure irrigations systems, reasons for low irrigation efficiency, irrigation terminology, basic soil water relationships, water in soil, soil water availability to the plant, soil water potential, Field water balance, infiltration, Evapotranspiration, consumptive use, Crop water requirement, irrigation water requirement, total irrigation water requirement, Irrigation scheduling, indicators of irrigation needs, irrigation scheduling methods, scheduling strategies

Unit II: Irrigation water conveyance (6 Hrs)

Canal system, lining of irrigation canals, water conveyance structures, diversion structures, structure for pipeline, Irrigation channel design, pipe flow of irrigation water,
Water Application Methods classification, surface irrigation methods: borders, basins, furrows, Sprinkler irrigation, drip irrigation, other forms

Unit III: Measurement of Irrigation water (6 Hrs)

Measurement of irrigation water in open channel, types of flow measuring devices, measurement of velocity, measurement of depth, measuring structures
Measurement of irrigation water in pipes using orifice meter, venturi meter, nozzle meter

Unit IV: Irrigation system design (6 Hrs)

Sprinkler irrigation design, Sprinkler irrigation hydraulic design, Drip irrigation-I, Drip irrigation

design

Unit V: Agricultural drainage **(6 Hrs)**

Introduction, what is drainage, benefits, pressure in soil water, soil moisture characteristics curves, soil water potential, soil water movement, hydraulic conductivity, drainable pore space, drainable porosity, water balance equation, infiltration and percolation, problems of drainage, sources of excess water, drainage requirements

Drainage system components: field drainage system, surface drainage system, sub surface drainage system, combined drainage system, Drainage system design: surface drainage, pipe drainage

Unit VI: Drainage system Design **(6 Hrs)**

Sub-surface drainage system design: Drainage coefficient, drain spacing, Hooghoudt formula, equivalent depth, Ernst's equation,

Surface drainage system design, hydrologic design (rational, Cook's and SCS-CN), , hydraulic design, design of open ditch

Text books:

1. Irrigation, Water Resources and water power engineering- Dr. P. N. ModiPubl Standard book house.
2. Irrigation Theory and Practices: A.M.Michael, S Chand Publications,
3. Land Drainage: Principles, methods and Applications, A.K.Bhattacharya and A.M.Michael, Vikas Publications
4. Land and Water Management Engineering V.V.N. Murthy, Madan Jha, Kalyani Publishers 2015

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
4. Irrigation Engineering and hydraulic structures – S.R.Sahasrabudhe- Catson books, Delhi, 2014-3ed.

Program Elective I	
Air Pollution and Control (CVPA11204A)	
Teaching Scheme	**Examination scheme**
Credits :3	**CIE:20**
Lectures :3hrs / week	**ISE: 30**
	SCE:20
	ESE:30
	PR/OR/ TW:NA
Prerequisite: Environmental Engineering I & APC (Elective) at UG level	
Course Objectives: 1. Student would understand the concept of meteorology and its parameter. 2. Controlling techniques for gaseous and particulate matter. 3. Vehicle emission controlling technique	
Course Outcomes: Upon completion of this course, students will be able to – 1. Introduce the student to the air pollution, quality and standards. 2. Understand the 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 (6Hrs)	
Concept of meteorological parameters such wind, solar radiation, humidity, lapse rate, inversion, stability conditions, Pasquil stability model. Effect of meteorological parameter on dispersion of pollutant, plume behavior.	
Unit II: Air Pollution Modelling and air standards (6Hrs)	
Types of air pollution models, pollutant transportation mechanism, maximum mixing depth of pollution in atmosphere, Gaussian plume model for diffusion of pollutant , extermination of effective stack height. National ambient standards for air.	
Unit III: Air Pollution Particulate matter (6Hrs)	
Properties of particulate pollution, particle size distribution ,control mechanism ,dust removal equipment – principle and operation of settling chambers, cyclones, wet dust scrubbers, fabric filters & electro static precipitator.	
Unit IV: Control of Gaseous Pollutants (6Hrs)	
Principle and mechanism use for the removal gaseous pollutant by absorption , adsorption , combustion and condensation process.	
Unit V: Indoor Air Pollution (6Hrs)	
Indoor air pollution sources, indoor pollutant levels, monitoring instruments; indoor pollution control strategies: source control, control equipment and ventilation; effects of indoor air pollution.	
Unit VI: Motor Vehicle Emissions (6Hrs)	
Vehicle combustion chemistry ,sources of emission of pollutants from automobiles, methods used for controlling emission by different methods, BS norms for emission of automobile pollution	

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.

Program Elective I

Environmental Impact Assessment (CVPA11204B)

Teaching Scheme	**Examination scheme**
Credits :3	**CIE:20**
Lectures :3hrs / week	**ISE: 30**
	SCE:20
	ESE:30
	PR/OR/ TW:NA

Prerequisite: Environmental Engineering I & II at UG level

Course Objectives:

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

Course Outcomes:

Upon completion of this course, students will 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. Apply norms &standards for EIA of any small scale industry project
6. Understand and become well conversant with EIA notification procedure for obtaining environmental clearance for construction projects.

Unit I: Environmental impact assessment (6 Hrs)

Environmental impact assessment: Introduction, concepts and aims, impact statement, methods and processes. Mitigation process, 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 (6 Hrs)

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 and air quality Impact Assessment (6 Hrs)

Water Quality Impact Assessment – attributes, water quality impact assessment of water resources projects, data requirements of water quality impact assessment for water body. Impacts of dams on environmental a 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. (6 Hrs)

Categorization of Industries for seeking environmental clearance from concerned authorities, procedure for environmental clearance, procedure for conducting environmental impact assessment report, rapid

and comprehensive on EIA, general structure of EIA document, environmental management plan, post environmental monitoring

Unit V: Norms and Standards (6 Hrs)

Norms & Standards: OHSHAS 18001 & its significance, ISO 14000 & its significance, other acts in ESE and case studies, feasibility studies and management issues.
Related Issues: Principles of sustainable development and implications of finite biosphere and complexities for engineering design and decision-making, design of controlled environments to enhance health and protection of natural resources for sustainable development, resource problems and design with ecology and economics.

