Anna University, Chennai

2017, Regulations

GE6075 **PROFESSIONAL ETHICS IN ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES **10**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS **9**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES **8**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society

TEXTBOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi 2013.
6. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011

Web sources:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

GE6084 HUMAN RIGHTS L T P C
3 0 0 3

OBJECTIVES :

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I 9

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II 9

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III 9

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV 9

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V 9

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

OUTCOMES:

- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

GE6083 DISASTER MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster damage assessment and management

TEXTBOOK:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

GE6351 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

To the study of nature and the facts about environment.

- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 12

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds
Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 10

Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry- Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;- Mitigation procedures- Control of particulate and gaseous emission, Control of SO_2, NO_X, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources

for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins –Biochemical degradation of pollutants, Bioconversion of pollutants.
Field study of local area to document environmental assets – river/forest/grassland/hill/mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT **7**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization-environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark). enforcement machinery involved in environmental legislation- central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides. Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT **6**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- -GIS-remote sensing-role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

OUTCOMES:

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- Public awareness of environment at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions.
- Development and improvement in standard of living has lead to serious environmental disasters.

TEXT BOOKS:

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd Edition, Pearson Education 2004.
2. Benny Joseph, 'Environmental Science and Engineering', Tata Mc Graw-Hill, New Delhi, 2006.

REFERENCES:

1. R.K. Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standard", Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia',Jaico Publ.,House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice Hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press 2005.

EXCEL ENGINEERING COLLEGE

(Autonomous)

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai
Accredited by NBA and NAAC with "A+" and Recognised by UGC (2f &12B)
KOMARAPALAYAM - 637303

DEPARTMENT OF CIVIL ENGINEERING
M.E ENVIRONMENTAL ENGINEERING
REGULATION -2022
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULUM

SEMESTER I									
Code No.	Course	Category	Periods /Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course (s)									
22PMA102	Statistical Methods for Engineers	FC	3	2	0	4	40	60	100
22PEE101	Environmental Chemistry	FC	3	0	0	3	40	60	100
22PEE102	Environmental Microbiology	FC	3	0	0	3	40	60	100
22PEE103	Design of Physico- Chemical Treatment Systems	PC	3	0	0	3	40	60	100
22PEE104	Transport of Water and Wastewater	PC	3	0	0	3	40	60	100
Practical Course (s)									
22PEE105	Environmental Chemistry Laboratory	FC	0	0	4	2	50	50	100
22PEE106	Environmental Microbiology Laboratory	FC	0	0	4	2	50	50	100
Total			**15**	**2**	**8**	**20**	**300**	**400**	**700**

SEMESTER II									
Code No.	Course	Category	Periods /Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course (s)									
22PEE201	Design of Biological Treatment systems	PC	3	0	0	3	40	60	100
22PEE202	Industrial Wastewater Management	PC	3	0	0	3	40	60	100
22PEE203	Air and Noise Pollution Control Engineering	PC	3	0	0	3	40	60	100
22PEEEXX	Professional Elective I	PE	3	0	0	3	40	60	100
22PEEEXX	Professional Elective II	PE	3	0	0	3	40	60	100
22PEEEXX	Professional Elective III	PE	3	0	0	3	40	60	100
Practical Course (s)									
22PEE204	Environmental Process Monitoring Laboratory	PC	0	0	6	3	50	50	100
Employability Enhancement Course EEC									
22PEE205	Seminar	EEC	0	0	2	1	100	0	100
Total			**18**	**0**	**8**	**22**	**340**	**460**	**800**

Passed in Board of studies meeting on 25.02.2022 *Approved in Academic Council meeting on 09.03.2022*

CHAIRMAN - BOARD OF STUDIES

PROFESSIONAL ELECTIVES I ,II& III									
SEMESTER II									
Sub code	Course	Category	Periods /Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
22PEEE01	Ecological Engineering	PE	3	0	0	3	40	60	100
22PEEE02	Solid and Hazardous Waste Management	PE	3	0	0	3	40	60	100
22PEEE03	Operation and Maintenance of Treatment Systems	PE	3	0	0	3	40	60	100
22PEEE04	Environmental Policy and Legislation	PE	3	0	0	3	40	60	100
22PEEE05	Environmental Quality Monitoring	PE	3	0	0	3	40	60	100
22PEEE06	Climate change and adaptation	PE	3	0	0	3	40	60	100
22PEEE07	Marine Pollution and Control	PE	3	0	0	3	40	60	100

PROFESSSIONAL ELECTIVES IV & V									
SEMESTER III									
Sub code	Course	Category	Periods /Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
22PEEE11	Air and Water Quality Modeling	PE	3	0	0	3	40	60	100
22PEEE12	Membrane Separation for Water and Wastewater Treatment	PE	3	0	0	3	40	60	100
22PEEE13	Computing Techniques in Environmental Engineering	PE	3	0	0	3	40	60	100
22PEEE14	Landfill Engineering and Remediation Technology	PE	3	0	0	3	40	60	100
22PEEE15	Environmental Risk Assessment	PE	3	0	0	3	40	60	100
22PEEE16	Remote Sensing and GIS Applications in Environmental Management	PE	3	0	0	3	40	60	100
22PEEE17	Environmental Impact Assessment	PE	3	0	0	3	40	60	100

22PEE101	Environmental Chemistry	L	T	P	C
		3	0	0	3

Nature of Course	Foundation Course
Pre requisites	NIL

Course Objectives

The course is intended

1. To educate the students in the area of water, air and soil chemistry
2. To impart knowledge on the transformation of chemicals in the environment
3. To gain knowledge on atmospheric chemistry
4. To understand the nature and composition of soil
5. To acquire knowledge on environmental chemicals

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	To understand the essential theoretical background of the principles of chemistry applied to the solutions of environmental problems.	Understand
CO2	To apply the principles of chemistry in solving water and wastewater treatment problems.	Apply
CO3	To analyses the chemistry related issues in water and wastewater treatment.	Analyse
CO4	To evaluate the characteristics of raw water, treated water, products of biodegradation of wastewaters and the performance of different units of water and wastewater treatment.	Apply
CO5	To impart knowledge on the transformation of chemicals in the environment	Apply

Course Contents:

Unit- I Introduction **9**

Stoichiometry and mass balance-Chemical equilibrium, acid base, solubility product (Ksp) ,heavy metal Precipitation, hydroxides, CO2 solubility in water and species Distribution – Chemical kinetics , First order- 12 Principles of green chemistry**.**

Unit- II Aquatic Chemistry **9**

Water quality parameters- environmental significance and determination; Fate of chemicals in aquatic environment, volatilization, partitioning, hydrolysis, photochemical transformation- Degradation of synthetic chemicals-Metals, complex formation, oxidation and reduction , pE – pH diagrams, redox zones – sorption- Colloids, electrical properties, double layer theory, environmental significance of colloids, coagulation ..

Unit- III Atmospheric Chemistry **9**

Atmospheric structure –-chemical and photochemical reactions – photochemical smog. Ozone layer depletion- greenhouse gases and global warming, CO2 capture and sequestration – Acid rain- origin and composition of particulates Air quality parameters-effects and determination

Unit - IV Soil Chemistry **9**

Nature and composition of soil-Clays- cation exchange capacity-acid base and ion exchange reactions in soil -Agricultural chemicals in soil-Reclamation of contaminated land; salt by leaching-Heavy metals by electro kinetic remediation**.**

Unit- V Environmental Chemicals **9**

Heavy metals-Chemical speciation -Speciation of Hg &As- Organic chemicals- Pesticides, Dioxins, PCBs,PAHs and endocrine disruptors and their Toxicity- Nano materials, CNT, titania, composites ,environmental applications**.**

Total: 45 Periods

Reference Books:

1. Colin Baird„ Environmental Chemistry", Freeman and company, New York, 5th Edition,2012..
2. Sawyer, C.N., Mac Carty, P.L. and Parkin, G.F., "Chemistry for Environmental Engineering and Science", Tata McGraw – Hill, , New Delhi 5th Edition 2003.
3. Manahan, S.E., "Environmental Chemistry", , CRC press,9th Edition 2009.

Additional References:

1. Ronald A. Hites ,"Elements of Environmental Chemistry",Wiley, 2nd Edition,2012.
2. Web basedsources

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3									1	1		
CO2	3	3	3									1	1		
CO3	3	3	3									1	1		
CO4	3	3	3									1	1		
CO5	3	3	3									1	1		
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Final Examination (60)**
	IAE 1 (7.5)	**IAE2 (7.5)**	**IAE 3 (10)**	
Remember	0	0	0	0
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	10	10	10	20
Evaluate	0	0	0	0
Create	0	0	0	0

22PEE102	Environmental Microbiology	L	T	P	C
		3	0	0	3

Nature of Course	Foundation Course
Pre requisites	NIL

Course Objectives

The course is intended

1. To provide a basic understanding on microbiology relevant to environment
2. To outline the morphology, behavior and biochemistry of bacteria, fungi, protozoa, viruses, and algae
3. To provide The microbiology of wastewater, sewage sludge and solid waste treatment processes
4. To gain the knowledge on the pathogens in waste water
5. To provide an exposure to toxicology due to industrial products are also covered

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Have the basic understanding on the basics of microbiology and their diversity and on the genetic material in the living cell.	Understand
CO2	Understand and describe the type of microorganisms in the environment and the role of microorganisms in the cycling of nutrients in an ecosystem.	Understand
CO3	Understand the role microbial metabolism in a wastewater treatment plant.	Understand
CO4	Know the role of microorganisms in a contaminated water and the diseases caused.	Apply
CO5	Conduct and test the toxicity due to various natural and synthetic products in the environment	Apply

Course Contents:

Unit- I Classification And Characteristics **9**

Classification of microorganisms – prokaryotic, eukaryotic, cell structure, characteristics, Preservation of microorganisms, DNA, RNA, replication, Recombinant DNA technology.

Unit- II Microbes And Nutrient Cycles **9**

Distribution of microorganisms - Distribution / diversity of Microorganisms - fresh and marine, terrestrial- microbes in surface soil, Air – outdoor and Indoor, aerosols, bio safety in Laboratory – Extreme Environment – archae bacteria – Significance in water supplies – problems and control. Transmissible diseases. Biogeochemical cycles-----Hydrological - Nitrogen, Carbon, Phosphorus, Sulphur, Cycle – Role of Microorganism in nutrient cycle.

Unit- III Metabolism Of Microorganisms **9**

Nutrition and metabolism in microorganisms, growth phases, carbohydrate, protein, lipid metabolism – respiration, aerobic and anaerobic-fermentation, glycolysis, Kreb's cycle, hexose monophosphate pathway, electron transport system, oxidative phosphorylation, environmental factors, enzymes, Bioenergetics

Unit- IV Pathogens In Wastewater **9**

Introduction to Water Borne pathogens and Parasites and their effects on Human, Animal and Plant health, Transmission of pathogens – Bacterial, Viral, Protozoan, and Helminthes, Indicator organisms of water – Coli forms - total coli forms, E- coli, Streptococcus, Clostridium, Concentration and detection of virus. Control of microorganisms; Microbiology of biological Treatment processes – aerobic and anaerobic, a-oxidation, β-oxidation, nitrification and gentrification, eutrophication. Nutrients Removal – BOD , Nitrogen, Phosphate. Microbiology of Sewage Sludge.

Unit - V Toxicology **9**

Eco toxicology – toxicants and toxicity, Factors influencing toxicity. Effects – acute, chronic, Test organisms – toxicity Testing, Bio-concentration – Bioaccumulation, biomagnifications, bioassay, bio-monitoring, bioleaching.

Total: 45 Periods

Reference Books:

1. Frank C. Lu and Sam Kacew, LU's" Basic Toxicology", Taylor & Francis, London 5thEdition ,2003
2. Hurst, C.J. Manual of "Environmental Microbiology". 3rd Edition. ASM PRESS, Washington, D.C. ISBN 1-55581 - 199 -X.2007
3. Grerard J. Tortora, Berdell R. Funke, Christine and L. Case. Microbiology: An Introduction.Benjamin Cummings, U.S.A.2004
4. Stanley E. Manahan, "Environmental Science and Technology", LewisPublishers.2000
5. Prescott, L.M., Harley, J.P. and Klein, D.A. Microbiology. McGraw Hill, Newyork2006.
6. SVS. Rana, "Essentials of Ecology and Environmental Science", 3rd revised Edition, Prentice Hall of India
   Private Limited,2007.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3									1	1		
CO2	3	3	3									1	1		
CO3	3	3	3									1	1		
CO4	3	3	3									1	1		
CO5	3	3	3									1	1		
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Final Examination (60)**
	IAE I (7.5)	**IAE 2 (7.5)**	**IAE 3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Passed in Board of studies meeting on 25.02.2022 *Approved in Academic Council meeting on 09.03.2022*

CHAIRMAN - BOARD OF STUDIES

22PEE105	Environmental Chemistry Laboratory	L	T	P	C
		0	0	4	2
Nature of Course	Foundation Course				
Pre requisites	NA				

Course Objectives

The course is intended

1. To understand on quality control aspects
2. To impart knowledge on sampling of water
3. To familiarize on analysis of water
4. To understand the waste water analysis
5. To gain knowledge on sampling and characteristics of soil

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1	Familiarize on quality control aspects	Apply
CO2	Develop skills on the determination of physical and chemical characteristics of water and wastewater	Understand
CO3	Carry out the various treatment techniques for pollutant removal	Apply
CO4	Gain knowledge on simplifying of soil	Understand
CO5	Acquire knowledge on characteristics of soil	Understand

S.No	List of Exercises	CO Mapping	RBT
1	Good Laboratory Practices, Quality control and calibration	CO1	Understand
2	Sampling and Analysis of water (pH, alkalinity, hardness, chloride, Sulphate , turbidity EC, TDS,TS, nitrate, fluoride)'	CO2	Understand
3	Wastewater analysis (BOD, COD, Phosphate, TKN, Oil & Grease, Surfactant and heavy metals).	CO2	Understand
4	Sampling and characterization of soil (CEC & SAR, pH and K).	CO4	Understand

Passed in Board of studies meeting on 25.02.2022 *Approved in Academic Council meeting on 09.03.2022*

CHAIRMAN - BOARD OF STUDIES

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1		3			3			2					3	1	
2		3			3			2					3	1	
3		3			3			2					3	1	
4		3			3			2					3	1	
5		3			3			2					3	1	
	3	High				2	Medium					1	Low		

Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [50 marks]**	**End Semester Examination [50 marks]**
Remember	30	30
Understand	70	70
Apply		
Analyze		
Evaluate		
Create		

Passed in Board of studies meeting on 25.02.2022 *Approved in Academic Council meeting on 09.03.2022*

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22EE106	Environmental Microbiology Laboratory	L	T	P	C
		0	0	4	2

Nature of Course	Foundation Course
Pre requisites	NA

Course Objectives

The course is intended

1. To impart knowledge on microbial contamination
2. To acquire knowledgeable on toxicity
3. To gain knowledge on microbes in the contaminated environment
4. To familiarize on assay of enzymes involved in biotransformation
5. To understand the on effect of pesticides on soil microorganisms

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Gain knowledge on microbial contamination of water, wastewater and solid waste	Apply
CO2	Become knowledgeable on toxicity	Apply
CO3	Observe and identify the microbes in the contaminated environment	Apply
CO4	Identify assay of enzymes involved in biotransformation	Apply
CO5	Gain knowledge on effect of pesticides on soil microorganisms.	Understand

S.No	List of Exercises	CO Mapping	RBT
1	Preparation of culture media,	3	Understand
2	Isolation, culturing and Identification of Microorganisms	3	Understand
3	Microorganisms from polluted habitats (soil, water and air)	3	Understand
4	Measurement of growth of microorganisms,	1	Understand
5	Assay of enzymes involved in biotransformation	2	Understand
6	Biodegradation of organic matter in waste water	1	Understand
7	Analysis of air borne microorganisms,	3	Understand
8	Staining of bacteria	3	Understand
9	Effect of pH, temperature on microbial growth	1	Understand
10	Pollutant removal using microbes from industrial effluent.	2	Understand
11	Effect of pesticides on soil microorganisms.	2	Understand

12	Bacteriological analysis of wastewater (Coliforms, *E.coli, Streptococcus*) – MPN	3	Understand
13	Bacteriological analysis of wastewater (Coliforms, *Streptococcus)* - MF techniques, Effect of Heavy metals on microbial growth.	3	Understand
14	Detection of Anaerobic bacteria (*Clostridium* sp.)	3	Understand
15	Bioreactors(cultivation of microorganisms)	1	Understand

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	Pos												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1		3			3			2					3	1	
2		3			3			2					3	1	
3		3			3			2					3	1	
4		3			3			2					3	1	
5		3			3			2					3	1	
	3	High				2	Medium					1	Low		

Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [50 marks]**	**End Semester Examination [50 marks]**
Remember	30	30
Understand	70	70
Apply		
Analyze		
Evaluate		
Create		

Passed in Board of studies meeting on 25.02.2022 *Approved in Academic Council meeting on 09.03.2022*

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22PEE204	Environmental Processes Monitoring Laboratory	L	T	P	C
		0	0	6	3
Nature of Course	Professional Core				
Pre requisites	Waste Water Engineering				

Course Objectives

The course is intended

1. To develop knowledge coagulation, flocculation , settling
2. To impart knowledge on filtration and softening
3. To gain knowledge about the saturation index
4. To familiarize about the interpret about sludge test
5. To gain knowledge about tge ambience level

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1	Understand about basics of coagulation, flocculation , settling	Understand
CO2	Analyse about filtration and softening	Apply
CO3	Understand about saturation index	Understand
CO4	Interpret about Sludge test	Understand
CO5	Analyse ambience level	Apply

Course Content

S.No	List of Experiments	CO MAPPING	RBT
1.	Coagulation and Flocculation	CO1	Understand
2.	Batch studies on settling	CO1	Understand
3.	Studies on Filtration-Characteristics of Filter media	CO2	Apply
4.	Water softening	CO2	Apply
5.	Adsorption studies/Kinetics	CO2	Apply
6.	Langelier Saturation Index and Silt Density Index-For Membrane Filtration	CO3	Understand
7.	Kinetics of suspended growth process(activated sludge process)-and Sludge volume Index	CO3	Understand
8.	Sludge Filterability Test	CO4	Understand
9.	Anaerobic Reactor systems/kinetics(Demonstration)	CO4	Understand
10.	Advanced Oxidation Processes-(Photo catalysis)	CO5	Apply
11.	Disinfection for Drinking water (Chlorination)	CO2	Apply
12.	Ambient Air Sampling-Determination of PM10, PM2.5, SO2and NO2	CO5	Apply
13.	Noise Monitoring-Determination of Equivalent Noise Level	CO5	Apply

Total: 45 Periods

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Reference Books:

1. AEESP Environmental Processes Laboratory Manual, Association of Environmental Engineering and Science Professors Foundation,Washington, 2002.
2. Aery N C., "Manual of Environmental Analysis", