Course Curriculum Details

of

Master of Technology
Environmental Engineering

(2020-22)

SCHOOL OF TECHNOLOGY

Pandit Deendayal Petroleum University, Gandhinagar

May, 2020

SEMESTER – I

Sr. No	Course Code	Course Name	Teaching Scheme				
			L	T	P	C	Hrs/wk
1	MA 503T	Advanced Numerical Techniques and Computer Programming	3	1	0	4	4
	MA 503P	Advanced Numerical Techniques and Computer Programming	0	0	2	1	2
2	EN 501T	Environmental Chemistry and Microbiology	3	0	0	3	3
	EN 501P	Environmental Chemistry and Microbiology	0	0	2	1	2
3	EN 502T	Air Pollution Modelling, Monitoring and Control	3	0	0	3	3
4	EN 503T	Water Treatment, Distribution and Management	3	0	0	3	3
5	EN XXT	Elective-I	3	0	0	3	3
6	EN 505T	Solid and Hazardous Waste Management	3	0	0	3	3
7	EN 5XXT	Elective-II	3	0	0	3	3
Total			**21**	**1**	**4**	**24**	**26**

Elective I	Elective II
• EN504T: Environmental Legislation • EN 508T: Big Climate Data and Environment • IE 522T: Financial & Management Accounting for Engineers	• EN 506T: Atmospheric Processes and Climate Change • EN 507T: Remote Sensing & Geographical Information Systems • EN 509T: Environmental Economics and Socio-economic Planning

Foundation Course (For M. Sc background students)	• EN500T: Foundation of Environmental Engineering

SEMESTER – II

Sr. No	Course Code	Course Name	Teaching Scheme				
			L	T	P	C	Hrs/wk
1	EN 510P	Advanced Environmental Engineering Laboratory	0	0	3	1.5	3
2	EN 511T	Sewage treatment & Disposal System	3	1	0	4	4
3	EN 512T	Industrial Wastewater Management	3	0	0	3	3
4	EN 513T	Environmental Impact Assessment	3	0	0	3	3
5	EN 514P	Environmental Simulation Laboratory	0	0	3	1.5	3
6	EN 51XT	Elective III	3	0	0	3	3
7	EN 5XXT	Elective IV	3	0	0	3	3
8	CE 527T	Successful Research Program Development	2	0	0	2	2
Total			**19**	**1**	**6**	**21**	**24**

Elective III	Elective IV
• EN 515T: Occupational Health & Safety • EN 516T: Ground Water Flow and Contaminant transport through Porous Media • EN 517T: Environmental Modelling • EN524T: Equipment and Process Design for Material and Energy Recovery	• EN 518T: Carbon Sequestration and Clean Development Mechanism • EN 519T: Energy Conversion and Environment • EN 520T: Waste to Energy • EN 521: Environmental Risk Assessment and Management • IE 523T: projects

SEMESTER – III

Sr. No	Course Code	Course Name	Teaching Scheme				
			L	T	P	C	Hrs/wk
1	MT 611	Seminar	--	--	--	5	--
2	MT 612	Dissertation	--	--	--	14	--
3	MT 613	Industrial Training	--	--	--	--	--
Total			--	--	--	**19**	**--**

SEMESTER – IV

Sr. No	Course Code	Course Name	Teaching Scheme				
			L	T	P	C	Hrs/wk
1	MT 621	Seminar	--	--	--	5	--
2	MT622	Dissertation	--	--	--	24	--
Total			--	--	--	**29**	--

MA 503T					ADVANCED NUMERICAL TECHNIQUES AND COMPUTER PROGRAMMING					
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. To understand and acquaint the concept of various numerical methods.
2. To develop numerical skills in solving problem of engineering interest.
3. To enrich the concept of finite element techniques.
4. To extract the roots of a polynomial equation.

UNIT 1 EIGEN VALUES EIGEN VECTORS AND INTERPOLATION **10 Hrs.**

Role of computer and software, Numerical evaluation of largest as well as smallest (numerically) Eigen values and corresponding Eigen vectors. Curve fitting, Least square approximations (discrete and continuous data), Introduction to interpolation, Newton Gregory Forward Interpolation Formula, Newton Gregory Backward Interpolation Formula, Central difference interpolation formula, Lagrange's Interpolation Formula for unevenly spaced Formula, Error in interpolation, Newton's Divided Difference Formula, cubic spline interpolation, surface interpolation.

UNIT 2 NUMERICAL SOLUTION NON-LINEAR EQUATIONS AND POLYNOMIAL **8 Hrs.**

Introduction, Solution of nonlinear simultaneous equations, Descarte's Sign rule, Horner's method, Lin-Bairstow's method, Graeffe's root squaring method, Muller's method, Comparison of various methods.

UNIT 3 NUMERICAL SOLUTION OF ODEs AND PDEs **14 Hrs.**

Mathematical modelling and engineering problem solving, Taylor's method, Euler's method, Runge-Kutta methods of various order, Modified Euler's method, Predictor corrector method: Adam's method, Milne's method. Solution of Boundary value problems using finite differences. Finite difference approximation of partial derivatives, Classification of 2nd order PDEs, different type of boundary conditions, solutions of Elliptic, parabolic and hyperbolic equations of one and two dimensions, Crank-Nicholson method, ADI method.

UNIT 4 FINITE ELEMENT METHOD **8 Hrs.**

Introduction, Method of Approximation, The Rayleigh-Ritz Method, The Galerkin Method, Application to One dimensional/ two-dimensional problems.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to'

CO1 – Understand the data generated by performing an experiment or by an empirical formula with a polynomial on which operations like
division, differentiation and integration can be done smoothly.
CO2 – Apply a suitable numerical technique to extract approximate solution to the problem whose solution cannot be obtained by routine
methods.
CO3 – Analyze / interpret the achieved numerical solution of problems by reproducing it in graphical or tabular form.
CO4 – Evaluate the error bounds of various numerical methods.
CO5 – Evaluate a sufficiently accurate solution of various physical models of science as well as engineering interest whose governing equations
can be approximated by nonlinear ODEs or PDEs or system of ODEs or PDEs.
CO6 – Design/ create an appropriate numerical algorithm for various problems of science and engineering.

TEXT/REFERENCE BOOKS

1. B.S. Grewal, Numerical Methods in Engineering and Science with Programs in C & C++, Khanna Publishers (2010).
2. S.S. Sastry, Introductory Methods for Numerical Analysis,4th Ed., Prentice Hall of India (2009).
3. M.K. Jain, S.R.K. Iyenger and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 5thEd., New Age International (2007).
4. C F Gerald and P O Wheatley, Applied Numerical analysis, Pearson education, 7th edition, 2003.
5. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley publication, 9th edition. 2005
6. R.K. Jain & S.R.K. Iyenger, Advanced Engineering Mathematics, 3rd Ed., Narosa (2002).
7. S C Chapra, Raymond P. Canale, Numerical Methods for Engineers, Tata McGraw Hill Pub. Co. Ltd.
8. Open source software/ learning website : www.nptel.ac.in

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 4 questions 6 marks each	24 Marks (40 min)
Part B: 4 questions 10 marks each	40 Marks (60 min)
Part C: 3 questions 12 marks each	36 Marks (40 min)

MA503P					ADVANCED NUMERICAL TECHNIQUES AND COMPUTER PROGRAMMING					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2				50	50	100

COURSE OBJECTIVES

5. To understand and acquaint the concept of various numerical methods.
6. To develop numerical skills in solving problem of engineering interest.
7. To enrich the concept of finite element techniques.
8. To extract the roots of a polynomial equation.

Computer program (in MATLAB) of following topics/methods will be discussed and executed in the lab.

1. Evaluation of largest as well as smallest (numerically) Eigen values and corresponding Eigen vectors.
2. Curve fitting,
3. Newton Gregory Forward Interpolation Formula,
4. Newton Gregory Backward Interpolation Formula,
5. Lagrange's Interpolation Formula for unevenly spaced Formula,
6. Newton's Divided Difference Formula, cubic spline interpolation.
7. Lin-Bairstow's method,
8. Graeffe's root squaring method,
9. Euler's method,
10. Runge-Kutta methods,
11. Modified Euler's method,
12. Predictor corrector method: Adam's method, Milne's method.
13. Solution of Boundary value problems using finite differences.
14. Solution of tridiagonal system,
15. Solution of elliptic, parabolic and hyperbolic equations of one and two dimensions,
16. Crank- Nicholson method.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Apply a suitable numerical technique to extract approximate solution to the problem whose solution cannot be obtained by routine methods.

CO2 – Analyze the accuracy of numerical methods by estimating error.

CO3 – Analyze / interpret the achieved numerical solution of problems by reproducing it in graphical or tabular form.

CO4 – Evaluate a polynomial on which operations like division, differentiation and integration can be done smoothly from the data generated by
performing an experiment or by an empirical formula with.

CO5 – Evaluate a sufficiently accurate solution of various physical models of science as well as engineering interest whose governing equations
can be approximated by nonlinear ODEs or PDEs or system of ODEs or PDEs.

CO6 – Design / create an appropriate numerical algorithm for various problems of science and engineering.

TEXT/REFERENCE BOOKS

1. B.S. Grewal, Numerical Methods in Engineering and Science with Programs in C & C++, Khanna Publishers (2010).
2. S.S. Sastry, Introductory Methods for Numerical Analysis,4th Ed., Prentice Hall of India (2009).
3. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 5thEd., New Age International (2007).
4. C F Gerald and P O Wheatley, Applied Numerical analysis, Pearson education, 7th edition, 2003.
5. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley publication, 9th edition. 2005
6. R.K. Jain & S.R.K. Iyengar, Advanced Engineering Mathematics, 3rd Ed., Narosa (2002).
7. S C Chapra, Raymond P. Canale, Numerical Methods for Engineers, Tata McGraw Hill Pub. Co. Ltd.
8. Open source software/ learning website : www.nptel.ac.in

EN501T				ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY						
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding technical details for analysis of water and wastewater parameters.
2. Understanding basic chemistry involved in chemical treatment of water and wastewater.
3. Understanding fundamentals of microbiology.
4. Understanding about roles of microbes in biological treatment of wastewater.

UNIT 1 **10 Hrs.**

Introduction: Water and Wastewater Characteristics, Principles of Analysis, Valency: Oxidation, State and Bonding, Colloids Redox potentials – Beer Lamberts Law : Instrumentation Techniques, basics of measurement, Fundamentals of Process Kinetics: Reaction Rates, factors effecting, order of reactions, error analysis of environmental data

UNIT 2 **10 Hrs.**

Concepts of Equilibrium Chemistry: Le,Chatlier's principle, Factor influencing equilibrium: Activity, Coefficient: Variations of the equilibrium relationship, Oxidation Reduction reactions, Gas laws, acids and bases, buffers, solubility of salts, Lanmier Index, Lime soda process, degradation chemistry of food products, detergents, pesticides and hydro carbons

UNIT 3 **12 Hrs.**

Fundamentals of Microbiology: Prokaryotic, eukaryotic nucleic acids, Nutrition and growth conditions, Effect of environmental conditions, bacterial growth in terms of numbers and mass, growth curve, interpretation of curve, substrate limited growth, Monod's expression, substrate utilization and cell growth, effect of endogeneous metabolism, inhibition, effect of temperature, culturing of micro-organisms, application of growth and substrate removal kinetics to biological treatment

UNIT 4 **10 Hrs.**

Distribution of microorganisms, indicator organisms, staining, coliforms - fecal coliforms, E.coli, Streptococcus fecalis, differentiation of coliforms, significance, MPN index, Aerobic, anaerobic and facultative, M.F. technique, standards, Microbiology of wastewater treatment processes such as activated sludge process, trickling filter, anaerobic processes. Introduction to Microbiology of Soil and Air and Industrial Microbiology, soil chemistry Introduction to algae for treatment of wastewater, Microbiology of bioremediation and solid waste treatment

Total 42 hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Understand characterization of water and wastewater parameters

CO2- Understand estimation involved in measurement of water and wastewater parameters

CO3- Apply basic chemistry involved in treatment of water and wastewater

CO4- Understand differentiation and measurement of microbes

CO5- Understand about the factors affecting microbial growth

CO6- Apply different microbes for biological treatment of wastewater

TEXT/REFERENCE BOOKS

1. Sawyer, C.N. and McCarty, P.L., and Parkin, G.F. Chemistry for Environmental Engineers, 4th Edn. McGraw Hill, New Delhi, 1994.
2. Benefield, Judkins and Weand – Process Chemistry for Water and Wastewater Treatment, Prentice Hall
3. Maier R M, Pepper I L and Gerba C P. Environmental Microbiology, Second Edition, Elsevier- AP, 2009.
4. Pelczar, Jr, M.J., Chan, E.C.S., Krieg, R.N., and Pelczar M. F, Microbiology, 5th Edn., Tata McGraw-Hill Publishing Company Limited, New Delhi, 1996.
5. Rittman B, McCarty P L McCarty P, Environmental Biotechnology: Principles and Applications, 2nd edition, McGraw-Hill, 2000

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of i^{th} question Q

EN501P				ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY						
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	-	-	-	50	50	100

COURSE OBJECTIVES

1. Understanding the sampling procedures for water and wastewater collection
2. Estimating the pollutants present in the Water through experimentation
3. Estimating the pollutants present in the Wastewater through experimentation
4. Analyze the Water and Wastewater quality based on the respective standards

LABORATORY

1. Determination of pH, TDS, EC
2. Determination of Turbidity
3. Determination of Alkalinity and Acidity
4. Determination of chlorides
5. Determination of total hardness and calcium hardness
6. Determination of sulphates
7. Determination of fluoride and nitrates
8. Determination of dissolved oxygen
9. Determination of coagulant dosage by jar test
10. Determination of BOD
11. Determination of COD
12. Determination of residual chlorine
13. Preparation of media and inoculation and Identification of microbes by staining
14. Test for plate count, coliforms, fecal coliforms, E. coli, S. fecalis, M.P.N. and M.F. techniques

Total 26 hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Estimate the concentration of a pollutant present in the water

CO2 – Analyze the quality of water based on water quality standards

CO3 – Propose appropriate measures for improving the water quality

CO4 – Estimate the concentration of a pollutant present in the wastewater

CO5 – Analyze the quality of wastewater based on wastewater quality standards

CO6 – Propose appropriate measures for improving the wastewater quality

TEXT/REFERENCE BOOKS

1. Sawyer, C.N. and McCarty, P.L., and Parkin, G.F. Chemistry for Environmental Engineers, 4th Edn. McGraw Hill, New Delhi, 1994.
2. Indian Standards (IS: 3025)
3. Indian Standards (IS: 10500-2012)
4. Standard Methods for The Examination of Water and Wastewater (American Water Works Association), ISBN-9780875532875

EN502T					AIR POLLUTION MODELLING, MONITORING AND CONTROL					
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

5. Introduction to various aspects of Air Pollutants
6. Assessing the impact of meteorology on air pollution
7. Measuring and estimating various air pollutants
8. Mitigating air pollution through various devices and modeling approach

UNIT I AIR POLLUTANTS 08 Hrs.

Classification of air pollutants, properties of gaseous and particulate matter, effects of Air pollution on plants, animals, materials, human health, Sources of Air pollution, Preparation of Emission inventory, Air quality standards and Air Quality Index, Introduction to Air Pollution Legislation

UNIT II AIR POLLUTION METEOROLOGY 10 Hrs.

Atmospheric energy balance, environmental lapse rates and atmospheric stability, winds, wind profiles, plume behaviour, turbulence, Dispersion of Air pollutants, Prediction of effective stack height - physics of plume rise, Holland's equation, Briggs equation, modifications of Gaussian dispersion models

UNIT III AIR POLLUTION MEASUREMENTS 10 Hrs.

Instruments used in monitoring the air pollution, sampling and analysis of indoor air, ambient air and stack gas, design of sampling network design, application of satellite data for air pollution assessment, case studies for different cities of India

UNIT IV AIR POLLUTION MODELLING AND CONTROL 12 Hrs.

Introduction to various air quality models (like Envi-MET, WRF-CHEM, LandGEMS, AERMOD, CALPUFF) for simulating air quality concentration, Modelling Health Risk by interfacing air quality with population density and time of exposure, Introduction to Industrial air pollution control devices like settling chambers, cyclones, spray towers, electrostatic precipitators, etc., Indoor Air Quality enhancement, Assessing the cost of air pollution control framework.

TOTAL 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify the sources of air pollutants in a city

CO2 – estimate the damage due to air pollutants

CO3 – relate air pollution with meteorology

CO4 – estimate air pollution concentration

CO5 – simulate air quality concentration

CO6 – design air pollution control framework

TEXT/REFERENCE BOOKS:

1. Air Pollution by M N Rao and H V N Rao, Tata McGraw Hill, 2017
2. Fundamentals of Air Pollution, A. C. Stern, Academic Press, 1994
3. Atmospheric Chemistry and Physics, John H. Seinfeld and Spyros N. Pandis, Wiley Interscience Publication, 2006
4. Sewage Disposal and Air Pollution Engineering, S K Garg, Khanna Publishers, 2016
5. Introduction to Atmospheric Chemistry, Daniel Jacob, Princeton University Press, 1999
6. Environmental Engineering, Arcadio P., Prentice Hall of India, 1999.
7. Environmental Pollution Control Engineering- CS Rao, Wiley Eastern Ltd., New Delhi, 1996.

   Air Pollution Control Equipment H. Brauer and Y. B. G. Verma, Berlin Heidelberg, New York, latest edition

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of ith question Q

EN503T					WATER TREATMENT, DISTRIBUTION AND MANAGEMENT					
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding the various aspects of water - sources, quality, demands
2. Design of Water Treatment Plant
3. Design of Water Distribution Network
4. Understanding the Water Management Concepts

UNIT 1 DRINKING WATER 08 Hrs.

Water cycle, Sources of water, Water quality standards, Impact of water quality on - human health, agriculture, materials etc., Water Demands types and estimation, Water Budget, Population Forecasting Methods.

UNIT 2 WATER TREATMENT 12 Hrs.

Design of Screens, Types of settling and settling tests, Design of Sedimentation Tank, Coagulation: mechanisms of coagulation, Mixing and Flocculation, Design of clariflocculator, Filtration: Slows sand filters, rapid sand filters, Water Softening, Water Disinfectioning, Action plan for efficient plant operation

UNIT 3 WATER DISTRIBUTION NETWORK 12 Hrs.

Pumps for lifting the water, Storage Reservoir, Water Distribution Network: analysis and design, Appurtenances in the distribution network, Application of smart technologies and internet of things for gauging / monitoring the water distribution network

UNIT 4 WATER HARVESTING AND MANAGEMENT 08 Hrs.

Rain water Harvesting, Ground Water Recharge and Development, Water Conservation (ancient and modern practices), Water Footprint, Planning and preparing Water Supply Projects

TOTAL 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Estimate the present and future needs of water of a city

CO2 – Design a Water Treatment Plant

CO3 – Propose measures for efficient functioning of a water treatment plant

CO4 – Design a Water Distribution Network

CO5 – Design of Water Harvesting units

CO6 – Devise a Water Supply project for a community / city

TEXT/REFERENCE BOOKS

1. Water Supply Engineering (Environmental Engineering), S. K. Garg, Khanna Publishers, 2016
2. Water Supply and Sanitation Engineering, GS Birdie, JS Birdie, Galgotia Publishing Ltd
3. Environmental Engineering, HS Paevy, DR Rowe, G Tchobanoglous, McGraw Hill
4. Water and Wastewater Engineering, Metcalf and Eddy, McGraw Hill
5. Chemistry for Environmental Engineers, Sawyer, C.N. and McCarty, P.L., and Parkin, G.F. 4th Edn. McGraw Hill, New Delhi, 1994.
6. Process Chemistry for Water and Wastewater Treatment, Benefield, Judkins and Weand, Prentice Hall

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of ith question Q

EN504T					ENVIRONMENTAL LEGISLATION					
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding about Institutions responsible for Environmental Legislation
2. Understanding of various Environmental Laws
3. Understanding of Industry Specific Environmental Standards
4. Understanding of processes of Environmental Clearance and Audit

UNIT I **08 Hrs.**

Key Institutions responsible for the formulation and enforcement of environmental acts and rules in India. Role of Ministry of Environment, Forests & Climate Change, National Green Tribunal, Central Pollution Control Board, State Pollution Control Board, Municipal Corporations.

UNIT II **10 Hrs.**

Background of Environmental Legislation, Water Act 1974, Air Act 1981 and Environment (Protection) Act 1986: Genesis of the Act, delegation of powers, Role of Central Government, EIA Notification, Sitting of Industries, Coastal Zone Regulation, Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management, Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorization, Biomedical waste rules, Public Liability Insurance for Industries, responsibilities of generators and role of Pollution Control Boards.

UNIT III **10 Hrs.**

Environmental Clearance, NOC, Water Consent, Air Consent, Hazardous Waste Authorization, GroundWater Abstraction Approvals, Forest Clearance, International Environmental Legislation: US EPA, European Environmental laws, UN international conference-1972, Kyoto and Montreal Protocols, Doha convention, Introduction to softwares related to EIA. MOEF notification

UNIT IV **12 Hrs.**

General and Industry specific Indian environmental standards for stack emission, industrial waste water discharge, ambient air quality, noise levels, work zone air quality and sewage water. Comparison of environmental standards of India, US-EPA & European Union. EMS and IS14001, IS9000, NABL acredition training, ISO Training

Total 40 hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand of roles and responsibilities of various institutions

CO2 – Understand scope and powers of various Environmental laws

CO3 – Understand about coastal zone regulations and environmental protection

CO4 – Understand various kinds standards devised for protective environment

CO5 – Understand detailed procedure to acquire Environmental Clearance

CO6 – Understand international protocols and conventions for climate change mitigation

TEXT/REFERENCE BOOKS

1. Canter R.L., Environmental Impact Assessment, Mc Graw Hill International Edition, 1997.
2. CPCB, "Pollution Control acts, Rules and Notifications issued there under "Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997.
3. Shyam Divan and Armin Roseneranz "Environmental law and policy in India "Oxford University Press, New Delhi, 2001.
4. Constitution of India [Referred articles from part-III, part-IV and part-IV A]
5. P. K. Goel and K. P. Sharma, "Environmental guidelines and standards in India", Technoscience Publications, Jaipur (1996)
6. Gurdip Singh, "Environmental law in India", Macmillan India, New Delhi. (2005)
7. Kailash Thakur, "Environmental protection law and policy in India", Deep and Deep publishers. (1997)
8. Relevant MoEF Notifications and CPCB / GPCB Acts & Rules.
9. Commentaries on Water & Air Pollution Laws by M C Mehta, Delhi Law House

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of ith question Q

EN505T				SOLID AND HAZARDOUS WASTE MANAGEMENT						
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Characterizing solid, hazardous and bio-medical waste
2. Understanding waste segregation technologies
3. Optimizing waste collection system and landfill sitting
4. Understanding waste treatment technologies and legislation for waste management

UNIT 1 **08 Hrs.**

Types and Sources of solid wastes: Need for solid, hazardous and bio-medical waste management, Legislations on management and handling of municipal solid wastes, hazardous wastes and biomedical wastes. Waste generation rates, Composition, Hazardous Characteristics, TCLP tests, Waste sampling, Source reduction of wastes, Recycling and reuse.

UNIT 2 **12 Hrs.**

Handling and segregation of wastes at source: Storage and collection of municipal solid wastes, Analysis of collection systems: Need for transfer and transport, Transfer stations, labelling and handling of hazardous wastes, Waste processing: Processing technologies, biological and chemical conversion technologies Composting, Thermal conversion technologies, Energy recovery, Incineration, Solidification and stabilization of hazardous wastes, treatment of biomedical wastes, Methods for Analysis and optimization of collection system; Disposal in landfills: site selection analysis for optimal sitting of landfill

UNIT 3 **12 Hrs.**

Disposal in landfills: site selection, design and operation of sanitary landfills, secure landfills and landfill bioreactors, Leachate and landfill gas management, Landfill closure and environmental monitoring, landfill remediation, Elements of integrated waste management

UNIT 4 **08 Hrs.**

Hazardous Waste Management: Definition and identification of hazardous wastes, sources and characteristics, hazardouswastes in Municipal Waste, Hazardous waste regulations, minimization of HazardousWaste, compatibility, handling and storage of hazardous waste, collection and transport, e-waste, sources, collection, treatment and reuse management, handling of nuclear waste, nuclear waste management.

TOTAL 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1-Understand characterization of solid, hazardous and bio-medical waste

CO2-Apply waste projection models

CO3- Apply waste segregation technologies for waste management

CO4- Utilize methods for optimization of waste collection system and landfill sitting

CO5- Apply waste treatment technologies for waste utilization

CO6- Apply legislations for solid, hazardous and bio-medical waste management

TEXT/REFERENCE BOOKS

1. George Techobanoglous et al, "Integrated Solid Waste Management", McGraw, Hill Publication, 1993.
2. Charles A. Wentz; "Hazardous Waste Management", McGraw Hill Publication, 1995.
3. Manual on Municipal solid Waste Management, CPHEEO, Govt. of India.
4. Guidelines for Hazardous and Other waste Rules MOEF (2016), Govt. of India.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of ith question Q

EN506T					ATMOSPHERIC PROCESSES AND CLIMATE CHANGE					
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding the various aspects of Physical Meteorology
2. Understanding the various aspects of General Meteorology
3. Application of Satellite data for Meteorological Assessment
4. Understanding the various aspects of Climate Change

UNIT I PHYSICAL METEOROLOGY 10 hrs

Vertical temperature and pressure profile of atmosphere, atmospheric composition, scale height, solar and terrestrial radiation, transport of matter, energy and momentum in nature, wind, type of clouds and rain formation process. Conventional observational techniques, conventional measurement of pressure, temperature, humidity, wind, precipitation, visibility, Modern Observational Techniques: LIDARS, SODARS, RADARS, CTD, ARGO

UNIT II GENERAL METEOROLOGY 10 hrs

Thermodynamics of dry and moist air: atmospheric stability and dry adiabatic lapse rate, saturated adiabatic lapse rate, pseudo adiabatic processes and equivalent potential temperature Clausius-Clapeyron (C-C) equation. Micrometeorology: Atmospheric fluid mechanics, turbulence, surface roughness and convective boundary layer.

UNIT III SATELLITE METEOROLOGY 08 hrs

Introduction to satellite meteorology, weather satellite and orbits, satellite images, satellite winds, Data acquisition, data processing and applications, monitoring the local and global environment

UNIT IV CLIMATE CHANGE 11 hrs

Elements of weather and climate modeling, Basic equation and dynamics of atmosphere, Climate variability and climate change, Global warming and climate change, Elementary idea of Global climate models, Comparison of various IPCC reports, important findings of IPCC AR5, Impacts of climate change – Global and India. Environmental management plan for mitigating climate change

[Total 39 hrs]

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Explain the various aspects of Physical Meteorology

CO2 – Explain the various aspects of General Meteorology

CO3 – Analyze the prevailing meteorological condition of a given city

CO4 – Apply satellite data for environmental assessment

CO5 – Illustrate the reasons of Climate change

CO6 – Devise environmental management plan for mitigating climate change

TEXT/REFERENCE BOOKS:

1. F. K. Lutgnes, E. J. Tarbuck, D. G. Tasa, The Atmosphere: An Introduction to Meteorology, Pearson, 11th edition.
2. J. R. Holton, An Introduction to Dynamic Meteorology, Academic Press, 4th edition, 2004.
3. K. N. Liou, An introduction to atmospheric radiation, Academic press, 2nd edition, 2002
4. T. P. DeFelice, An Introduction to Meteorological Instrumentation and Measurement, Prentice Hall, 1st edition, 1997.
5. David G. Andrews, An introduction to atmospheric physics, Cambridge University press, 2nd Edition, 2010

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of ith question Q

EN507T					REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEMS					
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. To understand the basic utility of advance surveying (RS and GIS) in engineering field.
2. To understand the important of advance surveying in decision making modelling
3. To learn and understand the art of cartography through software techniques.
4. To learn the complex engineering application using Geospatial Techniques

UNIT 1 **12Hrs.**

Basic principles of remote sensing, Electromagnetic energy and spectrum, Spectral characteristics, Laws of radiation, Interaction with atmosphere and surface, Data and image interpretation, Sensors and platforms, Visible and infrared sensors, IR and MW sensors, Resolutions, visual image analysis and processing, Supervised and unsupervised classifications, LIDAR remote sensing, Passive and active microwave remote sensing, Hyper spectral remote sensing, Improving the utilization of remote sensing data, Emerging issues UAV and Drone techniques

UNIT 2 **10 Hrs.**

Introduction , History of GIS, Basic GIS concepts, Representation of earth features, Map basics, Map projections, Raster and vector data models, representation of GIS, GIS data sources, Map and models, Methods of vector and raster inputs, Remote sensing inputs, Surveys and GPS inputs, Field surveys, Data storage and editing, Errors and corrections of errors.

UNIT 3 **10 Hrs.**

Spatial analysis, Location and identifying spatial objects, Measurements, Surface mapping, Non topographical surfaces, Terrain analysis, Spatial arrangements, Map overlays, Cartographic modeling, Types of cartographic models, GIS design and applications, Decision support tools for engineers Spatial and Attribute Data Modelling

UNIT 4 **07 Hrs.**

Software tools: ERDAS, ENVI, Q-GIS and ARC GIS; Application and case studies of a RS and GIS techniques in Infrastructure management, Environmental Engineering, Transportation Engineering, Disaster management.; Indian Satellite Missions: Chnadrayaan- 1and 2, NISAR, Vedas, Mars orbiter Mission, ASTROSAT, Gaganyaan, RISAT-1A, Aditya-L1, Shukrayaan-1

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Max. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 –Understand the basic concept of Remote Sensing and GIS techniques

CO2 –Classify the advance instrument techniques (GPS and UAV) in surveying

CO3 –Analyse a data using a spatial analysis techniques

CO4 –Illustrate the application of RS and GIS in decision making activities

CO5 –Appraise the use of advance software techniques for map making activities.

CO6 –Create an art of map making activities.

TEXT/REFERENCE BOOKS

1. Remote sensing and image interpretation by Thomas M. Lillesand, Ralph W. Kiefer
2. Advances in land remote sensing system, Modelling, Inversion and application by Shunlin Liang
3. Haywood L, Cornelius S and S Carver (1988) An Introduction to Geographical Information Systems, Addison Wiley Longmont, New York.
4. Burgh PA (1986) Principles of geographical Information System for Land Resources Assessment, Clarendon Press, Oxford.
5. Burrough PA, McDonnell PA (2000) Principles of Geographical Information systems, London: Oxford University Press.
6. LoCP, Young KW Albert (2002) Concepts And Techniques of Geographic Information Systems, Prentice-Hall of India Pvt ltd, New Delhi

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of ith question Q

EN508T					Big Climate Data and Environment					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding big data and its source
2. Understanding application of big data for environment control
3. Understanding about machine learning for big data
4. Understanding about big data for climate change mitigation

UNIT 1 **08 Hrs.**

Big data and environment, sources of big data; satellite, big sensor data, remote sensing; data from output of climate simulation and urban microclimate models, meteorological data, land surface temperature; big data characterization: volume, velocity, variety, veracity, valorisation;climate output data: climate forecast system reanalysis, MERRR (V1, V2), CMAP, GPCP, ERA-Interim;

UNIT 2 **08 Hrs.**

Big data acquisition, cleaning, aggregation, modelling and interpretation; Big data application in: climate, agriculture, urban heating, forestry, land degradation, pollution management, wind energy and wind forecasting, time series forecasting of climate data,'effect of climate change on society, ecosystem and remedial measures', geo-spatial distribution of extreme events, land-use land cover change analysis,near real-time monitoring of particulate matter, particulate matter prediction, assistive living, disaster management, thermal comfort using big data, big data for comfortable indoor living, Climate informatics

UNIT 3 **12 Hrs.**

Machine learning: support vector machine, artificial neural network, extreme learning machine, random forest, genetic algorithms, decision tree, machine learning library (MLib);

UNIT 4 **12 Hrs.**

data analytics tool: Python, ClimateSpark, Apache Spark,cloud computing, HRDS, Map Reduce;Climate Data files: NetCDF, GRIB, HDF, GeoRaster, SciDB; deep learning for climate pattern, feature extraction of big climate data, climate network and entropy, spectra of climate network, Monte Carlo of climate system, Taylor diagram

TOTAL 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1- Understanding big data and their characterization

CO2- Understanding big data and its source

CO3- Understanding application of big data for environment control

CO4- Understanding about machine learning for big data

CO5- Understanding about big data storage and their processing tools

CO6- Understanding about big data for climate change mitigation

TEXT/REFERENCE BOOKS:

1. Big data for development: opportunities and challenge-white paper, UN Global Pulse, 2012
2. Jason Bell, Machine learning for big data, Wiley, ISBN-10: 9788126553372
3. Davy Cielen, Introducing data science: big data, machine learning and more using python tools, Dreamtech Press, ISBN-10: 9351199371
4. Victor M. S., Big data: a revolution that will transform how we live, work and think, Hodder and Stoughton, ISBN-10: 9781848547926
5. ArshdeepBahga, Big data analytics: a hands on approach, VPT, ISBN-10: 099602557
6. Zhang, Z., Big data mining for climate change, Elsevier, ISBN: 9780128187043

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of i^{th} question Q

EN509T					ENVIRONMENTAL ECONOMICS AND SOCIO-ECONOMIC PLANNING					
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding the various aspects of Environmental Economics
2. Understanding the various facets of development and environmental risks
3. Understanding the concepts of social-economic planning
4. Understanding the social cost of environment

UNIT 1 **11 Hrs.**

Environmental Economics: Economy and Environment -the historical development of environmental economics; the circular economy, The sustainable economy. Economics of Pollution;-The optimal level of pollution, The market achievement of optimal pollution, Taxation and optimal pollution, Environmental standards, Taxes and subsidies, Marketable pollution permits, Measuring environmental damage -Total economic volume and valuation methodology, pollution control policy in mixed economics. Environmental Values Ethics, discounting the future, alternative to adjusting discounting rates. Economics of Natural Resources;-Renewable resources, Extinction of species, optimal use of exhaustible resources Measuring and mitigating natural resource scarcity.

UNIT 2 **09 Hrs.**

Development and Environment;- Development, Preservation and conservation, Irreversibility and sustainability, Environment and the developing countries. Carrying capacity based development planning. Cost Benefit Analysis of Environmental Change; Appraisal of Sustainable development Projects; Principles of Cost Allocation, Preventive, Punitive and social costs.

UNIT 3 **10 Hrs.**

Socio-economic Planning: Importance of Socio-economic development planning. Social indicators and their importance, Social impacts of industrial and developmental activities, Quality of life concept- and its use in development planning, Social surveys and socio-economic data generation.

09 Hrs.

UNIT 4

Social cost of environmental pollution, Rehabilitation and resettlement of project affected people. Laws related to social development. Corporate Social Responsibility (CSR), different models; Social Accountability (SA) 8000; Certification

Total 39 hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: Understand the various aspects of Environmental Economics
CO2: Understand the various facets of development and environmental risks
CO3: Apply the concepts of social-economic planning
CO4: Understanding the social cost of environment
CO5: Understand the corporate social responsibility
CO6: Understand the social accountability and certification

TEXT/REFERENCE BOOKS

1. Values for the Environment: A Guide to Economic Approach Winpeny JT, Overseas Development Institute, London, HMOS, 1991.
2. Economic Analysis of Environmental Impacts Dixon, John, A, Scura LF, Carpenter RA and Sherman PB, Earthscan Publications Ltd., London 1995.
3. Environmental Assessment Source Book (Vol 1)- World Bank, Environment Department, Washington DC, The World bank, 1991.
4. Valuing the Environment Barde J and Pearce DW (ed), Earthscan Publication, London, 1991

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of i^{th} question Q

EN510P					ADVANCED ENVIRONMENTAL ENGINEERING LABORATORY					
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	3	1.5	3	--	--	--	50	50	100

COURSE OBJECTIVES

1. To give an exposure about the methods of measurement and analysis of various water and wastewater parameters.
2. To give an exposure about the basic pollutant removal from water.
3. To introduce the concepts biological treatment of wastewater.
4. To give an exposure about the analysis of pollutant concentration in air and soil.

Laboratory preparation of reagents with different normality and molarity - Preparation of exothermic and endothermic reagents. Solids- types of solids and its significance, different biological and chemical oxidizers, Carbonaceous BOD – nitrogenous BOD, Soluble BOD, Total BOD and its significance, Chemical Oxygen Demand and importance of BOD/COD ratio with respect to treatment of wastewater, Ammoniacal Nitrogen, deoxygenation rate and reoxygenation rate and its importance in self purification of streams, Sampling and analysis of ambient, importance of particular matter analysis and chemical compounds and hydrocarbons.

1. Determination of chlorine dosage by break point chlorination
2. Determination of deoxygenation constant and reoxygenation constant
3. Determination of total solids, suspended and dissolved solids, volatile and fixed solids.
4. Determination of settleability of solids
5. Determination of sludge volume index
6. Determination of MLSS and MLVSS in Activated Sludge Process
7. Color and heavy metals removal from wastewater by adsorption and other physiochemical methods.
8. Estimation of suspended particulate matter
9. Estimation of SO_2, NO_2,
10. Determination of Ozone, Lead, Carbon monoxide, Ammonia, Arsenic, Nickel
11. Determination indoor air quality
12. Soil Analysis: pH, Conductivity, TDS, Cation exchange capacity of soil, Sodium Adsorption ratio of soil
13. Determination of nitrogen, potassium, phosphorous and carbon in soil

Total 39 hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Understand about water and wastewater parameters.

CO2- Understand about procedure to prepare reagent for measuring parameters

CO3- Understand procedure to estimate water and wastewater parameters.

CO4- Compare treatment method to be adopted for treatment of water.

CO5- Understand and develop sense of biological treatment methods for wastewater.

CO6- Analyse pollutant concentration for air and soil.

TEXT/REFERENCE BOOKS:

1. Sawyer, C.N. and McCarty, P.L. and Parkin, G.F. Chemistry for Environmental Engineers, 5th edition, McGraw Hill, New Delhi, 2002.
2. Anil K. De. Environmental Chemistry, New Age International Ltd., New Delhi, 2003.
3. Standard Methods for the Examination of Water and Wastewater, 21st Edition, American Public Health Association, Washington. D.C. 2005.

EN511T				SEWAGE TREATMENT AND DISPOSAL SYSTEM						
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

1. To learn about the different types of reactors, its analysis and the primary treatment of wastewater.
2. To study the design of secondary biological treatment plants like suspended and attached growth process.
3. To gain knowledge about the treatment of nutrients and bio-solids by different methods.
4. To learn the basics behind the advanced oxidation methods for the treatment of wastewater

UNIT 1 **12 Hrs.**

Introduction to wastewater characteristics, collection of sewage and design of sewer system, Reactors and reactor analysis: Types of reactors and their analysis, Preliminary Treatment: Screening, Grit removal; Primary Treatment: Primary sedimentation Physical Unit operations, High rate clarification, Oxygen transfer - two film theory, flotation, Aeration systems

UNIT 2 **14 Hrs.**

Design of Secondary Treatment Units: Fundamentals of Biological Treatment, Suspended growth biological treatment processes (ASP), Attached growth and combined biological treatment processes: Trickling filters, Rotating Biological Contractors, Fluidized-Bed Bioreactors, Anaerobic Suspended and attached growth biological treatment processes: Upflow Anaerobic Sludge Blanket (UASB)

14 Hrs.

UNIT 3

Tertiary Treatment: purpose of tertiary treatment, Disinfection. Nutrients in domestic wastewater, Biological Nitrogen Removal processes (BNR), Biological Phosphorus Removal (BPR), and chemical nutrient removal process. Natural and constructed wetlands, different types, Mechanisms, performance, design, case studies, Land treatment systems

12 Hrs.

UNIT 4

Disposal systems: characteristics of sludge, aerobic digester, anaerobic digester and its design, Dry sanitation methods, Pit latrines, VIP latrines, Aquaprivy, septic tank, Ecological Sanitation, and other waste disposal systems Advanced Treatment Process: Electro-oxidation, Fenton, Electro Fenton, Electro-coagulation, approach to combined physico-chemical and biological, approach to Decentralized wastewater systems

Total 52 hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1-Understand primary water treatment process

CO2-Understand Analysis of different types of reactors

CO3- Design of secondary treatment processes

CO4-Understanding tertiary treatment processes

CO5-Design processes of sludge digester

CO6-Apply advanced oxidation methods for the treatment of wastewater.

TEXT/REFERENCE BOOKS

1. Metcalf and Eddy Inc, Wastewater Engineering: Treatment, and Reuse, 4th edition, Tata McGraw Hill, 2007.
2. Benefield L D, and Randall, C W. Biological Process Design for Wastewater Treatment Prentice Hall, 1980.
3. Schroeder E D., Water and Wastewater Treatment, McGraw-Hill, 1997
4. Arceivala S J, Wastewater Treatment for pollution control and Reuse, 3rd edition Tata McGraw Hill, 2007
5. Cites R W, Middlebrooks E J, Reed S C, Natural wastewater Treatment Systems, CRC Taylor and Francis, 2006.
6. Cairncross S, Feachem R. Environmental Health Engineering in the Tropics; 2nd edition, John Wiley & Sons 1993.
7. The World Bank – Appropriate technology for water supply and sanitation. (Series)
8. Compendium of Sanitation Systems and Technologies, 2nd revised edition, IWA.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of ith question Q

EN512T				INDUSTRIAL WASTEWATER MANAGEMENT						
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Understanding of technical issues and management of industrial waste water
- Understanding challenges of wastewater treatment, conservation, efficiency, reuse and recycle.
- Understanding of sector specific exposure on wastewater treatment and management
- Understanding of methods, laws, policy and standards of environmental management system

UNIT 1 **10 Hrs.**

Industrial wastes: Industrial waste source, Nature and characteristics, quantity and quality of industrial wastes and their impact on the environment, waste volume reduction, waste strength reduction, neutralization, removal of suspended and colloidal solids, removal of inorganic and organic dissolved solids, disposal of sludge solid treatment of cyanide waste, heavy metal and radio activity.

UNIT 2 **09 Hrs.**

Industrial Wastewater Treatment: Waste management Hierarchy, Source reduction techniques, Pollution Prevention of Assessment, Material balance, Evaluation of Pollution prevention options, Cost benefit analysis, payback period, Waste minimization Circles, Case Studies: Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles, Tanneries, Pulp and paper, metal finishing, Oil Refining, Pharmaceuticals, Sugar and Distilleries etc.

UNIT 3 **10 Hrs.**

Wastewater Reuse And Residual Management: Individual and Common Effluent Treatment Plants, Joint treatment of industrial and domestic wastewater, Zero effluent discharge systems, Quality requirements for Wastewater reuse, Industrial reuse, Present status and issues, Disposal on water and land, Residuals of industrial wastewater treatment, Quantification and characteristics of Sludge Thickening, digestion, conditioning, dewatering and disposal of sludge, Management of RO rejects, wasteland reclamation techniques

UNIT 4 **10 Hrs.**

Environmental audit: Environmental audit, objectives, types, features, planning of audits, Organisation of Auditing Programme, pre-visit data collection, Audit Protocol, Onsite Audit; Data Sampling, Inspections, Evaluation and presentation; Exit Interview; Audit Report Action Plan, Management of Audits, Waste Management Contractor Audits, Life Cycle Approach

Total. 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand basic concepts of technical issues and waste management of industrial waste water

CO2 - Understand and classify the sector wise variation in industrial waste water quality and treatment

CO3 - Apply concepts of waste water management in control and prevention of waste generation

CO4 - Analyse and compare steps in waste treatment and management

CO5 - Determine and evaluate management options involving environmental management system

CO6 - Design and improve wastewater treatment and minimization option

TEXT/REFERENCE BOOKS

1. Rao M N and Datta A K,'Wastewater Treatment, Oxford & IBH Publishing, New Delhi.
2. Eckenfelder. Industrial Water Pollution Control, McGraw-Hill, 2000
3. V VRanade and V Bhandari, 'Industrial Wastewater Treatment, Recycling and Reuse', 1st edition, 'Butterworth-Heinemann, 2014
4. Nelson LNemerow, "Industrial waste treatment – contemporary practice and vision for the future", Elsevier, Singapore, 2007
5. I.V Murali Krishna ValliManickam, 'Environmental Management', Butterworth-Heinemann, 2017
6. Frank Woodard, 'Industrial waste treatment Handbook', Butterworth Heinemann, New Delhi, 2001
7. S J. Arceivala, S R. Asolekar, 'Wastewater Treatment for Pollution Control and Reuse', McGraw-Hill, 2006
8. Environment management system ISO 14001 manual
   Case studies can be taken from relevant journal articles.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of ith question Q

EN513T					ENVIRONMENTAL IMPACT ASSESSMENT					
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding environmental problems due to project activities.
2. Understanding methods for environmental impact assessment
3. Understanding models to assess impacts and life cycle assessment
4. Writing report for environmental impact assessment

UNIT 1 **10 Hrs.**

Evolution of EIA: Concepts, Methodologies, Screening, Scoping, Base line studies, Mitigation, Matrices, Check list. Methods for impact assessment: Background information, interaction matrix methodologies, network methodologies, environmental setting various factors, environmental impact assessment methodology, documentation and selection process, environmental indices and indicators for describing affected environment, Life cycle assessment, principal component analysis; multivariate analysis, red listing process; Leopold matrix

UNIT 2 **10 Hrs.**

Prediction and assessment of impact for air and noise 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. Basic information of noise, existing noise levels and standards, prediction of noise levels and assessment of impact, mitigations, Models for air, water, soil, noise pollution assessment: AERMOD, MODFLOW, CADNA etc; ecological model (MAXENT, Biomapper, BACI)

UNIT 3 **09 Hrs.**

Prediction and assessment of impact for water and soil environment: Basic information of water quality (Surface water and ground water), water quality standards, identification of impact, prediction of impact and assessment, mitigations. Background information of soil environment, soil and ground water standards, prediction and assessment of impact for ground water and soil, mitigations.

UNIT 4 **10 Hrs.**

Prediction and assessment of impact on cultural and socioeconomic environment: Basic information on cultural resources and socioeconomic environment, rules and regulations for cultural resources like archaeological, historical structures, Cultural system, prediction and assessment of impact, mitigations. EIA notification by Ministry of Environment and Forest (Govt. of India): Provisions in the EIA notification, Rapid and Comprehensive EIA, general structures of EIA document, Environmental management plan, post environmental monitoring. Case studies in EIA, mini-projects related to EIA

TOTAL 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1- Understand impact of project activities on environment

CO2-Apply methods for carrying out environmental impact assessment

CO3-Apply models to assess impacts

CO4-Understand life cycle analysis of product and process

CO5-Understand about various organization involved in regulating impact assessment

CO6-Apply knowledge for writing report for environmental impact assessment

TEXT/REFERENCE BOOKS:

1. Canter R.L., Environmental Impact Assessment, Mc Graw Hill International Edition, 1997.
2. John G. Rau and David C. Wooten (Ed), Environmental Impact Analysis Handbook, McGraw Hill Book Company.
3. Gilpin A., Environmental Impact Assessment (EIA)- Cutting Edge for the 21st Century-1st Edition, Cambridge University Press 1994
4. Handbook of environmental management and technology: Gwendolyn Holmes, Ben Ramnarine Singh, Louis Theodore.
5. Michael Z., H., Ralph K. S., Life cycle assessment: theory and practice, Springer, 2018, ISBN-10: 3319564749

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of i^{th} question Q

EN514P					ENVIRONMENTAL SIMULATION LABORATORY					
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	3	1.5	3	--	--	--	50	50	100

COURSE OBJECTIVES

1. Understanding the functions of various models for Environmental Management
2. Understanding the scientific principles on which the respective model works
3. Applying the various models for simulating the different parameters
4. Propose mitigational framework for improving the Environmental Quality

LIST OF PRACTICALS

1. Modelling Meteorological parameters (Ambient Temperature, Wind Speed, Wind Direction) for a city
2. Ambient Air Quality Modelling and Mapping for a city focussing point sources
3. Ambient Air Quality Modelling and Mapping for a city focussing line sources
4. Ambient Air Quality Modelling and Mapping for a city focussing Landfills
5. Indoor Air Quality Modelling for assessing the efficiency of ventilation systems
6. Modelling the impact of various strategies for improving the Indoor Air Quality
7. Modelling Thermal Comfort for a city
8. Noise Modelling and Mapping for a city
9. Building Energy Simulation for choosing construction materials for reducing power consumption for air conditioning
10. Building Energy Simulation for assessing the impact of Roof-Top Gardens, Living Walls for reducing power consumption for air conditioning

OURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand the importance of modelling for Environmental Management

CO2 – Apply Models for Simulating Meteorological Parameters

CO3 – Apply Models for simulating Ambient Air Quality

CO4 – Apply Models for simulating Indoor Air Quality

CO5 – Apply Models for Simulating Sound levels

CO6 – Apply Models for simulating Building Energy Consumption

TEXT/REFERENCE BOOKS:

1. https://www.mmm.ucar.edu/weather-research-and-forecasting-model
2. https://ruc.noaa.gov/wrf/wrf-chem/Tutorial.html
3. Landfill Gas Emissions Model - EPA**www3.epa.gov › ttncatc1 › dir1 › landgem-v302-guide**
4. https://www.envi-met.com/
5. **https://www.datakustik.com/products/cadnaa/cadnaa/**
6. https://energyplus.net/
7. http://www.doe2.com/equest/

EN515T					OCCUPATIONAL HEALTH & SAFETY					
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding the various aspects of Environmental Health
2. Understanding the various aspects of Occupational Health
3. Understanding the various aspects of Occupational Hazardous
4. Propose a Safety Plan for an Industry

UNIT I ENVIRONMENTAL HEALTH 08 Hrs.

Dimensions of environmental health, causative agents of diseases, social factors, urban problem , housing and health, economy and health, climate and other atmospheric elements, violence, crime and mental health, family health practice, health care planning and delivery, chronic and communicable diseases.

UNIT II OCCUPATIONAL HEALTH 09 Hrs.

Industrial and agricultural pollutants, occupational health, epidemiological data, occupational health hazards, environmental exposure and diseases, industrial toxicants, hazardous wastes, preventing exposure to unhealthy and unsafe working conditions, ergonomics, controlling stress of life. Disease control, disease prevention, morbidity and mortality, diseases and progressive deterioration, controlling diseases and disability. Food borne and waterborne diseases outbreaks

UNIT III OCCUPATIONAL HAZARDS 10 Hrs.

Types of hazards, analysis of hazards, precautions & preventions, grades of hazards, Safety methods, Safety measures. IS 18001:2000/ 9001:2000 ISO 14001:1996 Comparison, Importance of H.F& S, Industrial scope/Act/Compensation, Fire hazards: Classification of fire, Grades of fire hazard. Classification of buildings /structures / materials / chemicals according to fire load. Fire hazard analysis, consequences & management. Mode of fire, fire fighting,

UNIT IV OCCUPATIONAL SAFETY 12 Hrs.

Different types of fire alarms / detectors & extinguishers, fire fighting requirements as per NBC 1983 / Municipality water supply requirements for fire, required fire flow, storage. Wet risers, sprinkler, fire fighting services, Protection & prevention measures of accidents & hazards Transportation & storage of chemicals, leakage & accident prevention. Industrial risk & Disaster management Survey of two industries for disaster / safety control systems, Electrical Safety Programme pollution control Practices in pesticides Industries

Total 39 hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Explain the various aspects of Environmental Health

CO2 – Explain the various aspects of Occupational Health

CO3 – Explain the various aspects of Occupational Hazards

CO4 – Analyze the Occupational Hazards of an Industry

CO5 – Assess the safety requirements of an Industry

CO6 – Devise a Safety Plan for an Industry

TEXT/REFERENCE BOOKS:

1. Cairncross S, Feachem R. Environmental Health Engineering in the Tropics; 2nd edition, John Wiley & Sons 1993.
2. Morgan M T, Environmental Health, Wadsworth Publishing Co, 1997
3. National Safety Council Publication
4. Environmental Chemistry by Stanley E. Manahan, VIth Ed. Lewis Publishers, London
5. CPCB Green Book

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of ith question Q

EN516T					GROUND WATER FLOW AND CONTAMINANT TRANSPORT THROUGH POROUS MEDIA					
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding about process of groundwater flow
2. Understanding equations for transport of groundwater and pollutants
3. Understanding models used for groundwater contaminant transport
4. Understanding different remediation techniques for control and treatment

UNIT 1 **10 Hrs.**

Occurrence of ground water, geological formations as aquifers; types of aquifers, ground water movement, Darcy's law, permeability and its measurement, tracing of ground water movement, fundamental equations for steady and unsteady ground water flow, flow nets.

UNIT 2 **09 Hrs.**

Infiltration galleries, Ground-water replenishment, recharge of ground water, different methods. Groundwater modeling techniques: porous media models, analog models, electric analog models, digital computer models

UNIT 3 **10 Hrs.**

Well hydraulics: Steady and unsteady flow in confined, semi-confined and unconfined aquifers, radial flow, superposition; multiple well system, Wells near aquifer boundaries, Different methods of well construction; construction of well casings and screens, natural and artificial gravel packed wells.

UNIT 4 **10 Hrs.**

Salt water intrusion: Concept; interface and its location; control of intrusion. Pollutant transport: Plume Transport, source identification, tracer methods and control measures and remediation: Insitu air sparging, Permeable reactive barrier, Bio-based technologies and treatment, pump and treat, bio-electrochemical systems; pathways for contamination: natural substances, petroleum based fuel, chlorinated solvents, heavy metals and metalloids, ; uniform and mobile-immobile model, mudflow model, model sensitivity analysis, transport control: physical control, surface sorption, biodegradation control,

TOTAL 39 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1- Understand about process of groundwater flow

CO2- Understand about different processes for groundwater contamination

CO3- Understand equations for transport of groundwater and pollutants

CO4- Apply models used for groundwater transport

CO5- Apply models used for contaminant transport

CO6- Apply different remediation techniques for control and treatment

TEXT/REFERENCE BOOKS:

1. Todd, D K Groundwater Hydrology , John Wiley publishers , 2004
2. Jacob and Bear, Hydraulics of Groundwater, McGraw Hill, 1997
3. Mutreja K.N., Applied Hydrology, Tata McGraw-Hill Publishing company Ltd., New Delhi, 1990
4. Raghunath, Groundwater & Well Hydraulics, Wiley Eastern Ltd, New Delhi, 1992
5. Singh V. P, Elementary Hydrology, Prentice Hall India, 1992.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of i^{th} question Q

EN517T					ENVIRONMENTAL MODELLING					
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding environmental processes and their scales
2. Understanding equation used in modeling pollutant dispersion
3. Understanding different types of model for pollutant dispersion in different medium
4. Understanding solution of dispersion equation using software tools

UNIT I **06 Hrs.**

Environmental systems and processes and their scales, reactions, reactor mass balance, introduction to mass transport, mass balance, mass conservation equation, Initial and boundary conditions

UNIT II **10 Hrs.**

Molecular and turbulent diffusion, derivation of general transport equation, advection and diffusion equation, similarities in mass, momentum and heat diffusion equation, transport relative to moving co-ordinate system, constitutive transport equation, mass transport equations in cartesian, cylindrical and spherical co-ordinate system, theories of mass transport; mass transport coefficients; boundary layer, turbulent transport, Reynold time averaging for mass, momentum, and energy equation ; zero, one and two equation turbulence model, Reynold stresses

UNIT III **14 Hrs.**

Transport through air-water exchange, bed-water exchange, biofilm Kinetics, modelling plug flow biofilm, dispersion; mixing in lakes, rivers, estuaries, ocean, air; diffusion from point, line and areal source; plume dispersion, contaminant transport in soil and ground water, chemical adsorption, partitioning, adsorption Isotherms. BOD/DO modelling, Microbial Kinetics

UNIT IV **10 Hrs.**

Computational methods in modelling, finite different method to solve system of equations, Introduction to Matlab and its use in transport processes

Total 40 hrs

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand pollutant transport processes and their scales

CO2 – Understand equation used in modeling pollutant dispersion

CO3 – Understand different types of model for pollutant dispersion in different medium

CO4 – Understand solution of dispersion equation using software tools

CO5 – Apply dispersion models for modelling pollutant concentration

CO6 – Apply numerical techniques to customize use of models

TEXT/REFERENCE BOOKS:

1. Environmental Transport Processes, Bruce E. Logan, Wiley.
2. Chemical Fate and Transport in the Environment, H F. Hemond and E. J. Fechner, Academic Press.
3. Transport Modeling for Environmental Engineers and Scientists, Mark M. Clark , Wiley

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of ith question Q

EN518T					CARBON SEQUESTRATION AND CLEAN DEVELOPMENT MECHANISM					
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding of physical/scientific evidence for climate change and global warming
2. Understanding of CO_2 separation from industrial gas streams
3. Understanding about CO_2 mitigation through sequestration and utilization
4. Understanding about cleaner production linked to CO_2 market and economics

UNIT 1 **10 Hrs.**

Global warming and climate change: Greenhouse gases, CO_2 emission and Global temperature; scientific evidence: UNFCCC and IPCC roles and reports, Energy and environment, carbon footprint, Global climate models, predictions, stabilization strategies and socio-economic impact,

UNIT 2 **10 Hrs**

CO_2 emission from large point sources, Technology options/challenges for clean energy/power production, CO_2 capture technologies: Absorption, Adsorption, membrane separation etc., Process requirements andresearch needs, CO_2 transportation, CO_2 capture case studies and economics.

UNIT 3

10 Hrs.

Geological CO_2 storage: storage in aquifer and depleted Oil and gas fields, CO_2 Storage through Enhanced Oil Recovery (EOR), Enhanced Coal Bed Methane Recoveryand Shale Gas recovery, trapping mechanism and CO_2 integrity.CO_2 Utilization: Bio-sequestration and bio-fuel form CO_2, fuels and chemicals from CO_2, building material form Carbon mineralization, CO_2 curing concrete.

UNIT 4 **10 Hrs.**

UNFCC, IPCC and Kyoto Protocol, Conference of Parties and police making. Cleaner production and flexible mechanisms for CO_2reduction. CDM Projects: Eligibility, execution and implementation, base line and life cycle; options and challenges in energy efficiency, solar, wind and conventional fuel power projects, CDM projects case studies

Max. 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Showcase and interpret Climate Change data, predictions and impact on environment
CO2 - Estimate carbon footprint and analyze power plant technologies for Clean energy
CO3 - Demonstrate processes for CO_2 separation from industrial flue gas streams
CO4 - Demonstrate and analyze options for CO_2 sequestration, trapping and integrity
CO5 - Analyse technology challenges for CO_2 utilization, technology comparison
CO6 - List and demonstrate CDM projects, base line and life cycle with case studies

TEXT/REFERENCE BOOKS

1. *Climate Change Science: A Modern Synthesis, Volume I: The PhysicalClimate by* G. Thomas Farmer • John Cook, Springer, 2018
2. Clean -Coal engineering Technology by Bruce G.Miller, ISBN 978-0-12-811365-3, @2017 Elsevier
3. Carbon Capture and Storage, second edition by Stephen A. Rackley, ISBN: 978-0-12-812041-5 @2018 Elsevier
4. Clean Development mechanism, CDM Methodologies 11th ed., by UNFCCC, 2019

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of ith question Q

EN519					ENERGY CONVERSION AND ENVIRONMENT					
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding linkages between energy and environment
2. Understanding about different power conversion technologies and emission from them
3. Understanding contribution of renewable energy technologies to emission reduction
4. Understanding effect of energy conversion plants on changes in environment

UNIT 1 **08 Hrs.**

Inter-linkages of energy and environment: Principles of energy conversion methods: thermal, nuclear, hydro, solar, pure oxygen-based coal conversion

UNIT 2 **12 Hrs.**

An introduction to fuels, combustion fundamentals, thermodynamics, kinetics and properties of combustion products; combustion principles for gases, liquids and solids; Formation of pollutants, measurements and control

UNIT 3 **08 Hrs.**

Automobile emissions, power production and emissions from waste incineration, Energy policies, economics related to energy along with cost factor, the renewable energy sources and conversion processes and sustainable energy, power electronics contribution to renewable energy and emission reduction,

UNIT 4 **12 Hrs.**

Energy externalities, Energy and climate change global issues; Alternative energy sources, economics, sustainability, air flow changes due to energy conversion plants, wave energy conversion and coastal morphodynamics, solar plants and environment, energy environment and economic assessment in remanufacturing

TOTAL 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1- Understand linkages between energy and environment

CO2- Understand about different power conversion technologies and

CO3- Understand emission form different energy conversion technologies

CO4- Understand contribution of renewable energy technologies to emission reduction

CO5- Understand effect of energy conversion plants on changes in environment

CO6- Design environment of energy conversion units for energy reduction and better environment

TEXT/REFERENCE BOOKS:

1. International Energy Markets: Understanding Pricing, Policies and Profits by Carol A.Dahl, PennWell Corporation (2004) ISBN: 978-0-87814-799-1
2. Energy: Technology and directions for the future by John R. Franchi, Elsevier Academic Press (2004). ISBN: 0-12-248-291-3
3. Principles of Sustainable Energy by Frank Keith and Jan F Kreider, CRC press (Taylor and Francis group) (2011), ISBN: 978-1-4398-1407-9
4. Energy Economics: A Modern Introduction by Ferdinand E Banks. Kluwer Academic Publishers. 2nd ed. (2003), ISBN: 0-7923-7700-1
5. Fundamentals of Air Pollution Engineering, Prentice Hall, New Jersey, 1988. Kanury, A.M.,
6. Introduction to Combustion Phenomena, Gordon and Breach Science Publishers, New York, 1992

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of ith question Q

EN520T					WASTE TO ENERGY					
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding different types of waste and their energy content
2. Understanding about different types of waste to energy conversions technologies
3. Designing reactors used for waste to energy conversions technologies
4. Designing bio-reactors for conversion of bio-waste to energy

UNIT 1 **08 Hrs.**

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, physico-chemical characteristics and calorific value of components, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT 2 **12 Hrs.**

Incineration, different types of incineration, and design of incineration plants, Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications, pyrolysis and liquefaction

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

UNIT 3 **08 Hrs.**

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

UNIT 4 **12 Hrs.**

Biogas: Properties of biogas - Biogas plant technology and status - Bio energy system, Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass – Bio-fuel production - Urban waste to energy conversion - Biomass energy programme in India.

TOTAL 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1- Understand different types of waste and their energy content

CO2- Understand about different types of waste to energy conversions technologies

CO3- Design reactors used for waste to energy conversions technologies

CO4- Understand construction and operation of reactors

CO5- Designing bio-reactors for conversion of bio-waste to energy

CO6- Understand construction and operation of reactors for processing bio-waste

TEXT/REFERENCE BOOKS:

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of i^{th} question Q

EN521T					ENVIRONMENTAL RISK ASSESSMENT AND MANAGEMENT					
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding the various aspects of Environmental Hazardous
2. Understanding the various aspects Environmental Risks
3. Assessing the Environmental Risk of a particular system
4. Preparing Environmental Risk Management Plan

UNIT I ENVIRONMENTAL HAZARDS 09 hrs.

Sources of Environmental hazards, Environmental and ecological risks, Environmental risk assessment framework, Regulatory perspectives and requirements, Risk Analysis and Management and historical perspective; Social benefit Vs technological risks; Path to risk analysis; Perception of risk, risk assessment in different disciplines.

UNIT II BASICS OF ENVIRONMENTAL RISK 09 hrs.

Hazard identification and accounting, Fate and behaviour of toxics and persistent substances in the environment, Properties, processes and parameters that control fate and transport of contaminants, Receptor exposure to Environmental Contaminants, Dose Response Evaluation, Exposure Assessment, Exposure Factors, Slope Factors, Dose Response calculations and Dose Conversion Factors, Risk Characterization and consequence determination,

UNIT III TYPES OF ENVIRONMENTAL RISKS 09 hrs.

Cause failure analysis, Event tree and fault tree modelling and analysis, Multimedia and multipath way exposure modelling of contaminant migration for estimation of contaminant concentrations in air, water, soils, vegetation and animal products, Estimation of carcinogenic and non carcinogenic risks to human health

UNIT IV ENVIRONMENTAL RISKS ASSESSMENT 12 hrs

HAZOP and FEMA methods, Methods in Ecological risk assessment, Probabilistic risk assessments, radiation risk assessment, Data sources and evaluation. Risk Management: Risk communication and Risk Perception, comparative risks, Risk based decision making, Risk based environmental standard setting, Risk Cost Benefit optimization and tradeoffs, Emergency Preparedness Plans, Emergency planning for chemical agent release, Design of risk management programs, risk based remediation; Risk communication, adaptive management, precaution and stake holder involvement. Vulnerability assessment, Uncertainty analysis

[Total 39 hrs]

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Explain the various aspects of Environmental Hazardous

CO2 – Explain the various aspects of Environmental Risks

CO3 – Apply Fault Tree Modelling for a given system

CO4 – Analyze a given system and evaluate its Environmental Risk

CO5 – Calculate Risk Cost Benefit optimization and tradeoffs

CO6 – Devise a Risk management plan

TEXT/REFERENCE BOOKS:

1. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff, Risk Assessment and Management Handbook, McGraw Hill Inc., New York, 1996.
3. Kofi Asante Duah, Risk Assessment in Environmental management, John Wiley and sons, Singapore, 1998.
4. Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., Global Environmental Risks, V.N.University Press, New York, 2003.
5. Risks and Decisions for Conservation and environmental management, Mark Burman, Cambridge University Press.

Susan L Cutter, Environmental Risks and Hazards, Prentice Hall of India, New Delhi, 1999.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of i^{th} question Q

EN522T					Financial & Management Accounting for Engineers					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	-	-	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Equip the students with technical and analytical skills in management of funds
2. Develop managerial decision-making with special emphasis on the practical aspects
3. Equip the students distinguish the relevant issues from the irrelevant matters
4. Grasp the implication of the various factors in a given situation and marshal the thought process logically so as to be able to present information in a meaningful manner.
5. Display an understanding of the relative merits of each alterative.

UNIT 1 Management Accounting and Decision making-I **10 Hrs.**

Management & Accounting Functions
Profit Planning
Incremental Analysis
Budgetary Control – Operation

UNIT 2 Management Accounting and Decision making-II **10 Hrs.**

Cost Control Through Variance analysis
Performance Reporting

Management Control System
Decision Models

UNIT 3 Financial Management-I **10 Hrs.**

Analysis and Interpretation of Published Statements
Capital Structuring and sourcing of Long Term Funds
Working Capital
Capital Budget:

UNIT 4 Financial Management-II **10 Hrs.**

Appraisal of Capital Expenditure Proposals
Internal Financing
Investment Management
Forecasting & Planning

Max. 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify the uses and needs of financial statements & their relationship

CO2 – Identify how strategic planning determines the path organisation chooses for attaining its long term goal;

CO3 – Explain the role that budgeting plays in overall planning and evaluation of performance of an organisation

CO4 – Analyses the performance against the operational goal using revenues and cost of various centres

CO5 – Calculate product line; business line & customer line profitability for overall profit planning of an organisation

CO6 – Understand the importance of KPI & its role in evaluating the performance of keys areas of an organisation

TEXT/REFERENCE BOOKS

1. Financial Management by Prasana Chandra TMH
2. Introduction to Management Accounting by Charles Horngren& others –Prentice Hall
3. https://maaw.info/MAAWTextbookMain.htm
4. Reading material of ICAI & ICWA

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of i^{th} question Q

IE523T					Projects					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	-	-	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Lay an important foundation in managing projects
2. To interconnect every phase of project such as project planning, analysis; selection; financing Execution, monitoring and review& exit
3. Understand & apply appropriate technique in various phases of project
4. Appreciate the significance of teams in projects
5. Develop the discipline wise case across the various phases by students

UNIT 1 Management Accounting and Decision making-I **10 Hrs.**

Management & Accounting Functions
Profit Planning
Incremental Analysis
Budgetary Control – Operation

UNIT 2 Management Accounting and Decision making-II **10 Hrs.**

Cost Control Through Variance analysis
Performance Reporting
Management Control System
Decision Models

UNIT 3 Financial Management-I **10 Hrs.**

Analysis and Interpretation of Published Statements
Capital Structuring and sourcing of Long Term Funds
Working Capital
Capital Budget:

UNIT 4 Financial Management-II **10 Hrs.**

Appraisal of Capital Expenditure Proposals
Internal Financing
Investment Management
Forecasting & Planning

Max. 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify the uses and needs of financial statements & their relationship
CO2 – Identify how strategic planning determines the path organisation chooses for attaining its long term goal;
CO3 – Explain the role that budgeting plays in overall planning and evaluation of performance of an organisation
CO4 – Analyses the performance against the operational goal using revenues and cost of various centres
CO5 – Calculate product line; business line & customer line profitability for overall profit planning of an organisation
CO6 – Understand the importance of KPI & its role in evaluating the performance of keys areas of an organisation

TEXT/REFERENCE BOOKS

1. Financial Management by Prasana Chandra TMH
2. Introduction to Management Accounting by Charles Horngren& others –Prentice Hall
3. https://maaw.info/MAAWTextbookMain.htm
4. Reading material of ICAI & ICWA

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of i^{th} question Q

EN524T					Equipment and Process Design for Material and Energy Recovery					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

1. Understanding processes of material and energy recovery with case studies
2. Understanding various material recovery products and their application
3. Understanding equipment for emission control in material and energy recovery
4. Equipment and Process design for material and energy recovery

UNIT 1 **08 Hrs.**

Material: biochar, biogas, bio-oil recovery; heat recovery from high temperature solid granules: packed bed, fluidized bed, moving bed; thermal energy storage, bioelectrochemical systems for resource recovery, case studies for material and energy recovery;

UNIT 2 **08 Hrs.**

Pollutant and residue from thermal treatment and their control with equipments, Spray Drying adsorption, scrubbing, treatment of bottom ash; ash products: construction material, aggregate replacement and process design

UNIT 3 **12 Hrs.**

E-Waste chemical and bioleaching process optimization; Incinerated ash metal recovery process design; Design of plasma arc gasification for biomedical waste, product yield analysis and characterization; Reactor design for catalytic Thermolysis of waste for fuel grade products, Reactor design for non-catalytic Thermolysis of waste for fuel grade products, product yield analysis and characterization; Process design for energy recovery from Tyre waste, product yield analysis and characterization

UNIT 4 **12 Hrs.**

Design of solid state gas fermenter to convert syngas to methane; Three stage reactor design for conversion of MSW to Methanol, Process design of aerobic, gasification, pyrolysis and anaerobic plant for material and energy recovery; Thermal waste treatment process design; segregation, separator, and classifier design; microwave pyrolysis design; Combustion/Incinerator Technologies: Grate, Fluidized bed, RDF combustion;

TOTAL 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to:

CO1: Understanding processes of material and energy recovery with case studies
CO2: Understanding various material recovery products and their application
CO3: Understanding about emission control technologies and pollutants emission
CO4: Understanding equipment for emission control in material and energy recovery
CO5: Process design for material and energy recovery
CO6: Reactor and equipment design for material and energy recovery

TEXT/REFERENCE BOOKS:

5. N. J. Themelis, Recovery of material and energy from urban waste, Springer, ISBN: 978-1-4939-7850-2
6. S. K. Ghosh, Envergy recovery processes from waste, Springer, ISBN: 978-981-329-228-4
7. P. Jayarama Reddy, Energy Recovery from Municipal Solid Waste by Thermal Conversion Technologies, CRC Press, ASTIN: B01DLRHY9I

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of ith question Q

EN500T					Foundation of Environmental Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

COURSE OBJECTIVES

5. Understanding the various natural resources
6. Understanding the basics of water and wastewater
7. Understanding the various aspects of pollution
8. Understanding the various Pollution Mitigation concepts

UNIT – I Introduction to Natural Resources [08 Hours]

Ecosystem and its various types, factors affecting the functioning of an ecosystem; Biodiversity – its importance, threats and conservation; Natural Resources – Forest, Water, Mineral, Energy, Minerals, Food; Review of State of India's Environment.

UNIT – II Basics of Water & Wastewater [10 Hours]

Sources of water, Water quality standards, Impact of water quality on - human health, agriculture, materials etc; Wastewater, classification of wastewater, composition of wastewater, characterization of wastewater (physical, chemical and biological), basics of sewage quality assessment, sources of wastewater, estimation of wastewater quantity.

UNIT – III Environmental Pollution [10 Hours]

Concept of Clean Environment, Introduction to various environmental standards – air, water, soil, noise, heat. Causes and Effects of Air Pollution, Water Pollution, Soil Pollution, Solid Waste (organic and Inorganic) Pollution, Hazardous Waste Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Radioactive Pollution

UNIT-IV Environmental Pollution Control [10 Hours]

Technological concepts for controlling various pollutions, Review of the Central and State Government's policies and mechanisms for managing various natural resources and controlling the various types of pollutions, Global Initiatives for environmental management.

Total Hr. 40

COURSE LEARNING OBJECTIVES

CO-1 Describe the various aspects of the Natural Resources

CO-2 Discuss the Water Quality and its impact

CO-3 Describe the various aspects of characterizing the Wastewater

CO-4 Explain the concept of Clean Environment

CO-5 Explain the causes of various types of Environmental Pollution

CO-6 Outline a basic Environmental Management Framework

** This subject should be taken by students admitted to environmental engineering having M. Sc. degree as eligibility criteria for admission.

Text-book and Reference Books:

1. Bharucha Erach, Textbook for Environmental Studies, UGC New Delhi
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd, Ahmedabad 380013, India
3. Gilbert Masters and Wendell P. Ela, 2012. Introduction to Environmental Engineering and Science, PHI Learning Pvt Ltd, New Delhi
4. Annual State of India's Environment 2020, Down to Earth, Centre for Science and Environment, New Delhi
5. Climate Actions – Increase Your Handprint and Decrease Your Footprint, Centre for Environment Education, Ahmedabad, 2015
6. Water Supply Engineering (Environmental Engineering), S. K. Garg, Khanna Publishers, 2016
7. Water Supply and Sanitation Engineering, GS Birdie, JS Birdie, Galgotia Publishing Ltd
8. Environmental Engineering, HS Paevy, DR Rowe, G Tchobanoglous, McGraw Hill
9. Air Pollution by M N Rao and H V N Rao, Tata McGraw Hill, 2017
10. Fundamentals of Air Pollution, A. C. Stern, Academic Press, 1994
11. Sewage Disposal and Air Pollution Engineering, S K Garg, Khanna Publishers
12. Water and wastewater engineering, Metcalf and Eddy, McGraw Hill

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of i^{th} question Q

CE527T				SUCCESSFUL RESEARCH PROGRAM DEVELOPMENT						
Teaching Scheme										
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	0	2	25	50	25	--	--	Fail/Pass

COURSE OBJECTIVES

1. To develop understanding of the basic framework of research process
2. To develop an understanding of various research designs and techniques.
3. To identify various sources of information for literature review and data collection.
4. To develop an understanding of the ethical dimensions of conducting applied research
5. Appreciate the components of scholarly writing and evaluate its quality

UNIT 1 **07 Hrs.**

The Research Organization: Objectives & Goals of a Research Organization, Components of a research organization, Contracting & Operational Support Activities, Indirect Support Activities, Direct Support Activities, Costs & Infrastructure Accounting, General & Administration Activities, Market & Business Development Activities, Profit & Non-Profit Entity Implications, Business Case for R&D, R&D Structures & Costs for Selected Industry Segments, Success stories. Research Staff: Research & Academic Faculty, Scientists & Technologists, Research Associates, Graduate Students, Visiting Researchers, Employment Laws, Contracts, & Implications, Workplace Regulations

UNIT 2 **07 Hrs.**

Sponsors & Funding Agencies: Funding Agencies – Types, Types of Interface with Funding & Sponsor Agencies, Call for Proposals & Opportunity Tracking, Types of Proposals & Grants, Contracting Vehicles & Arrangements, Deliverables, Interim & Final Reviews, Cost & Performance Audits, Contract Laws & Enforcement, Ethics & Lobbying, Conflict of Interest & its Management. Proposals for Research Program Funding: Center & Consortia Proposals, Individual Principal Investigator Proposals, Continuation & Renewal Proposals, Prime/Subcontractor Relationships & Contracting, Cost Accounting, Laws and Regulations.

UNIT 3 **07 Hrs.**

Research Program Contracts: Types of Contracts – IDIQ, Cost-Sharing, Cost-Plus, Intellectual Property & Patent Laws, Export Control & Arms Regulations Compliance, Academic versus Commercial Contracts, Technology Transfer, Overhead & Indirect Costs, Federal & Government Cost & Accounting Regulations (FAR), Case Studies. Writing a Successful Research Proposal: Technical Proposal, Management Proposal, Cost Proposal, Technology Proposal, Statement of Work & Deliverables, Case Studies.

UNIT 4 **07 Hrs.**

The Research Process – I: Steps in development of successful research program, Quality and Cost consideration, Laboratories and infrastructure setup, Staffing & Support Models, Peer-Review, Independent Verification & Validation, Internal & External Review processes, Ethics & Regulatory Laws & Guidelines, Case Studies. The Research Process – II: Problem Definition, Background Study, Valuation & Current Practice, Proposal Writing, Deliverables & Timelines Development, Results Projection, Staffing, Costs & Progress Tracking, Quality Management, Publication & Patents, Intellectual Property & Licensing, Technology Transfer, Validation & Test. Deliverables & Audits: Technical Reports, Software, Hardware, Systems, Qualification, Cost Reports, Test Reports, Papers & Publications, Patents, Case Studies.

Total 28 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify the overall process of designing a research study from its inception

CO2 - Understand the characteristics of various kinds of research (quantitative and qualitative).

CO3 - Apply the knowledge in framing the literature review for a scholarly educational study

CO4- Analyze quality of article using various database and their functions

CO5- Exercise on various ethical issues in conducting research

CO6- Develop research designs and project proposals in achieving project deliverables

TEXT/REFERENCE BOOKS

1. Research Methodology (Methods and Techniques) book by CR Kothari New age Publications 3rd edition
2. Research Methodology book by Ranjith Kumar, Sage Publications 3rd edition (Softcopy Available)
3. Nptel Lectures: Introduction to Research,Prof. Prathap Haridoss, Department of Metallurgical and Materials Engineering, Indian Institute of Technology, Madras

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: $\sum W_{Q_i}$ 100 Marks

$Where, W_{Q_i}$=Weight of i^{th} question Q

MT611					Seminar					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
	-	-	5					--	--	100

COURSE OBJECTIVES

1. To demonstrate a sound technical knowledge of a project.
2. To understand research work for new knowledge creation
3. To develop ability to solve complex problems and find engineering solution
4. To lean new knowledgeandlatest changes in technologyfor handling environmental challenges

Details:

Students will do a mini environmental related project for seminar. The seminar work will be carried individually and student needs to prepare seminar report consisting of major learning's, novelty of their work. The project work will be reviewed/evaluated by faculty mentor/s.

COURSE OUTCOMES

On completion of the project, student will be able to

CO1 - Define relevance of project for environmental problems and solutions

CO2 - Summarize the literature survey and documentation skills.

CO3 - Apply analytical tools for data/information processing for problem solution.

CO4 - Analyse problems using latest tools/techniques for solution

CO5 – Apply writing skill to produce report

CO6 –Apply presentation skills in professional career

MT612					Dissertation					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
	-	-	14					--	--	100

COURSE OBJECTIVES

1. Demonstrating a sound technical knowledge of project.
2. Learn engineering knowledge to solve environmental problem.
3. Solve complex problems and find engineering solution based on a systematic approach.
4. Learn new knowledge, andlatest changes in technology for handling environmental challenges

Details:

Students will do a project related to environmental engineering under supervision of mentor/s. The project & dissertation work will be reviewed following procedure laid down in M. Tech rules and regulations document.
The hard bound copy of the thesis will be prepared as per PDPU format. The same should be submitted to PG coordinator.

COURSE OUTCOMES

On completion of the project, student will be able to

CO1 - Define relevance of project for environmental problems and solutions

CO2 - Summarize literature survey and documentation skills.

CO3 - Apply analytical tools for data/information processing for problem solution.

CO4 - Analyse problems using latest tools/techniques for solution

CO5 – Apply writing skill to produce report

CO6 –Apply presentation skills in professional career

MT613					Industrial Training					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
	-	-						--	--	PP/NP

COURSE OBJECTIVES

1. Understanding industrial operation involved in providing environmental solution.
2. Understanding process design and technology of environmental solutions
3. Understanding roles and functions of different official involved in environmental field
4. Getting trained about treatment process applied in industry

Details:

The students need to undertake about 6 weeks' project training in any industry/consulting firm. . At the end of the successful completion, the students need to prepare a comprehensive project training report and have to appear before a panel of jury members for its assessment, as laid down in M. Tech rules and regulation documents.

COURSE OUTCOMES

On completion of the project, student will be able to

CO1–Define the relevance of training work in any industry

CO2 –Understand the role and responsibility of officials.

CO3–Understand technologies applied for treatment

CO4– Understand process flow of treatment

CO5- Understand the different between academic knowledge and industry practices.

CO6- Practice the acquired knowledge, skills and attitudes for becoming a professional engineer

MT621					Seminar					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
	-	-	5					--	--	100

COURSE OBJECTIVES

1. To demonstrate a sound technical knowledge of a project.
2. To understand research work for new knowledge creation
3. To develop ability to solve complex problems and find engineering solution
4. To lean new knowledge, and latest changes in technological for handling environmental challenges

Details:

Students will do a mini environmental related project for seminar. The seminar work will be carried outindividually and student needs to prepare seminar report consisting of major learning's, novelty of their work. The project work will be reviewed/evaluated by faculty mentor/s.

COURSE OUTCOMES

On completion of the project, student will be able to

CO1 - Define relevance of project for environmental problems and solutions

CO2 - Summarize literature survey and documentation skills.

CO3 - Apply analytical tools for data/information processing for problem solution.

CO4 - Analyze problems using latest tools/techniques for solution

CO5 – Apply writing skill to produce report

CO6 –Apply presentation skills in professional career

MT622					Dissertation					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
	-	-	24					--	--	100

COURSE OBJECTIVES

1. To demonstrate sound technical knowledge related to project.
2. To understand tools and technologies to solve environmental problem.
3. To solve complex problems and find engineering solution based on a systematic approach.
4. To learn new knowledge and latest changes in technology for handling environmental challenges

Details:

Students will do a project related to environmental engineering under supervision of mentor/s.
The project & dissertation work will be reviewed following procedure laid down in M. Tech rules and regulations document.
Following number of thesis copies should be produced and submitted to respective office:

1. One copy for mentor/mentors
2. One copy for departmental library
3. Once copy for central library
4. One student copy (for self)

COURSE OUTCOMES

On completion of the project, student will be able to

CO1 - Define relevance of project for environmental problems and solutions

CO2 - Summarize literature survey and documentation skills.

CO3 - Apply analytical tools for data/information processing for problem solution.

CO4 - Analyze problems using latest tools/techniques for solution

CO5 –Apply writing skill toproduce report

CO6 –Apply presentation skillsin professional career