Unit VI: Provisions of EIA (6 Hrs)

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 having area more than 1000 sq.mtr.

Text books:

1. Canter R.L., Environmental Impact Assessment, McGraw Hill International edition, 1997. 2. Peter Watten (Eds.) - `Environmental Impact Assessment Theory and Practice', Unwin Hyman, London (1988).
3. Environmental Impact Assesment By R.RBarthwal (New Age Intenational Publishers)

Reference Books:

1. John G. Rau and David C. Woolen (Eds.) `Environmental Impact Analysis Hand Book', McGraw Hill, (1980).
2. Meyers A. Robert (Eds.) Encyclopedia of Environmental Analysis and Remediation Vol. 1-8, John Wiley & Sons, 1998.
3. Encyclopedia of Industrial Safety and Health, 1999

Program Elective I	
Environmental Instrumentation (CVPA11204C)	
Teaching Scheme	**Examination scheme**
Credits :3	**CIE:20**
Lectures :3hrs / week	**ISE: 30**
	SCE:20
	ESE:30
	PR/OR/ TW:NA
Prerequisite: Environmental Engineering I & II at UG level	
Course Objectives: **1.** To study various instrumentation technique for environmental analysis.	
Course Outcomes: Upon completion of this course, students will be 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	**(6 Hrs)**
Introduction to chemical instrumental analysis, advantages over classical methods, classification, various units used in chemical analysis. Introduction to electro analytical methods, potentiometry, voltammetry, coulometry	
Unit II: Spectrometric Methods-I	**(6 Hrs)**
Laws of photometry, UV-visible instrument component, photo colorimeters, 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	**(6 Hrs)**
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-IIIand Miscellaneous Instruments	**(6 Hrs)**
Fluorimeters and Phosphorimeters: Principle, spectrofluorometers, spectrophosporimeter, Raman effect, Raman spectrometer. Nuclear Magnetic Resonance (NMR) spectrometry. Chemical shift principle, working of NMR, FTNMR. Gas analyzers: CO, CO_2, Hydrocarbons, O_2, NO_X	
Unit V: Separate Methods	**(6 Hrs)**
Mass Spectrometer(MS): Principle, ionization methods, mass analyzer types magnetic deflection type time of flight, quadruple, double focusing, detectors for MS.T.E.	
Unit VI: Radioactive Instrumentation	**(6 Hrs)**
X-ray spectrometry: Instrumentation for X-ray spectrometry, X-ray diffract meter: Bragg's law, Auger emission spectroscopy, Electron spectroscopy for chemical analysis(ESCA).B. Radiation detectors: Ionization 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

Program Elective II	
Solid and Hazardous Waste Management (CVPA11205A)	
Teaching Scheme	**Examination scheme**
Credits :3	**CIE:20**
Lectures :3hrs / week	**ISE: 30**
	SCE:20
	ESE:30
	PR/OR/ TW:NA

Prerequisite: Environmental Engineering I & II at UG level

Course Objectives:

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

Course Outcomes : Student will able to

1. Understand source and scenario of solid waste in India.
2. Analyze solid waste generation, transfer and transportation operation.
3. Apply waste processing techniques and 3 R principle.
4. Design composting system in solid waste.
5. Understand biomedical waste disposal system.
4. Understand hazardous waste disposal system

Unit I: Sources of solid, characteristics, Indian scenario and SWM Rule 2016. (6Hrs)

Solid waste sources, types, composition, physical, chemical and biological characteristics Indian Scenario: Present Indian scenario and measures to improve system for different functional elements of solid waste management system, SWM Rule 2016 only study.

Unit II: Solid waste generation, transfer and transportation operation. (6Hrs)

Solid waste generation rate as per CPHEEO manual, Indian scenario for city generate solid waste and management system (Indoor City) , factors affecting storage and collection, types of collection systems. Transfer station concept and application, types of transportation system sued, vehicle routing, vehicle collection capacity.

Unit III: Waste processing techniques, material recovery and recycling (6Hrs)

Various waste processing techniques such as mechanical volume and size reduction, component separation technique material recovery process.

Recycling method of solid waste commonly recycled materials and processes energy recovery from solid waste: Parameters affecting, Fundamentals of thermal processing, biomethanation, pyrolysis, incineration, refuse derived fuels.

Unit IV: Composting of solid waste & landfills site management (6Hrs)

Types of composting process such as aerobic and anaerobic composting with chemistry, gas formation, advantage and disadvantage Site selection of land filling, design of land filling and management of land filling sites.

Unit V: Biomedical Waste (6Hrs)

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 (6Hrs)

Details related to hazardous waste, types, sign for handling and storage of hazardous waste. Methods of disposal of hazardous disposal for solid and liquid type. Hazardous waste rule.

Text books

1. Bhide. A.D. And Sundaresan. B.B, *"Solid Waste Management",* Indian National Scientific Documentation Centre, 1st Edition, 1983.
2. CPHEEO, "Manual on Municipal Solid waste management", Central Public Health and
3. Environmental Engineering Organization, Government of India, New Delhi, 2000

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

Program Elective II	
Environmental Chemistry & Microbiology (CVPA11205B)	
Teaching Scheme	**Examination scheme**
Credits :3	**CIE:20**
Lectures :3hrs / week	**ISE: 30**
	SCE:20
	ESE:30
	PR/OR/ TW:NA

Prerequisite: Environmental Engineering I & II at UG level

Course Objectives:

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

Course Outcomes:

Upon completion of this course, students will be able to –

1. Apply the physical, inorganic and organic chemistry knowledge.
2. Understand the process in chemistry for water and waste water.
3. Analyze water, waste water, solid waste and air pollutant.
4. Understand fundamental of microbial structure and its function.
5. Understand microbial nutrient requirement, cell growth and instruments.
6. Apply bio kinetic coefficients (water and waste water).

Unit I: Basic concept of physical, inorganic and organic chemistry. (6 Hrs)

Fundamental of physical chemistry and its importance. Inorganic chemistry basics application in water, waste water and air pollution analysis. Application of organic chemistry in environmental filed.

Unit II: Process chemistry for water and wastewater treatment. (6 Hrs)

Chemistry of water and waste water treatment process in preliminary, primary, secondary and tertiary treatment. Fundamentals of process kinetics: reaction rates and order, reactor design; concept of surface and colloidal chemistry; adsorption – physical versus chemical adsorption, factors influencing adsorption, adsorption isotherms, absorption process.

Unit III: Analysis of water, waste water, solid waste and air pollutants (6 Hrs)

Analysis of physical, chemical and biological characteristics of water, waste water, solid waste sample. Air pollutant sample analysis. Various techniques and instruments used in analysis of pollutant.

Unit IV: Microbial cell structure its function and instruments used in analysis (6 Hrs)

Study of microbial 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 requirement, cell growth and taxonomy of microbial. (6Hrs)

Microbial nutrient requirements, nutritional types of microorganisms, uptake of nutrients by the cell, culture media. Microbial growth and control, bacterial cultures, growth curve, measurement of microbial growth, influence of environmental factors on growth, microbial growth in natural environments.

Microbial taxonomy and phylogeny, Archaea, Bacteria, fungi, slime molds, water molds, algae, protozoa, helminths.

Unit VI: Bio kinetics and its application in waste water treatment. (6 Hrs)

Microbial growth kinetics; bio kinetic coefficients, determination of bio kinetic coefficient, application of bio kinetic constant in waste water treatment (aerobic and anaerobic).
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

Program Elective II

Remote Sensing and GIS (CVPA11205C)

Teaching Scheme	Examination scheme
Credits :3	**CIE:20**
Lectures :3hrs / week	**ISE: 30**
	SCE:20
	ESE:30
	PR/OR/ TW:NA

Prerequisite: Surveying at UG level

Course Objectives:

1. To introduce students to Remote Sensing
2. To make students aware of methodologies of Aerial Photography And Photogrammetry.
3. To impart the knowledge of Remote Sensing Satellites
4. To make students aware of procedure for Image Interpretation.
5. To introduce students to GI

Course Outcomes:

Upon completion of this course, students will 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. Understand 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 (6 Hrs)

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 (6 Hrs)

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 (6 Hrs)

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

Unit IV: Introduction to GIS (6 Hrs)

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

Unit V: Data and Processing (6 Hrs)

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 (6 Hrs)
Simple-complex query with two or more tables using SQL. Queries using Union, Intersection, Join etc operations. Types of Models, Conceptual Models of WREE, GIS analysis and Interpretation, Over view of Open sources softwares such as ARC – GIS, Q – GIS.
Text books: 1. R. Michael Hord, Remote sensing methods & applications, Wily Interscience Publication. 2. Chang, K. T. (2008): Introduction to Geographic Information Systems, Avenue of the Americas, McGraw-Hill, New York 3. Kresse, W. and Danko, D. (2002): Springer Handbook of Geographic Information,Springer Drecht, London
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.

Open Elective I

Soft computing Techniques (IOEP11206A)

Teaching Scheme	**Examination scheme**
Credits :2	**CIE: NA**
Lectures :2 hrs / week	**ISE: NA**
	SCE: NA
	ESE: NA
	PR/OR/ TW:50

Prerequisite: UG level mathematics

Course Objectives:

1. To make students aware about soft computing techniques /AI techniques
2. To impart knowledge about working of ANN, applications of ANN
3. To impart knowledge about working of Genetic programming, applications of GP
4. To impart knowledge about working of Support vector Regression and Model Tree, applications of SVR and MT

Course Outcomes:

Upon completion of this course, students will be able to –

1. Understand working of ANN and design temporal and cause effect ANN models
2. Understand working of Genetic programming and design temporal and cause effect GP models
3. Understand working of Support Vector Regression and design temporal and cause effect SVR models
4. Understand working of Model Tree and design temporal and cause effect MT models

Unit I: Artificial Neural Networks (8 hrs)

Introduction to computing, hard computing-soft computing, AI and Soft computing, ANN as a soft computing technique, Biological neural network, artificial neuron, working of an artificial neural network, network training, validation and testing, standard Back propagation algorithm, introduction of first order, second order and global training algorithms

Unit II: Neural network design and applications (8 hrs)

important aspects of artificial network design, types of neural networks, Applications of ANN in temporal and cause effect modeling

Unit III: Genetic programming (4 hrs)

Introduction to Genetic programming, genetic operators, variants in GP, Algorithm of GP, GP parameters Application of GP in temporal and cause effect modeling

Unit IV: Support Vector Regression and Model Tree (4 hrs)

Introduction to Support vector machines, Support Vector Regression, basics of SVR, Application of MT in temporal and cause effect modeling. Introduction to Model Tree, M5 Algorithm, Application of MT in temporal and cause effect modeling

Term work:

1. Design cause effect model using ANN, GP, SVR and MT for the same problem and compare their results. Students will prepare a single report of these four applications.

Text books:

1. Bose, N. K., Liang, P. (1998), "Neural Network Fundamentals with Graphs, Algorithms and Applications", Tata McGraw-Hill Publication.
2. Kosko, B., (1992), "Neural Networks and Fuzzy systems", Prentice Hall, Englewood Cliffs, NJ
3. Wasserman, P.D., (1993), " Advanced methods in neural computing", Van Nostrand Reinhold,

New York
Reference Books: Publications in ASCE, Science Direct, Springer, Wiley, IEEE journals and/or similar peer reviewed international unpaid journals

Open Elective I

Ethical Hacking (IOEP11206B))

Teaching Scheme	**Examination scheme**
Credits :2	**CIE: NA**
Lectures :2 hrs / week	**ISE: NA**
	SCE: NA
	ESE: NA
	PR/OR/ TW:50

Prerequisite: UG level mathematics

Course Objectives:

1. Aware of legal perspective of cybercrime including Indian IT ACT 2008
2. Learn techniques of gathering network information
3. Identify security tools including, but not limited to intrusion detection and firewall software
4. Learn to perform different kind of attacks

Course Outcomes:

Upon completion of this course, students 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

Unit I: Introduction to Network and security (4 hrs)

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 (4 hrs)

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 (4 hrs)

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

Unit IV: Port Scanning and Vulnerability Assessment (4 hrs)

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

Term work:

Assignments on each unit

Text books:

1. Rafay baloch, "Ethical hacking and Penetration Testing guide", CRC press, 2015, ISBN: 13: 978-1-4822-3162-5 (eBook - PDF).
2. Nina Godbole, SunitBelapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", WILEY Publications, 2015, ISBN:978-81-265-2179-1

Reference Books:

1. Behrouz Fourzon, " Data Communication and Computer Networks", Pearson Education,5th edition ISBN : 978-0070634145
2. Andrew S. Tanenbaum, " *Computer Networks",* International Economy Edition, 5th edition ISBN: 10: 9332518742

Open Elective I	
Product Design Engineering (IOEP11206C)	
Teaching Scheme	**Examination scheme**
Credits :2	**CIE: NA**
Lectures :2 hrs / week	**ISE: NA**
	SCE: NA
	ESE: NA
	PR/OR/ TW:50

Prerequisite: UG level mathematics

Course objectives:

1. To understand basic techniques for particular phases of product development
2. Make and manage design teams for product development in a company.

Course Outcomes:

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

1. Describe an engineering design and development process
2. Employ engineering, scientific, and mathematical principles to execute a design from concept to finished product
3. Create 3D solid models of mechanical components from the perspective of aesthetic, ergonomic and functional requirement using CAD software
4. Work collaboratively on a team.
5. Create new product based on mechanical design engineering.
6. Investigate contemporary issues and their impact on provided solution.

Unit 1 – Introduction to Product Design

Characteristics of Successful Product Development, Innovative Thinking, Challenges to Product Development, Product Development Process, Concept Development, Economics – Cost Vs Performance, Design Considerations

Unit 2 – Product Development Process

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

Unit 3 –Product Design Tools

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.

Unit 4 – Design for Manufacture and Assembly

Design for assembly, design for disassembly, design for environment, design for graphics and packaging

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

Research Methodology (CVPA11207)

Teaching Scheme	Examination scheme
Credits :2	**CIE: NA**
Lectures :2 hrs / week	**ISE: NA**
	SCE: NA
	ESE: NA
	PR/OR/ TW:50

Prerequisite: Basic statistical tools

Course Objectives:

1. To introduce to the concept of research and research problem
2. To understand research ethics
3. Get introduced to the concept of Intellectual property rights.
4. To understand developments in IPR

Course Outcomes:

Upon completion of this course, students will be able to –

1. Define research and formulate a research problem
2. Discuss the importance of Research Design and Literature Review
3. Discuss classification of data and preliminary data analysis
4. Write a research proposal to a suitable funding agency

Unit I : Introduction to Research and Research problem (6 Hrs)

Meaning of research, types of research, process of research, Objectives of research, Research and Scientific Method, 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), formulation of research hypotheses, Qualities of a good Hypothesis, Null Hypothesis & Alternative Hypothesis. Hypothesis Testing -Logic & Importance

Unit II: Research Design and Literature review (6 Hrs)

Research Design- Concept and Importance in Research, different research designs in research studies, Literature survey- Definition of literature and literature survey, need of literature survey, elements and objectives of literature survey, sources of literature-monographs-patents – web as a source, Critical literature review – Identifying gap areas from literature review and strategies of literature survey, Errors in research.

Unit III: Data and Data Analysis (6 HrS)

Classification of data, benefits and drawbacks of data, qualitative methods of data collection, types of data analysis, Sampling, sample size, sample design, Testing of hypothesis and Goodness of Fit: Definition of null and alternative hypothesis, student's 't' distribution, Chi-square distribution, F-test, analysis of variance techniques, introduction to non-parametric tests. Regression Analysis – Simple Linear Regression, Multiple linear Regression

Unit IV: Report, Research proposal and funding agencies (6 Hrs)

Need of effective documentation, types of reports and their format. Essentials of a research proposal. Different funding agencies for research. Research briefing, presentation styles, elements of effective presentation, writing of research paper, presenting and publishing paper, patent procedure, ethical issues.

Text books:

1. Dr. C. R. Kothari, Research Methodology: Methods and Trends', New Age International

Publishers.
2. Wayne Goddard and Stuart Melville, Research Methodology: An Introduction'
3. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners'

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.

Laboratory I (CVPA11208)

Teaching Scheme	**Examination scheme**
Credits :2	**CIE: NA**
Practical :4 hrs / week	**ISE: NA**
	SCE: NA
	ESE: NA
	PR/OR/ TW:50

Prerequisite: Basic statistical tools

Course Objectives:

1. To impart the necessity and aspects of water resource planning and management, role of central and state government in water resources planning , reservoir operation ,cost benefit analysis.
2. To make students aware of various water conservation structures and miscellaneous systems like basin planning; inter-basin transfer of water and ground water evaluation.
3. To understand different methods for water analysis.
4. To understand different instruments in environmental engineering**.**
5. To impart the knowledge of soil water and crop relationship and various aspects of Irrigation and its methods, effects of water logging, salinity and its remedial measures.
6. To equip the students to design the lift, drip , Sprinkler irrigation schemes and drainage system of irrigated land

Course Outcomes:

