Course Structure and Syllabus

of

M. Tech Programme

in

Civil Engineering

Specialization: Environmental Science & Engineering

VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY
BURLA – 768 018, SAMBALPUR, ODISHA

Vision

To emerge as an internationally acclaimed Civil Engineering Department for imparting futuristic technical education and creation of vibrant research enterprise to create quality civil engineers and researchers, truly world class leaders and unleash technological innovations to serve the global society and improve the quality of life.

Mission

The Department of Civil Engineering, VSSUT Burla strives to create values and ethics in its products by inculcating depth and intensity in its education standards and need based research through

- Participative implementing in a cross-cultural environment that promotes the implementing beyond the class room.
- Collaborative partnership with industries and academia within and outside the country in implementing and research.
- Encouraging innovative research and consultancy through the active participation and involvement of all faculty members.
- Facilitating technology transfer, innovation and economic development to flow as natural results of research whereever appropriate.
- Expanding curricula to cater broader perspectives.
- Creation of service opportunities for upliftment of the society at large.

POs

- An ability to independently carry out research /investigation and development work to solve practical problems
- An ability to write and present a substantial technical report/document
- Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
- Ability to apply knowledge of mathematics, science and engineering to solve complex problems in civil engineering
- Ability to identify, formulate, and solve complex civil engineering problems using first principle of mathematics, basic science & engineering

- Ability to design and conduct complex civil engineering experiments as well as to analyze and interpret the experimental data

PEOs:

- To lead a successful career in industries, pursue higher studies and entrepreneurial endeavors.
- To offer techno-commercially feasible and socially acceptable solutions to real life engineering problems.
- To demonstrate effective communication skill, professional attitude and a desire to implement.

PSOs:

- Plan, analyze, design, prepare and execute all kinds of Water Resources Engineering projects.
- Apply latest construction techniques for successful completion of time bound Water Resources Engineering projects with optimized cost.

Course Structure for

PG Programmes (Environmental Science & Engineering/CE) to be introduced from July 2019

Semester I

Sl. No.	Core/ Elective	Subject Code	Subject Name	L	T	P	Credits
1	Core-1	MCEES101	**Water Treatment Technology**	3	0	0	3
2	Core-2	MCEES102	**Waste Water Management**	3	0	0	3
3	PE-1		**Programme Elective 1**	3	0	0	3
4	PE-2		**Programme Elective 2**	3	0	0	3
5	Common		**Research Methodology & IPR**	3	0	0	3
6	Lab-1	MCEES103	**Environmental Monitoring Lab.**	0	0	3	2
7	Lab-2	MCEES104	**Planning & Design of Water Supply System**	0	0	3	2
8	Audit -1						
Total Credits							19

Semester II

Sl. No.	Core/ Elective	Subject Code	Subject Name	L	T	P	Credits
1	Core-3	MCEES201	**Air pollution and Control**	3	0	0	3
2	Core-4	MCEES202	**Solid and Hazardous Waste Management**	3	0	0	3
3	PE-3		**Programme Elective 3**	3	0	0	3
4	PE-4		**Programme Elective 4**	3	0	0	3
5	Common		**Minor project**	0	0	3	2
6	Lab-3	MCEES203	**Planning & Design of Sewage Collection and Treatment System**	0	0	3	2
7	Lab-4	MCEES204	**Advanced Environmental Monitoring Lab.**	0	0	3	2
8	Audit -2						
Total Credits							18

Semester III

Sl. No.	Core/ Elective	Subject Code	Subject Name	L	T	P	Credits
1	PE-5		**Programme Elective 5**	3	0	0	3
2	OE-1		**Open Elective 1**	3	0	0	3
3	Minor Project		**Dissertation (Phase-I)**	0	0	20	10
Total Credits							16

Semester IV

Sl. No.	Core/ Elective	Subject Code	Subject Name	L	T	P	Credits
1	Major Project		**Dissertation (Phase-II)**	0	0	32	16
Total Credits							16

GRAND TOTAL CREDITS: 19+18+16+16= **69**

Programme Elective-I

Sl.No.	Course Code	Subject Name
1.	MESPE101	Ground Water Flow through Porous Medi
2.	MESPE102	Applied Chemistry & Microbiology
3.	MESPE103	Global Warming & Climate Change
4.	MESPE104	Numerical Methods in Engineering
5.	MESPE105	Application of Soft Computing Techniques

Programme Elective-II

Sl.No.	Course Code	Subject Name
1.	MESPE106	Environmental Chemistry
2.	MESPE107	Environmental Management
3.	MESPE108	Environmental Geotechnics
4.	MESPE109	Stability Analysis of Slopes

Programme Elective-III

Sl.No.	Course Code	Subject Name
1.	MESPE201	Urban Drainage, Sewarage and Water Distribution System
2.	MESPE202	Water Resources Engineering
3.	MESPE203	Ground Improvement Techniques (same as GTE)
4.	MESPE204	Water Quality Modeling and Management

Programme Elective-IV

Sl.No.	Course Code	Subject Name
1.	MESPE205	Industrial Wastewater Treatment
2.	MESPE206	Ground Water Engineering
3.	MESPE207	Hydrometry, Water acts and Water services
4.	MESPE208	Ground Water Hydrology

Programme Elective-V

Sl.No.	Course Code	Subject Name
1.	MESPE301	Environmental Impact Assessment
2.	MESPE302	Environmental Hydraulics
3.	MESPE303	Energy & Environment

Open Elective-I

Sl.No.	Course Code	Subject Name
1.	MESOE301	Optimization Techniques
2.	MESOE302	Quantitative Techniques
3.	MESOE303	Computational and Statistical Methods
4.	MESOE304	Applications of GIS

Audit course 1 & 2

Sl.No.	Course Code	Subject Name
1.	BCAC1001	English for Research Paper Writing
2.	BCAC1002	Disaster Management
3.	BCAC1003	Sanskrit for Technical Knowledge
4.	BCAC1004	Value Education
5.	BCAC2001	Constitution of India
6.	BCAC2002	Pedagogy Studies
7.	BCAC2003	Stress Management by Yoga
8.	BCAC2004	Personality Development through Life Enlightenment Skills.

Core Subjects: IST Semester

(Core-1) Subject name: Water Treatment Technology (3-0-0) CR-03

Course Content

Module-I

Quantity of Water: Per-capita demand, design period, population forecast, fluctuation in demand

General requirement: Sources of water, necessity of treatment, water quality standards for various water uses, Intake structures – Different types & design criteria, pumping and transportation of water

Module-II

Principles of sedimentation: Types of settling and settling equations, design criteria and design of settling tanks. Principle of Coagulation and Flocculation – types of coagulants, coagulant aids, coagulation theory, and optimum dose of coagulant, design criteria and numerical examples

Module-III

Filtration: Theory, types, hydraulics of filter bed, design criteria and design of filters, filter backwash, operational problems and trouble shooting.

Module-IV

Disinfection: different types, disinfectants, factors affecting disinfection, methods of disinfection, and chemistry of chlorination.

Principles and design of aeration systems – two film theory, water in air system, air in water system

Water Softening: Ions causing hardness, Langelier index, various methods.

Fluoridation and de-fluoridation - Principles and design

Module-V

Adsorption Process: Types, factors affecting adsorption, kinetics and equilibrium – different isotherm equations and their applications

Advanced water treatment: Ion exchange, electro-dialysis, Reverse Osmosis, Ultra filtration

Text Book:

1. Peavy, H.S., Rowe and Tchobonoglous,G., (1985), “Environmental Engineering”, McGraw Hill

Reference Books:

1. Environmental Engineering (Volume I) by S. K. Garg-Khanna Publishers
2. Environmental Engineering (Volume I) by B. C. Punmia-Khanna Publishers
3. Fair, G.M., Geyer J.C and Okun, (1969) “Water and Wastewater Engineering” Vol II, John Wiley Publications.
4. Weber W.J., (1975) “Physico - Chemical Processes for Water Quality Control”.
5. AWWA, (1971), “Water Quality and Treatment “McGraw Hill.
6. CPHEEO Manual, (1991), “Water Supply and Treatment”, GOI Publications.

Course Outcomes:

1. To identify sources of water, general requirement for water supply and characterize water.

2.To analyze the principals of sedimentation process and design treatment units.

3.To analyze the principals of filtration process and design treatment units.

4. To analyze disinfection, water softening, fluoridation and de-fluoridation.

5. To implement advanced water treatment processes.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**1**	**1**	**3**	**1**	**1**
CO2	**3**		**3**	**3**		
CO3	**3**		**3**	**3**		
CO4	**3**	**1**	**3**	**3**	**1**	**1**
CO5	**3**	**2**	**3**	**3**	**1**	**1**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	3	1	3	3	1	1

(Core-2) Subject Name: Waste Water Management (3-0-0) CR-03

Course Content

Module-I

Objectives of wastewater treatment: flow variations , characteristics, analysis of BOD, COD, solids and volatile solids & their significance, BOD progression & its formulation, types of reactors and reactors analysis. Wastewater Treatment, Flow Diagrams and Hydraulic Profile.

Module-II

Theoretical principles and design - screens, equalization basin, grit chamber, primary and secondary settling tanks.

Module-III

Kinetics of biological treatment systems: bio-kinetic constants and their determination, batch and continuous systems.

Module-IV

Theoretical principles and design: Suspended growth system - conventional activated sludge process and its modifications. Theoretical principles and design – attached growth system – trickling filter, bio-towers and rotating biological contactors. Principles and design of stabilization ponds

Module-V

Sludge Processing: Separation, sludge thickeners, volume reduction, conditioning and digestion – aerobic and anaerobic. Advanced Wastewater Treatment – Need and technologies used. Nitrification and Denitrification Processes, Phosphorous removal. Wastewater disinfection.

Text Book:

1. Peavy, H.S., Rowe and Tchobonoglous,G., (1985), “Environmental Engineering”, McGraw Hill

Reference Books:

1. Metcalf and Eddy Inc., (2003), “Wastewater Engineering - Treatment and Reuse”, 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. Benefield R.D., and Randal C.W., (1980), “Biological Process Design for Wastewater Treatment”, Prentice Hall, Englewood Chiffs, New Jersey.
3. 4. Karia G.L., and Christian R.A., (2001), “Wastewater Treatment Concepts and Design Approach”, Prentice Hall of India Pvt. Ltd., New Delhi.
4. Environmental Engineering (Volume II) by S. K. Garg-Khanna Publishers
5. Environmental Engineering (Volume II) by B. C. Punmia-Khanna Publishers

Course Outcomes:

1. To analyze the fundamental scientific processes underlying the operation of wastewater treatment plant
2. To analyze the principals of preliminary and primary treatment process and design treatment units.
3. To identify the kinetics of biological treatment systems
4. To analyze the principals of biological treatment process and design treatment units.
5. To identify the sludge management and tertiary treatment

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**1**	**1**	**3**	**1**	**1**
CO2	**3**		**3**	**3**		
CO3	**3**		**3**	**3**		
CO4	**3**	**1**	**3**	**3**	**1**	**1**
CO5	**3**	**2**	**3**	**3**	**1**	**1**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	3	1	3	3	1	1

Programme Electives: I Semester

(PE-1/1) Subject Name: Ground Water Flow through Porous Media **(3-0-0) CR-03**
Course Content: Same as M.Tech. – GTE (CE)

(PE-1/2) Subject Name: Applied Chemistry & Microbiology **(3-0-0) CR-03**

Course Content

Module-I
Importance of Environmental Chemistry: Types of reactions, redox reactions, chemical thermodynamics, chemical equilibrium, equilibrium constants and activity, reaction kinetics. acidity, alkalinity, carbonate system, solubility reactions, Electrochemistry and its applications.
pH – Principle, Measurement, Numerical Examples, Buffers and Buffer index.

Module-II
Colloidal Chemistry: Properties of colloids, colloidal dispersions, stability of colloids and applications.
Applications of Organic Chemistry in Environmental Engineering.

Colorimetric: Principles and applications. Applications of Analytical Chemistry – emission and absorption techniques.

Module-III
Microbiology: Microorganisms of importance in air, water and soil environment Principles and applications of microscopy, microscopic flora and fauna of importance.

Module-IV
Metabolism and metabolic pathways, Bio-concentration, Bio-magnification and Bioaccumulation.Bacteria :Morphology, typical growth curve and generation time, Measurement Techniques – APC, MPN (Probability and Thomas methods), MFT. Monod's equation and its applications. Algae - orphology, classification and their importance.

Module-V
Fungi - Protozoa - morphology, classification and their importance. Enzymes: classification, kinetics - Michaelis-Menten equation, factors influencing enzyme reaction.Virology: Types, characteristics and enumeration methodology.

Text Book:

1. Sawyer C.N. and McCarty, P.L ., (2003), **"Chemistry for Environmental Engineering and Science**", 5th Edition, TataMcGraw Hill Publishing Co. Ltd., New Delhi.

Reference Books:

1. McKinney R.E.(1962) "**Microbiology for Sanitary Engineers**", Newyork McGraw Hill.
2. Pelczar M.J ,Chan ECS, Krieg, NR(1998) **"Textbook of Microbiology"** 5th edition Tata McGraw Hill Publishing Co. Ltd., New Delhi
3. Gaudy and Gaudy (1980), "**Microbiology for Environmental Scientists and Engineers**", McGraw Hill.

Course Outcomes:
1. To identify basics of environmental chemistry.
2. To analyze the basics of colloidal and analytical chemistry.
3. To implement microbiology and microscopy.
4. To gain knowledge on metabolism and metabolic pathways
5. To identify different types of microorganisms.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**		**1**	**3**	**2**	**1**
CO2	**1**		**1**	**3**		
CO3	**1**		**1**	**3**	**1**	
CO4	**1**	**3**	**1**	**3**	**1**	**1**
CO5	**1**	**1**	**1**	**3**	**1**	**1**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	1	1	1	3	1	1

(PE-1/3) Subject Name: Global Warming & Climate Change **(3-0-0) CR-03**

Course Content

Module-I

Energy Issues and Climate Change , Alternate Energy Sources
Green-House Effect as a Natural Phenomenon, Green House Gases GHGs) and their Emission Sources

Module-II

Quantification of CO_2 Emission, Global Warming Potential (GWP) of GHGs
Modeling Climate change, Ozone layer depletion and its control

Module-III

Impacts of climate change – Global and India, Temperature Rise, Sea Level rise, Coastal Erosion and landslides, Coastal Flooding, Wetlands and Estuaries loss

Module-IV

Kyoto Protocol – Importance, Significance and its role in Climate Change
Carbon Trading - Mechanisms , Various Models (European, Indian) Global and Indian Scenario
Cleaner Development Mechanisms – Various Projects related to CO_2 Emission Reduction

Module-V

Alternatives of Carbon Sequestration – Conventional and non-conventional techniques , Role of Countries and Citizens in Containing Global Warming

Text Book:

1. Barry R.G., and Chorley R.L., (1992), **"Atmosphere, Weather and Climate",** 4th Edition, ELBS Publication.

Reference Books:

1. Bolin B., (Ed.), (1981), "Carbon Cycle Modelling", John Wiley and Sons Publications.
2. Corell R.W., and Anderson P.A., (Eds.), (1991), "Global Environmental Change", SpringlerVerlog Publishers.
3. Francis D., (2000), "Global Warming: The Science and Climate Change", Oxford University Press.
4. Frame B., Medury Y., and Joshi Y., (Eds.), (1992), "Global Climate Change: Science, Impact and Responses".
5. Linden E., (2006), "The Winds of Change: Climate, Weather and the Destruction of Civilizations", Simon and Schuster Publications.

Course Outcomes:

1. Measure climate factors

2.Analyze connections between global warming and human activities

3. Know how the climate factors change

4. Model possible scenarios for future climate change

5. Identify effects of climate change on biodiversity and ecosystems in different biomes and aquatic systems

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**		**1**	**1**		**1**
CO2	**1**		**1**	**1**		**1**
CO3	**3**	**3**	**1**	**3**	**1**	**2**
CO4	**3**	**2**	**1**	**3**	**1**	**2**
CO5	**3**	**1**	**1**	**3**	**1**	**2**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	2	1	1	2	1	2

(PE-1/4) Subject Name: Numerical Methods in Engineering **(3-0-0) CR-03**

Course Content: Same as M.Tech. – SE (CE)

(PE-1/5) Subject Name: Application of Soft Computing Techniques **(3-0-0) CR-03**

Course Content: Same as M.Tech. – SE (WRE)

(PE-2/1) Subject Name: Environmental Chemistry **(3-0-0) CR-03**

Course Content

Module-I

Significance, Sources, Impact and Measurement of Physical, chemical and biological water quality parameters

Atmospheric chemistry, Soil chemistry

Module-II

Water pollution: Water quality standards and parameters, Assessment of water quality, Aquatic Pollution, Freshwater pollution, Estuarine water quality, Marine pollution. Biochemical oxygen demand, Chemical oxygen demand, DO and BOD demand in streams, Transformation process in water bodies, Oxygen transfer by water bodies, Turbulent mixing, water quality in lakes and preservers, Eutrophication, Ground water quality.

Module-III

Air Pollution: Air pollutants - Air quality standards - Production, fate, effects of gaseous pollutants - Oxides of carbon, nitrogen and Sulphur - Organic air pollutants - photochemical reactions, photochemical smog, Climatic change, Green house effect, Acid rain and Ozone depletion

Module-IV

Noise Pollution: Physical properties of sound, Noise criteria, Noise standards, Noise measurement, Noise control.

Oils in fresh & marine water: Sources of oil pollution - chemistry and fate of hydrocarbons - oil in run off and ground water — biodegradation - effect on aquatic organisms and communities — treatment and disposal technology.

Module-V

Soil Pollution: Soil pollutants (Inorganic, organic, pesticides, radionuclides) - sources and effects on nature and properties of soil, claps, plants arid terrestrial animals.

Thermal pollution, Nuclear hazards

Other environmental Issues: Sustainable development, Bio gas, Natural gas, Biodiversity, Urban problems related to energy, water scarcity, Water conservation, rain water harvesting, artificial recharge, watershed management, carbon trading, carbon foot print

Text Book:

1. Environmental Chemistry by Stanley E.Manahan, 5th Ed., Lewis, 1991.

Reference Books:

1. Oil in Fresh Water - Ed., Vander Meulen and Hrudey, Pergamon , 1987.
2. Chemical Contamination in The Human Environment by Lippman and Schlesinger, Oxford, 1979.
3. Environmental Pollution by H.M.Dix., Wiley, 1981.
4. Environmental Chemistry by A.K.De,. 2nd Ed., Wiley Eastern 1989.
5. Water Treatment - Principles and Design by J.M.Montgomery., Wiley, 1985.

Course Outcomes:

1. To be familiar with basic concepts of chemistry and Analyze the fundamental underlying mechanisms related to chemistry.
2. To analyze the importance of environmental chemistry in Water pollution
3. To analyze the importance of environmental chemistry in Air pollution

4. To analyze the importance of environmental chemistry in noise pollution
5. To analyze the importance of environmental chemistry in soil pollution

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**1**	**1**	**3**	**2**	**1**
CO2	**1**	**1**	**1**	**3**		
CO3	**2**		**1**	**3**	**1**	
CO4	**1**	**3**	**1**	**3**	**1**	**1**
CO5	**1**	**1**	**1**	**3**	**1**	**1**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	1	1	1	3	1	1

(PE-2/2) Subject Name: Environmental Management (3-0-0) CR-03

Course Content

Module-I

Principles of Environmental Management, Ecosystem Concepts, Environmental Concerns in India, Policy and Legal Aspects of Environmental Management, Introduction to Environmental Policies, Environmental Laws and Legislations, Environmental Legislations in India.

Module-II

Environmental Impact Assessment (EIA), Impact Prediction, Evaluation and Mitigation, Forecasting Environmental Changes, Strategic Environmental Assessment (SEA), Environmental Clearance Procedure in India, EIA Documentation and Processes, EIA Monitoring and Auditing.

Module-III

Environmental Auditing, Elements of Audit Process, Waste Audits and Pollution Prevention Assessments, EA in Industrial Projects.

Module-IV

Life Cycle Assessment (LCA), Stages in LCA of a Product, Procedures for LCA, Different Applications of LCA. Sustainable approach towards Environment Management, Environmental Protocols

Module-V

Environmental Management System Standards, Implementation of EMS Conforming to ISO 14001. Environmental Economics: Introduction, economic tools for evaluation, Green GDP, Cleaner development mechanisms and their applications.

Text Book:

1. Vijay Kulkarni and Ramachandra T.V., 2006. Environmental Management, Commonwealth of Implementing, Canada and Indian Institute of Science, Bangalore.

Reference Books:

1. Lohani B.N (1984)., "Environmental Quality Management", South Asian Publishers, New Delhi
2. Chanlett, (1973) "Environmental Protection", McGraw Hill Publication, New York.
3. Danoy G.E., and Warner R.F., (1969), "Planning and Design of Engineering Systems",Unwin Hyman Publications.
4. MOEF, Government of India, "Carrying Capacity Based Developmental Planning Studies for the 6. National Capital Region", 1995-96.

Course Outcomes:

1. To identify the principles of environmental management.
2. To analyze environmental impact prediction, evaluation and mitigation.
3. To identify and review audit-related documentation, prepare checklists and audit process
4.To apply tools such life cycle assessment, environmental audits, evaluation of environmental performance for environmental decision-making.
5. To evaluate the effectiveness of systematic EMS monitoring processes and to analyze Implementation of EMS Conforming to ISO 14001

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**		**1**	**1**		
CO2	**1**		**2**	**1**		
CO3	**1**	**1**	**1**	**3**	**1**	
CO4	**2**	**2**	**1**	**3**	**1**	
CO5	**1**	**1**	**1**	**3**	**1**	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	1	1	1	2	1	0

(PE-2/3) Subject Name: Environmental Geotechnics **(3-0-0) CR-03**

Course Content: Same as M.Tech. – GTE (CE)

(PE-2/4) Subject Name: Stability Analysis of Slopes **(3-0-0) CR-03**

Course Content: Same as M.Tech. – GTE (CE)

(Lab-1)Environmental Monitoring Lab **(0-0-3) CR-02**

Complete physical, chemical and bacteriological analysis of water.

Course Outcomes:

- To gain better analyzeing about the processes.
- To develop experiments related to their field of research.
- To do physical analysis of water.
- To do chemical analysis of water.
- To do bacteriological analysis of water.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	3		1		1
CO2	1	3		1		1
CO3	1	3		1		1
CO4	1	3		1		1
CO5	1	3		1		1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	1	3	0	1	0	1

(Lab-2) Planning & Design of Water Supply System **(0-0-3) CR-02**

Design of water supply systems: Selection of site for the source of water supply, design of units for sedimentation, coagulation, flocculation, Granular media filtration, disinfection, water softening, advanced tertiary treatments, design of city water supply pumping and distribution system.

Course outcomes:

- Planning of water supply systems.
- Design environmental structures like water treatment plants.
- Design city water supply pumping systems.
- Design city water supply distribution system.
- Design units for sedimentation.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1		1	
CO2	3	3	1		1	
CO3	3	3	1		1	
CO4	3	3	1		1	
CO5	3	3	1		1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	3	3	1	0	1	0

Core Subjects: 2ND Semester

(Core-III) Subject Name: Air pollution and Control (3-0-0) CR-03

Course Content

Module-I

Introduction: sources, effects on – ecosystems, classification of atmospheric pollutants, air pollution episodes of environmental importance.

Module-II

Meteorology - composition and structure of the atmosphere, wind circulation, solar radiation, lapse rates, atmospheric stability conditions, wind velocity profile, Maximum Mixing Depth (MMD), Temperature Inversions, Windrose diagram.

General characteristics of stack emissions, plume behaviour, heat island effect.

Module-III

Air Quality models - Gaussian convection-diffusion model for point, line and areal sources.

Air Pollution Control of particulate matter & gaseous pollutants from point & non-point sources – gravity settling chambers, centrifugal collectors, wet collectors, fabric filters, electrostatic precipitator (ESP). – adsorption, absorption, scrubbers, condensation and combustion. Dust suppression measures.

Module-IV

Indoor Air Pollution – sources, effects and control.

Noise - sources, measurements, effects and occupational hazards. Standards, Noise mapping, Noise attenuation equations and methods, prediction equations, control measures, Legal aspects of noise.

Module-V

Monitoring of particulate matter and gaseous pollutants – respirable, non-respirable and nano - particulate matter. CO, CO2, Hydrocarbons (HC), SOX and NOX, photochemical oxidants.

Text Book:

1. Nevers N.D.(2000), Air Pollution Control Engg, McGraw Hill.

Reference Books:

1. Peavy, H.S., Rowe and Tchobonoglous,G., (1985), “Environmental Engineering”, McGraw Hill Seinfeld N.J., (1975), “Air Pollution”, McGraw Hill.
2. WarkK ., Warner C.F., and Davis W.T., (1998), “Air Pollution - Its Origin and Control”, Harper & Row Publishers, New York.
3. Lee C.C., and Lin S.D., (1999), “Handbook of Environmental Engineering Calculations”, McGraw Hill, New York.
4. Perkins H.C.(1974), “Air Pollution”, McGraw Hill.

Course Outcomes:

1. To identify anthropogenic sources.
2. To identify the meteorology condition.
3. To analyze air quality models.
4. To analyze indoor air and noise pollution.
5. To implement monitoring of pollutants.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**1**	**1**	**1**	**1**	**1**
CO2	**1**		**3**	**1**		
CO3	**3**		**3**	**3**		
CO4	**3**	**1**	**1**	**3**	**1**	**1**
CO5	**3**	**2**	**3**	**3**	**1**	**1**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	2	1	2	2	1	1

(Core-IV) Subject Name: Solid and Hazardous Waste Management (3-0-0) CR-03

Course Content

Module-I

Solid waste – sources and engineering classification, characterization, generation and quantification. Transport - collection systems, collection equipment, transfer stations, collection route optimization.

Module-II

Treatment methods - various methods of refuse processing, recovery, recycle and reuse, composting – aerobic and anaerobic, incineration, pyrolysis and energy recovery,

Module-III

Disposal methods – Impacts of open dumping, site selection, sanitary land filling – design criteria and design examples, leachate and gas collection systems, leachate treatment.

Module-IV

Biomedical Waste management – sources, treatment and disposal

Hazardous Waste Management- Introduction, Sources, Classification, Physico-chemical, Chemical and Biological Treatment of hazardous waste, regulations.

Module-V

Thermal treatment - Incineration and pyrolysis.

Soil contamination and site remediation – bioremediation processes, monitoring of disposal sites.

Text Book:

1. Tchobanoglous G., Theissen H., and EIiassen R.(1991), "Solid Waste Engineering - Principles and Management Issues", McGraw Hill, New York.

Reference Books:

1. PavoniJ.L(1973)., "Handbook of Solid Waste Disposal".
2. Peavy, Rowe and Tchobanoglous (1985), "Environmental Engineering", McGraw Hill Co. 4th Edition
3. Mantell C.L., (1975), "Solid Waste Management", John Wiley.
4. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.
5. WHO Manual on Solid Waste Management.
6. Vesiland A.(2002), "Solid Waste Engineering", Thompson Books.
7. Hazardous waste (management and handling) rules, 2001
8. Biomedical (Handling and Management) Rules 2008

Course Outcomes:

1. To be able to analyze components of solid waste management system.
2. To evaluate recovery, treatment alternatives for solid waste.
3. To evaluate disposal alternatives for solid waste.
4. To identify biomedical and hazardous waste management.
5. To introduce concept of soil remediation and thermal treatment.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**		**1**	**1**		**1**
CO2	**1**		**1**	**1**		**1**
CO3	**3**	**3**	**1**	**3**	**1**	**2**
CO4	**3**	**2**	**1**	**3**	**1**	**2**
CO5	**3**	**1**	**1**	**3**	**1**	**2**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	2	1	1	2	1	2

Programme Electives: II Semester

(PE-3/1) Subject Name: Urban drainage, sewerage and distribution system (3-0-0) CR-03

Course Content

Module-I

Urban Hydrological Cycle, Effects of Urbanization on Catchment Hydrology, Need for Urban Drainage System, Planning Objectives, Interaction of Urban and Surrounding Areas, Approaches to Urban Drainage.

Types of sewerage system: Combined system, Separate System, Partially separate system, Patterns of Collection System, Components of sewerage system, design and planning of sewerage systems.

Module-II

Quantity estimation of Sewage: Sources of Sanitary Sewage, Dry Weather Flow, Evaluation of Sewage Discharge, Design Period, Design Discharge, Population forecasting

Quantity Estimation of Storm Water: Factors Affecting the Quantity of Storm water, Storm hyetographs – Rainfall excess calculations, time of concentration, Methods for Estimation of Quantity of Storm Water

Module-III

Hydraulic Design of Sewers and Storm Water Drains: Difference Between Water Supply Pipes and Sewer Pipes, Requirements of Design and Planning of Sewerage System, Hydraulic Formulae for Determining Flow Velocities, Minimum and maximum Velocity, Hydraulic characteristics of circular sewer running full or partially full

Design of Storm Water Drains for Separate System: Important points for design.

Module-IV

Sewer materials, Laying of Sewer Pipes, Hydraulic Testing of Sewers.

Sewer Appurtenances: Manholes, Drop manholes, Lamp holes, Clean-outs, Street inlets, Catch basins, Flushing Tanks, Grease & Oil traps, Inverted Siphons, and Storm Regulators

Maintenance, cleaning and ventilation of Sewers

Sewage and Storm water Pumping Stations: Types of Pumps, Pumping System Design, Types of Pumping Stations

Module-V

Water distribution system design and analysis, distribution reservoirs and service reservoirs**.**

Text Book:

1. Environmental Engineering (Volume I &II) by S. K. Garg-Khanna Publishers

Reference Books:

1. Hall M.J. (1984), “Urban Hydrology”, Elsevier Applied Science Publishers
2. Geiger, W.F. Marsalek, J.Zudima and Rawls, G.J. (1987 “Manual on Drainage in Urban Areas”, 2 Volumes, UNESCO, Paris.)
3. Geiger, W.F. and Jayakumar, K.V. (Ed.) (1996) “Lecture Notes of the V International Course on Urban Drainage in Developing Countries”, Regional Engineering Collage, Warangal.
4. Wanielista, M.P. and Yousef, Y.A. (1993), “Stormwater Management”, John Wiley and Songs, Inc., New York.

Course Outcomes:

1. To identify urban hydrological cycle and sewerage system.
2. To estimate sewage and storm water generation and identify different aspects of it.
3. To impart knowledge of design of sewers and storm water drains.
4. To be able to analyze components of urban drainage and sewerage system.
5. To design water distribution system.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**		**1**	**1**		**1**
CO2	**1**		**1**	**1**		**1**
CO3	**3**	**3**	**1**	**3**	**1**	**2**
CO4	**3**	**2**	**1**	**3**	**1**	**2**
CO5	**3**	**1**	**1**	**3**	**1**	**2**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	2	1	1	2	1	2

(PE-3/2) WATER RESOURCES ENGINEERING (3-0-0) CR-03

Module I

Water resources of the world, India and Odisha, National Water Policy.Hydrology - Hydrologic cycle, estimation of missing precipitation and rain guage density. Hydrograph theory - Unit hydrograph – derivation, flow routing, low flow analysis.

Module II

Urban Hydrology - Run-off estimation – Design of Stormwater Drains. Basics and applications of Remote Sensing in water resources management.

Module III

Unsteady Flow through Conduits - Water hammer analysis, Water hammer protection methods - surge tanks.

Module IV

Flow Measurements – Area –Velocity method, Weir method, flumes, end-depth method & chemical and radioactive tracers method

Module V

Groundwater - Basic equations of flow, confined and unconfined aquifers, sea water intrusion, artificial recharge, groundwater pollution, borewells - types & design principles, open wells – types, yield tests.

REFERENCES:

1. Raghunath H.M.(1988), "Advanced Hydrology", Wiley Eastern Ltd New Delhi
2. Subramanya K.S(1994)., "Advanced Hydrology".TataMcGraw Hill, New Delhi
3. David Keith Todd(1980), "Ground Water Hydrology".2nd Edition John Wiley & Sons New Delhi
4. SabinsF.F(1997)., "Remote Sensing – Principles and Interpretations", W.H. Freeman & Co.
5. Anji Reddy, (2001), "Remote Sensing and GIS", B.S. Publications, Hyderabad.
6. Ven T. Chow (1988), "Hand Book of Applied Hydrology", 1st Edition McGraw Hill Publications
7. Hammer M.J, and Mackichan K.A.(1981), "Hydrology and Quality of Water Resources", Newyork:Wiley.
8. John Permankian, "Water Hammer Analysis".

Course outcomes:

- Analyze theories and concepts in surface and subsurface hydrology.
- Analyze theories and concepts of urban runoff.
- Analyze theories and concepts of unsteady flow.
- Analyze theories and concepts of flow measurements.
- Evaluate and analyze ground water hydrology.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**		**1**	**1**		**1**
CO2	**1**		**1**	**1**		**1**
CO3	**3**	**1**	**1**	**3**	**1**	**1**
CO4	**2**	**2**	**1**	**3**	**1**	
CO5	**3**	**1**	**1**	**3**	**1**	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	2	1	1	2	1	1

(PE-3/3) Subject Name: Ground Improvement Techniques **(3-0-0) CR-03**

Course Content: Same as M.Tech. – GTE (CE)

(PE-3/4) Subject Name: Water Quality Modeling and Management **(3-0-0) CR-03**

Course Content: Same as M.Tech. – WRE (CE)

(PE-4/1) Subject Name: Industrial Wastewater Treatment **(3-0-0) CR-03**

Course Content

Module-I

Types of industries and industrial pollution, Characteristics of industrial wastes, Population equivalent, effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health

Environmental legislations related to prevention andcontrol of industrial effluents and hazardous wastes

Module-II

Industrial Waste survey - Process flow charts, condition of waste stream. Sampling – Grab, Composite and integrated samples. Continuous monitoring – pH, Conductivity, Biomonitoring

Waste management Approach, Waste Audit, Volume and strength reduction, Material and process modifications, Recycle, reuse and byproduct recovery, Zero effluent discharge

Module-III

Sources, Characteristics, waste water treatment flow sheets for selected industries such as Textile, Tannery, Pharmaceutical, Dairy, Sugar, Pulp and Paper, Distillery, Steel plants, Oil refineries, fertilizer

Module-IV

Waste minimization, Equalization, Neutralization, Oil separation, Flotation, Precipitation, Heavy metal Removal, adsorption.

Module-V

Aerobic and anaerobic biological treatment, Sequencing batch reactors, high rate reactors, chemical oxidation, ozonation, Photocatalysis, Wet Air Oxidation, Evaporation, Ion Exchange, Membrane Technologies, Nutrient removal

Text Book:

1. Environmental Engineering (Volume II) by S. K. Garg-Khanna Publishers

Reference Books:

1. Eckenfelder(2000)- "Industrial Water pollution Control"- McGraw hill Company, New Delhi American Chemical Society, Washington D.C. USA
2. Mahajan (1984) –" Pollution control in Process industries". TMH, New Delhi.
3. Rao and Dutta (2007)- "Waste Water Treatment"- Oxford & IBH Pulishing Co. Pvt. Ltd., New Delhi
4. Azad N. S.,– "Industrial Wastewater Management Hand Book" McGraw Hill book Co., Newyork.

Course Outcomes:

1. To be able to analyze the characteristics of industrial waste.

2. To analyze the theory required for the industrial wastewater treatment unit processes.

3. To identify thewaste water treatment flow sheets for different industrial wastes.

4. To analyze the principals of primary industrial waste water treatment and design treatment units.

5. To analyze the principals of secondary and tertiary industrial waste water treatment and design treatment units.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**		**1**	**1**		
CO2	**1**		**1**	**1**		
CO3	**3**	**3**	**1**	**3**	**1**	
CO4	**3**	**2**	**1**	**3**	**1**	
CO5	**3**	**1**	**1**	**3**	**1**	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	2	1	1	2	1	0

(PE-4/2) GROUND WATER ENGINEERING (3-0-0) CR-03

Module-I

Groundwater Occurrence: Groundwater hydrologic cycle, origin of groundwater, rock properties effecting groundwater, vertical distribution of groundwater, zone of aeration and zone of saturation, geologic formation as Aquifers, types of aquifers, porosity, Specific yield and Specific retention.

Module-II

Groundwater Movement: Permeability, Darcy's law, storage coefficient. Transmissivity, differential equation governing groundwater flow in three dimensions, groundwater flow equation in polar coordinate system. Groundwater flow contours their applications.

Module – III

Analysis of Pumping Test Data – I: Steady flow groundwater flow towards a well in confined and unconfined aquifers – Dupuit's and Theim's equations, Assumptions, Formation constants, yield of an open well, well tests.

Analysis of Pumping Test Data – II: Unsteady flow towards a well – Non equilibrium equations – Thesis solution – Jocob and Chow's simplifications, Leak aquifers.

Tube wells- Types, strainers, yield of a tube well, Interference of wells, causes of failure, optimum capacity, rehabilitation and maintenance of tube wells.

Module – IV

Surface and Subsurface Investigation: Surface methods of exploration – Electrical resistivity and Seismic refraction methods. Subsurface methods – Geophysical logging and resistivity logging.Aerial Photogrammetry applications along with Case Studies in Subsurface Investigation.

Artificial Recharge of Groundwater: Concept of artificial recharge – recharge methods, relative merits, Applications of GIS and Remote Sensing in Artificial Recharge of Groundwater along with Case studies.

Module – V

Saline Water Intrusion in Coastal aquifer: Occurrence of saline water intrusions, Ghyben- Herzberg relation, Shape of interface, control of seawater intrusion. Groundwater Basin Management: Concepts of conjunctive use, Case studies.

Text Books:

1. Groundwater - H.M.Raghunath [Wiley Eastern Ltd.]

References:

1. Groundwater Systems Planning & Management - R.Willes&W.W.G.Yeh [Prentice Hall of India.]
2. Groundwater Hydrology - David Keith Todd [John Wiley & Son, New York.]

Course outcomes:

- To identify the characteristics of porous media, hydrologic cycle.
- To implement Darcy's law of fluid flow in porous media.
- To gain knowledge on Well hydraulics; aquifer and borehole testing.
- To know the engineering applications of groundwater hydraulics.
- To identify the modeling of groundwater problems.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**3**	**1**	**1**		**1**
CO2	**1**	**1**	**1**	**1**		**1**
CO3	**3**	**1**	**1**	**1**		**1**
CO4	**1**	**1**	**1**	**3**		
CO5	**1**	**1**	**1**	**3**	**1**	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	1	1	1	2	0	1

(PE-4/3) Subject Name: Hydrometry, Water acts and Water services **(3-0-0) CR-03**

Course Content: Same as M.Tech. – WRE (CE)

(PE-4/4) Subject Name: Ground Water Hydrology **(3-0-0) CR-03**

Course Content: Same as M.Tech. – WRE (CE)

(Lab-3) Advanced Environmental Monitoring Lab (0-0-3) CR-02

Complete physical, chemical and bacteriological analysis of waste water. Air quality monitoring.

Course Outcomes:

- To gain better analyzeing about the processes.
- To do physical analysis of waste water.
- To do chemical analysis of waste water.
- To do bacteriological analysis of waste water.
- To implement air quality monitoring

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	3		1		1
CO2	1	3		1		1
CO3	1	3		1		1
CO4	1	3		1		1
CO5	1	3		1		1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	1	3	0	1	0	1

(Lab-4) Planning & Design of Sewage Collection and Treatment System (0-0-3) CR-02

Design of wastewater collection and treatment unit, Design of air pollution control devices.

Course outcomes:

- Planning of waste water treatment system.
- Design of collection systems.
- Design of preliminary and primary units.
- Design of biological and tertiary treatment units.
- Design of air pollution control devices.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1		1	
CO2	3	3	1		1	
CO3	3	3	1		1	
CO4	3	3	1		1	
CO5	3	3	1		1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO	3	3	1	0	1	0

Programme Electives: III Semester

(PE-5/1) Subject Name: Environmental Impact Assessment **(3-0-0) CR-03**

Course Content

Module-I

National environmental policy act and its implementation:Terminology, Features of the National Environmental Policy Act, Screening in the EIA Process, Summary Statistical Information on EISs, EIA at the International Level, Utility of the EIA process, Expanded scope of EIA, Narrowed scope of EIA

Planning and management of impact studies: Conceptual Approach for Environmental Impact Studies, Proposal Development, Interdisciplinary Team Formations, Team Leader Selection and Duties, General Identify Management, Fiscal Control

Module-II

Simple method for impact identification: Background Information, Interaction Matrix Methodologies, Network Methodologies, Checklist Methodologies

Description of environmental setting:Conceptual Framework, Initial List of Factors, Selection Process, Documentation of Selection Process, Data Sources

Environmental indices and indicators: Background Information, Environmental-Media Index-Air Quality, Environmental-Media Index—Water Quality, Environmental-Media Index—Noise

Module-III

Prediction and assessment of impacts on the Air environment: Basic Information on Air Quality Issues, Conceptual Approach for Addressing Air Environment Impacts

Prediction and assessment of impacts on the Surface-water environment: Basic Information on Surface-water Quantity and Quality, Key Federal Legislation, Conceptual Approach for Addressing Surface-Water – Environment Impacts

Module-IV

Prediction and assessment of impacts on the soil and ground-water environments: Background Information on the soil Environment, Background Information on Groundwater Quantity and Quality, Key Federal Legislation, Conceptual Approach for Addressing Soil and Groundwater-Environment Impacts

Module-V

Prediction and assessment of impacts on the noise environment**:** Basic Information on Noise, Key federal Legislation and Guidelines, Conceptual Approach for Addressing Noise-Environment Impacts

Prediction and assessment of impacts on the biological Environment: Basic Information on Biological Systems, Key Federal Legislation, Conceptual Approach for Addressing Biological Impacts

Environmental laws and policies – Environmental laws for managing Air, water, land, wastewater, solid waste, hazardous waste, natural resources

Text Book:

1. Canter L., (1995), "**Environmental Impact Assessment**", McGraw Hill.

Reference Books:

1. Jain R.K., Urban L.V., Stacey G.S., (1977), "**Environmental Impact Analysis – A New Dimension in Decision Making**", VanNostrand Reinhold Co.
2. Rau and Wooten, (1981), "**Environmental Impact AssessmentHandbook**". McGraw Hill.
3. Environmental Law, Sengar, PHI.

Course Outcomes:

1. To plan and manage impact studies
2. To identifymethods for impact identification.
3. To implement prediction and assessment of impacts on the air environment.
4. To implement prediction and assessment of impacts on the soil and ground water environment.
5. To implement prediction and assessment of impacts on the noise and biological environment.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**		**1**	**1**		
CO2	**1**		**1**	**1**		
CO3	**2**	**1**	**1**	**1**	**1**	
CO4	**3**	**2**	**1**	**1**	**1**	
CO5	**3**	**1**	**1**	**1**	**1**	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	2	1	1	1	1	0

(PE-5/2) Subject Name: Environmental Hydraulics (3-0-0) CR-03

Module I

Ground water and well hydraulics: steady and unsteady radial flows in aquifers (confined, unconfined and leaky), effect of well bore storage, multiple well systems, partially penetrating wells, bounded aquifers, characteristic well losses, and estimation of aquifer parameters.

Module II

Transport and transformation of contaminants in groundwater: processes, formulation of the governing equations and initial and boundary conditions, solutions for simple cases.

Module III

Introduction to pollutant transport processes in surface water, governing equations for flow and transport in surface water, advection, diffusion and dispersion, Mixing Mechanisms in rivers, Streeter Phelps Equation, Modification to Streeter Phelps Equation, Lake Water Quality Models

Module IV

Fluid flow - continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow

Flow through Pipes: Major and minor losses of energy in pipes , Hydraulic gradient and total energy line, Flow through pipes in series, in parallel, equivalent pipe , Flow through branch pipe

Water Distribution network analysis – Hardy cross and Equivalent pipe method

Module V

Open channel hydraulics: open channel flow and its classifications, and properties, energy and momentum principles, Critical flow computation and its applications, transitions with sub critical and super critical flows uniform flow, gradually varied flow, Most efficient channel section

REFERENCES:

1. Fluid Mechanics, A.K. Jain, Khana Publishers.
2. Hydraulics and Fluid Mechanics, Modi and Seth, Standard Book House.
3. Open Channel Flow, Subramanya, Mcgraw-Hill Publishing Co.
4. Chrapra.C., "Surface water quality modeling," McGraw Hill, 1997.
5. Ground Water Hydrology, Raghunath, Wiley Eastern limited.

Course outcomes:

- Identify well hydraulics
- Use transport models for contaminant transport for ground water and surface water.
- Compute basic groundwater calculations.
- Apply basic fluid mechanics principles in the analysis of pipe flow.
- Apply open channel hydraulics for problems in open channel flow.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**		**1**	**1**		
CO2	**1**		**1**	**1**		
CO3	**2**	**1**	**1**	**1**	**1**	
CO4	**3**	**2**	**1**	**1**	**1**	
CO5	**3**	**1**	**1**	**1**	**1**	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	2	1	1	1	1	0

(PE-5/3) Subject Name: Energy & Environment **(3-0-0) CR-03**

Course Content

Module-I

Introduction to energy sources: Global Energy, Environmental Resources, Energy necessity and energy crisis. Indian Energy Scenario: Energy Consumption, needs and crisis, energy sources and availability.

Renewable sources of energy and environment: Biomass – introduction, energy plantation, bio-mass conversion technologies (wet and dry process), photosynthesis, agricultural waste derived energy, urban waste derived energy. BIOGAS: Generation, factors affecting bio-digestion, advantages of anaerobic digestion, classification of bio-gas plants.

Module-II

Hydropower: Site selection for hydroelectric power plants, classification of hydroelectric power plants, submergence, ecological imbalance, catchment area treatment, advantages and disadvantages of hydroelectric power plants. Submergence, Ecological Imbalance, Catchment Area Treatment.

Module-III

Tidal energy: OTEC (Ocean Thermal Electric Conversion), methods of ocean thermal electric power generation, site selection. Energy from tides – basic principles of tidal power, components of tidal power plant.

Module-IV

Solar energy: Solar constants, solar radiation at earth surface, physical principles of conversion of solar radiation into heat. Concentrating collectors (focusing and non-focusing).

Wind energy: Introduction, basic principles of wind energy conversion. Site selection considerations. Basic components of wind energy conversion system. Wind energy collectors. Natural gas – classification and comparison of different gas turbine power plants, Associated Environmental Effects.

Module-V

Nuclear energy: necessity, general components of nuclear reactors, different types of reactors,

breeding reactors, location of nuclear power plants, disposal of nuclear wastes, Associated Environmental Effects.

Geo-thermal energy: introduction, nature of geothermal fields, geo-thermal sources, binary fluid geo-thermal power system and arrangement for hybrid plants.

Text Book:

1. Mathur, A.N., and Rathore, N.S., "**Renewable Energy and Environment"** –Proceedings of the National Solar Energy, Himanshu Publications, Udaipur.

Reference Books:

1. Rao and Parulekar B.B., (1977), **Energy Technology–Non-conventional, Renewable and Conventional",** 2nd Edition,Khanna Publishers.
2. Rai, G.D **, "Non-conventional Energy Sources",** Khanna Publications.
3. Saha, H., Saha, S.K., and Mukherjee, M.K., (1990), "**Integrated Renewable Energy for Rural Development",** Proceedings of the National Solar Energy Convention, Calcutta, India,
4. Wilber, L.C., (1989), "**Handbook of Energy Systems Engineering",** Wiley and Sons.

Course Outcomes:

1. Develop energy efficient process
2.Analyze the significance of Hydropower
3. Analyze the significance of tidal energy
4. Analyze the significance of Solar energy
5.Analyze the significance of Nuclear energy

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1		1	1		
CO2	1		2	1		
CO3	1	1	1	3	1	
CO4	2	2	1	3	1	
CO5	1	1	1	3	1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	1	1	1	2	1	0

2ND Semester

Minor Project

It will be taken up by the student at the end of the first semester and the duration would be six months. This is aimed at training the students to analyze independently any problem posed to them. The work may be analytical, experimental, design or combination of these. The dissertation report is expected to exhibit clarity of thought and expression, critical appreciation of the existing literature and analytical and/or experimental or design skill.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	1	1	1	
CO2	2	3	1	1	1	
CO3	2	3	1	1	1	
CO4	2	3	1	1	1	
CO5	2	3	1	1	1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	2	3	1	1	1	0

3RD Semester

Dissertation (Phase-I)

It will be taken up by the student at the end of the second semester and the duration would be six months. This is aimed at training the students to analyze independently any problem posed to them. The work may be analytical, experimental, design or combination of these. The dissertation report is expected to exhibit clarity of thought and expression, critical appreciation of the existing literature and analytical and/or experimental or design skill.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	1	1	1	
CO2	2	3	1	1	1	
CO3	2	3	1	1	1	
CO4	2	3	1	1	1	
CO5	2	3	1	1	1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	2	3	1	1	1	0

4th Semester

Dissertation (Phase-II)

It will be taken up by the student at the end of the third semester and the duration would be six months. This is aimed at training the students to analyze independently any problem posed to them. The work may be analytical, experimental, design or combination of these. The dissertation report is expected to exhibit clarity of thought and expression, critical appreciation of the existing literature and analytical and/or experimental or design skill.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**2**	**3**	**1**	**1**	**1**	
CO2	**2**	**3**	**1**	**1**	**1**	
CO3	**2**	**3**	**1**	**1**	**1**	
CO4	**2**	**3**	**1**	**1**	**1**	
CO5	**2**	**3**	**1**	**1**	**1**	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	2	3	1	1	1	0