Upon completion of this course, students will be able to –

1. Understand the necessity and aspects of water resource planning and management, role of central and state government in water resources planning , reservoir operation ,cost benefit analysis.
2. Understand various water conservation structures and miscellaneous systems like basin planning; inter-basin transfer of water and ground water evaluation.
3. Analyzes the system in environmental engineering
4. Deign water , air ,EIA, instrumentation and solid waste management systems.
5. Understand soil water and crop relationship and various aspects of Irrigation and its methods, effects of water logging, salinity and its remedial measures.
6. Design the lift, drip , Sprinkler irrigation schemes and drainage system of irrigated land

Water Resources System Planning (CVPA11201)

The term work will be based on the following assignments (Any 8 assignments)

List of assignments:

1. Numerical on spatial and temporal characteristics of water resources using Excel.
2. Water budget, different water distribution policies for different sectors (private, industrial and domestic),
3. Water tariff, tariff regulations
4. Water conservation structures - CCT, MNB/ENB, CNB, Compartment bunding, Terracing,
5. Water conservation structures - Recharge shaft, KT Weir, Nala deepening, Farm pond and Forest pond

6. Financial analysis of single and multipurpose water resources projects
7. Benefit cost analysis of water resources projects
8. Numerical on reservoir operation
9. Flood routing using Excel
10. Numerical on ground water evaluation

Advance Water Treatment (CVPA11202)

The term work will be based on the following assignments (All 8 assignments)

List of assignments:

1. Three assignments on advance water treatment with design.
2. Three assignment on air pollution and control or EIA or Env. Instrumentation
3. Two assignment on solid and hazardous waste management or GIS orEnv. Chemistry and microbiology

Irrigation and Drainage (CVPA11203)

The term work will be based on the following assignments (All 8 assignments)

List of assignments:

1. Calibration of venturi flume
2. Calibration of venturi meter
3. Calibration of orifice meter
4. Measurement of velocity in open channel
5. Design of sprinkler irrigation system
6. Design of drip irrigation system
7. Design of sub-surface land drainage system
8. Design of surface land drainage system

SEMESTER - II

F.Y.M TECH WREE - SEMESTER II

Open Channel Hydraulics (CVPA12201)	
Teaching Scheme	**Examination scheme**
Credits :3	**CIE: 20**
Lectures :3 hrs / week	**ISE: 30**
	SCE: 20
	ESE: 30
	PR/OR/ TW:NA

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

Course Objectives:

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

Course Outcomes:

By the end of the course, students would be able

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 **(6Hrs)**

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

Unit II --Hydraulic Jump **(6Hrs)**

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 **(6Hrs)**

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 **(6Hrs)**

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 **(6Hrs)**

Gradually varied unsteady flow: Continuity equation, dynamic equation, Monoclinal rising waves, dynamic equation for uniformly progressive flow, wave profile of uniformly progressive flow, wave propagation, Rapidly varied unsteady flow: Uniformly progressive flow, positive surge, negative surge, dam break problem

Unit VI: Flood Routing	**(6Hrs)**
Hydraulic and Hydrologic flood routing, Reservoir and channel routing, Differential form of Momentum Equation, Muskinghum method, Finite difference scheme	
Text Books :	
1. Flow in open channel- K. Subramanya, Tata Mc-Graw Hill. **2.** Flow through Open Channel-K.G.Ranga Raju, Tata Mc-Graw Hill. **3.** .Flow through open channels-Rajesh Srivastava—Oxford	
Reference Books 1. Open Channel Hydraulics – Ven Te Chow, Mc-Graw Hill. 2. Open Channel flow– Madan Mohan Das, PHI learning private limited 3. The hydraulic of Open channel flow – Hubert Chanson, Arnold Publications UK	

Advanced Waste Water Treatment (CVPA12202)

Teaching Scheme	Examination scheme
Credits :3	**CIE: 20**
Lectures :3 hrs / week	**ISE: 30**
	SCE: 20
	ESE: 30
	PR/OR/ TW:NA

Prerequisite: Environmental Engineering at UG level

Course Objectives:

1. To introduce students to design waste water treatment units.
2. To impart the knowledge of low cost treatment & ecofriendly unit.
3. 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. Analyze characteristics of waste water and types of reactor used in waste water process.
2. Understand preliminary and primary unit operation in waste water.
3. Apply concept of chemical and biological unit process in waste water.
4. Design aerobic biological treatment process.
5. Design anaerobic biological treatment process.
6. Design the sludge treatment process.

Unit I: Waste water characteristic, reaction and reactor. (6Hrs)

Physical, chemical and biological characteristic of waste water. Types of reaction and reactor used in waste water treatment process.

Unit II: Preliminary and primary unit operation and basic design consideration. (6Hrs)

Preliminary and primary unit operation such sump and sump pump, approach channel, screen chamber, grit chamber, skimming tank, aeration its types and primary sedimentation tank.

Basic design consideration such as mass loading, hydraulic, weir loading, flow diagram, flow curves and their fluctuations..

Unit III: Chemical and biological unit process. (6Hrs)

Chemical neutralization, coagulation, precipitation, oxidation and disinfection. Biological unit process such as attach growth and suspended growth process and its applications.

Unit IV: **Design and concept of aerobic biological treatment process. (6Hrs)**

Design and concept of suspended growth treatment process such as activated sludge process, extended aeration system aerated lagoon and oxidation ditch.

Design and concept of attach growth treatment process such as trickling filter process, rotation biological contactor and bio towers.

Unit V: **Design and concept of aerobic biological treatment process. (6Hrs)**

Design and concept of suspended growth treatment process such as mix anaerobic reactor.

Design and concept of attached growth treatment process such as fluidized bed reactor and up-flow anaerobic sludge blanket reactor.

Unit VI: Design of sludge treatment units. (6Hrs)

Design essential sludge quantity, volume-weight relationship and treatment concepts. Anaerobic and aerobic sludge digestion process concept and design.

Text books

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

Reference books

1. Droste, Ronald L "Theory and Practice of Water and Wastewater Treatment", John Wiley & Sons Publication, 1st Edition, 1997.
2. Crites Ron and Tchobanoglous George, "Small and Decentralized Wastewater Management Systems", McGraw-Hill Book Company, International edition, 1998.
3. Sincero A, P and Sincero G, A, "Environmental Engineering A Design approach", PHI learning private limited, 2004.

Industrial Waste Water Treatment (CVPA12203)

Teaching Scheme	Examination scheme
Credits :3	CIE: 20
Lectures :3 hrs / week	ISE: 30
	SCE: 20
	ESE: 30
	PR/OR/ TW:NA

Prerequisite: Environmental Engineering at UG level

Course Objectives:

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

Course Outcomes:

At the end of the course student would able to,

1. Analyze characteristic of industrial waste water.
2. To understand physicochemical treatment process.
3. To understand the concept of biological treatment process.
4. To understand the concept of tertiary treatment process.
5. Apply the concept of common effluent treatment plant.
6. Understand manufacturing process and treatment methods for various industrial waste.

Unit I: Characteristic and different unit operations. (6Hrs)

Characteristics of industrial waste water and its importance in design a process. Various unit operation involved such as screening, grit chamber, sedimentation and pumping.

Unit II: Physicochemical treatment process. (6Hrs)

Various process such as sedimentation, coagulation, neutralization, equalization, heavy metal removal and disinfection process.

Unit III: Biological treatment process. (6Hrs)

Concept and design of aerobic and anaerobic biological treatment for industrial waste water treatment.

Unit IV: Tertiary treatment process. (6Hrs)

Removal of nutrients such as phosphate, nitrate, color and odor.

Unit V: Common effluent treatment plants.(CETP) (6Hrs)

Design and concept of common effluent treatment plant, location, legislation, cost of treatment, advantage and disadvantage. Present scenario in Indian and Govt. policies for CETP.

Unit VI: Manufacturing process & treatment methods for various industrial waste. (6Hrs)

Manufacturing process and sources of effluent from the process of industries like fertilizer, petroleum,

paper, sugar, distillery, textile, tannery and dairy industry.

Text books:

1. 1 Waste Water Engineering Metcalf Eddy McGraw Hill Publications.
2. 2 N.L. Nemerow, Liquid waste of Industry, Addison Wesely. 1996
3. 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.

Program Elective III	
Hydrology (CVPA12204A)	
Teaching Scheme	**Examination scheme**
Credits :3	**CIE: 20**
Lectures :3 hrs / week	**ISE: 30**
	SCE: 20
	ESE: 30
	PR/OR/ TW:NA

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

Course Objectives:

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

Course Outcomes:

At the end of the course student would 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 (6Hrs)

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

Unit II: Hydrograph Analysis (6Hrs)

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

Unit III: Stochastic processes and Flood Analysis (6Hrs)

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 (6Hrs)

Definition of Ground Water, aquifers, vertical distribution of subsurface water, Darcy's Law-it's range of validity, Dupuit-Forchheimer 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 (6Hrs)
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 (6Hrs)
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.

Program Elective III	
Advance Fluid Mechanics (CVPA12204B)	
Teaching Scheme	**Examination scheme**
Credits :3	**CIE: 20**
Lectures :3 hrs / week	**ISE: 30**
	SCE: 20
	ESE: 30
	PR/OR/ TW:NA

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

Course Objectives:

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

Course Outcomes:

Upon completion of this course, students will be able to –

1. Solve problems related to motion of fluid particles using principles of Kinematics.
2. Derive equations of motion using principles of dynamics and apply Navier Stokes equations for solving laminar flow problems
3. Determine boundary layer thickness using various methods
4. Apply the basics of turbulent flow in practical problems
5. Solve pipe flow problems
6. Calculate drag and lift of submerged bodies

Unit I: Kinematics (6 Hrs)

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 (6 Hrs)

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 (6 Hrs)

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

Unit IV: Turbulent Flow (6 Hrs)

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 (6 Hrs)

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 (6 Hrs)

Definitions and expressions for drag, lift, drag coefficient, lift coefficient, types of drag. Drag on sphere, cylinder, flat plate and airfoil, Karman's vortex street, Effect of free surface and compressibility on drag, Development of lift, Lift on cylinder and Aerofoil, Magnus effect, Polar diagram.

Text books:

1. SukumarPati, Fluid Mechanics and Hydraulic Machines, Tata McGraw-Hill
2. S. K. Som, Gautam Biswas, Suman Chakraborty, Introduction to fluid Mechanics and fluid machines, McGraw-Hill – 2013 ed.
3. Fluid Mechanics and Machninary, CSP Ojha, R. Berndtsson, P.N.Chandramouli, Oxford University Press

Reference Books:

1. White, Fluid Mechanics, Mc-Graw Hill
2. Introduction to Fluid Mechanics Edward J. Shaughnessy, Jr. Ira M. Katz, James P. Schaffer Oxford University Press
3. Fluid Mechanic and Machinery B. Ramdurhaiah, New Age International

Program Elective III	
Finite Element Method to Fluid Flow Problems (CVPA12204C)	
Teaching Scheme	**Examination scheme**
Credits :3	**CIE: 20**
Lectures :3 hrs / week	**ISE: 30**
	SCE: 20
	ESE: 30
	PR/OR/ TW:NA

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

Course Objectives:

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

Course Outcomes:

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

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

Unit I: Introduction of Finite element method (6Hrs)

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 (6Hrs)

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 (6Hrs)

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 (6Hrs)

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 (6Hrs)

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 **(6Hrs)**
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

Program Elective IV

Design of Hydraulic Structures (CVPA12205A)

Teaching Scheme	**Examination scheme**
Credits :3	**CIE: 20**
Lectures :3 hrs / week	**ISE: 30**
	SCE: 20
	ESE: 30
	PR/OR/ TW:NA

Prerequisite: FM I, FM II and Hydrology (Water Resources Engineering) at UG level

Course Objectives:

1. To introduce students to the concept of diversion head works
2. To analyze flow below weir
3. To impart the knowledge about canal falls along with their deign
4. To make students aware of different regulation modules and miscellaneous structures along with their design
5. To introduce students to cross drainage works along with their designs.
6. To introduce students to rivers, their behavior and control

Course Outcomes:

Upon completion of this 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 **(6 Hrs)**

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 weri and Barrage **(6 Hrs)**

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 **(6 Hrs)**

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 **(6 Hrs)**

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 (6 Hrs)

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 (6 Hrs)

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.
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

Program Elective IV	
Dam Engineering (CVPA12205B)	
Teaching Scheme	**Examination scheme**
Credits :3	**CIE: 20**
Lectures :3 hrs / week	**ISE: 30**
	SCE: 20
	ESE: 30
	PR/OR/ TW:NA

Course Objectives:

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

Course Outcomes:

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

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

Unit I :Introduction to dams (6Hrs)

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 (6Hrs)

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 (6Hrs)

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 (6Hrs)

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 **(6Hrs)**
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 **(6Hrs)**
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.

Program Elective IV

Wave Mechanics (CVPA12205C)

Teaching Scheme	Examination scheme
Credits :3	**CIE: 20**
Lectures :3 hrs / week	**ISE: 30**
	SCE: 20
	ESE: 30
	PR/OR/ TW:NA

Prerequisite: Fundamentals of probability and statistics

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:

Upon completion of this course, students 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 (6Hrs)

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 (6Hrs)

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 (6Hrs)

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 (6Hrs)

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(6Hrs)

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 (6Hrs)

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., Darlymple 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

Open Elective II

Project Planning and Management (IOEP12206A)

Teaching Scheme	Examination scheme
Credits :2	CIE:NA
Lectures :3 hrs / week	ISE: NA
	SCE: NA
	ESE: NA
	PR/OR/ TW:50

Prerequisite: Basic understanding of Project Management at UG level

Course Objectives:

1. To impart knowledge of project life cycle.
2. To introduce students to Project Identification Process, Project Initiation, Pre-Feasibility Study and Project feasibility Studies,
3. To construct CPM, PERT network for a project.
4. To introduce students to Steps in Risk Management, Risk Identification, Risk Analysis and Reducing Risks
5. To introduce students to process of project Performance Measurement, Evaluation and closeout.

Course Outcomes:

Upon the completion of the course, students will be able to

1. nderstand principles of Project Management and phases of project life
2. Understand the Project Identification Process, Project Initiation, Pre-Feasibility Study and Project feasibility Studies,
3. Construct CPM, PERT network for a project.
4. Understand the process of project Performance Measurement, Evaluation and closeout.

Unit I: Basics of Project Management (6 Hrs.)

Introduction, Need, Project Management Knowledge Areas and Processes, Concept of Organizational Structure and types, The Project Life Cycle (preferably with case study), Essentials Project Management Principles.

Unit–II: Project Identification and Selection (6 Hrs.)

Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point. Case study is preferred

Unit -III: Project Planning (6 Hrs.)

Introduction, Need for Project Planning, Work Breakdown Structure (WBS), LOB, CPM and PERT, Network Cost System, Resource Allocation, Scheduling, Project Cost Estimate and Budgets, concept of Project Risk Management

Unit IV: Project Performance Measurement, Evaluation and closeout (6 Hrs.)

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

Students are encouraged to register for On-line course in the relevant above course approved by authority.

TW: Assignments for all units

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 Wiely, New York.
4. Project Management-Planning and Control---Rory Burkey 4th ed.—Wiley,India.

Open Elective II	
Blockchain Technology (IOEP12206B)	
Teaching Scheme	**Examination scheme**
Credits :2	**CIE:NA**
Lectures :3 hrs / week	**ISE: NA**
	SCE: NA
	ESE: NA
	PR/OR/ TW:50
Prerequisite: Fundamentals of probability and statistics	
Course Objectives : To introduce fundamentals of Blockchain To explain Bitcoin Blockchain To explain Ethereum Architecture & Components To explain Blockchain creation using Ethereum Platform To explain Hyperledger Frameworks and Fabric Concepts To discuss Emerging Trends in Blockchain and Use cases	
Course Outcomes: After completion of the course, student will be able to Explain fundamental knowledge of Blockchain (Understand) Illustrate Bitcoin Blockchain (Understand) Summarise Ethereum Architecture & Components (Understand) Demonstrate Blockchain creation process using Ethereum Platform (Apply) Introduce Hyperledger Frameworks and Fabric Concepts (Understand) Explore emerging trends in Blockchain and Use cases (Understand)	
Unit I :	**Overview of Blockchain**
What is Blockchain?, History of Blockchain, Network and protocols, Smart Contract and Consensus Algorithms, Blockchain users and adoption, Blockchain challenges	
Unit II :	**Bitcoin Blockchain**
Blockchain TOC Bitcoin/Blockchain data structures, Keys as Identity, Digital Signatures, Hashes, Hashes as Addresses, Hash Pointers and Data Structures, Blockchain transactions, Blockchain block structure	
Unit III :	**Ethereum Architecture & Components**
Evolution of Ethereum, Ethereum Components, Ethereum Virtual Machine, Types of Transactions, Solidity language, Ethereum Smart Contracts, Tokenization, Dapps.	
Text Books :	
1. Mastering Bitcoin: Unlocking Digital Crypto currencies, by Andreas Antonopoulos 2. Blockchain by Melanie Swa, O'Reilly 3. Mastering Ethereum Building Smart Contracts and DApps, Andreas M. Antonopoulos, Gavin Wood, O'Reilly 4. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric	
Reference Books :	
1. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits 2. Etherium Yellow Paper : "Ethereum: A Secure Decentralised Generalised Transaction Ledger Petersburg", Dr. Gavin Wood	

Open Elective II	
Data Science for Engineers (IOEP12206C)	
Teaching Scheme	**Examination scheme**
Credits :2	**CIE:NA**
Lectures :3 hrs / week	**ISE: NA**
	SCE: NA
	ESE: NA
	PR/OR/ TW:50

Prerequisite: Fundamentals of probability and statistics

Course Objectives:

- Introduce the mathematical foundation.
- Introduce data science algorithms and data analytics.
- Introduce a practical capstone case study.

Course Outcomes:

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

1. Describe a flow process for data science problems.
2. Classify data science problems.
3. Correlate results to the solutions.
4. Construct use cases to validate approach.

Unit I : Linear Algebra Basics

Linear algebra for data science, Algebraic view - vectors, matrices, product of matrix & vector, rank, null space, solution of over-determined set of equations and pseudo-inverse), Geometric view - vectors, distance, projections, eigenvalue decomposition.

Unit II : Statistics and Optimization:

Statistics (descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates) and Optimization.

Unit III : Linear regression:

Typology of data science problems and a solution framework, Simple linear regression and verifying assumptions used in linear regression, Multivariate linear regression, model assessment, assessing importance of different variables, subset selection.

Unit IV : Classification techniques

Classification using logistic regression, Classification using kNN and k-means clustering.

Text Books :

1. Gilbert Strang, "Introduction to Linear Algebra," 2nd Ed., Wellesley-Cambridge Press.

Reference Books :

1. Douglas Montgomery and George Runger "Applied Statistic and Probability for engineers," 6th Ed., Wiley.

Intellectual Property Rights (CVPA12207)

Teaching Scheme	**Examination scheme**
Credits :2	**CIE:NA**
Lectures :3 hrs / week	**ISE: NA**
	SCE: NA
	ESE: NA
	PR/OR/ TW:50
Prerequisite: NA	

Course Objectives:

1. Explain the importance of ideas, concept and creativity
2. Transfer the knowledge about the IPR required for Engineer's
3. Describe the how IPR creates National wealth
4. Teach National and International IP System

Course Outcomes:

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

5. Explain property and Intellectual property their nature, importance and objectives. (Understand)
6. Discuss types of IPR: Patents, Designs, Trademarks (Registered and unregistered trademarks), Copyright, Traditional Knowledge, Geographical Indications, Trade Secrets, Idea Patenting
7. Understand the process of patenting, development and International scenario: WIPO, TRIPs
8. Explain administration of patent system.

Unit I: Introduction to the concepts Property and Intellectual Property (6Hrs)

Introduction to the concepts Property and Intellectual Property, Nature and Importance of Intellectual Property Rights, Objectives of understanding Intellectual Property Rights, IPR and IITs

Unit II: Intellectual Property Rights (6Hrs)

Understanding the types of Intellectual Property: - Patents, Designs, Trademarks (Registered and unregistered trademarks), Copyright, Traditional Knowledge, Geographical Indications, Trade Secrets, Idea Patenting, (Case Studies)

Unit-III: New Developments in IPR (6Hrs)

New Developments in IPR, Process of Patenting and Development: technological research, innovation, patenting, development, understanding of IPR issues in cyber world, International Scenario: WIPO, TRIPs, Indian Patent Office

Unit-IV: Administration of Patent System (6Hrs)

Administration of Patent System – Patenting under Indian Patent Act, Patenting under PCT, Patent Rights and its Scope, Licensing and transfer of technology, Patent information and database. Provisional and Non-Provisional Patent Application and Specification.

Text Books:

1. Resisting Intellectual Property by Halbert, Taylor & Francis Ltd ,2007
2. Industrial Design by Mayall, Mc Graw Hill

Intellectual Property in New Technological Age by Robert P. Merges, Peter S. Menell, Mark A. Lemley

Reference Books:

3. Intellectual Property Rights under WTO by T. Ramappa, S. Chand
4. Introduction to Design by Asimov, Prentice Hall

Laboratory II (CVPA12208)

Teaching Scheme	Examination scheme
Credits :2	**CIE: NA**
Practical :4 hrs / week	**ISE: NA**
	SCE: NA
	ESE: NA
	PR/OR/ TW:50

Prerequisite: Basic statistical tools

Course Objectives:

1. To give exposure to practical problems related to open channel flow, hydraulic jump on horizontal and sloping channel
2. To introduce students to the concept Uniform flow, specific energy and velocity distribution in open channel, calibration of discharge measuring device, flood routing and GVF analysis
3. To introduce advanced methods for waste water analysis.
4. To introduce advanced waste water treatment processes
5. To introduce different methods for Industrial waste water analysis.
6. To introduce different Industrial waste water treatment process.

Course Outcomes:

Upon completion of this course, students will be able to –

1. Understand practical problems related to open channel flow, hydraulic jump on horizontal and sloping channel, Uniform flow, calibration of discharge measuring device
2. Determine velocity, specific energy, flood discharge, gradually varied flow parameters.
3. Understand advanced methods for waste water analysis.
4. Understand advanced waste water treatment process.
5. Understand different methods for industrial waste water analysis.
6. Understand different industrial waste water treatment process.

Open Channel Hydraulics (CVPA12201)

The term work will be based on the following experiments (Any 8)

List of 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.

Advance Waste Water Treatment (CVPA12202)

The term work will be based on the following assignments (All 6 assignments)

List of assignments:

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.

Industrial Waste Water Treatment (CVPA12203)

The term work will be based on the following assignments (All 6 assignments)

List of assignments:

1. Sources of pollution of industrial waste water treatment
2. Waste Water Treatment
3. Advanced Treatment Methods
4. Common Effluent Treatment Plants (CETP'S)
5. Manufacturing process & treatment methods for I.W.W.
6. Characteristics and composition of effluent and different methods of treatment & disposal of effluent for the following industries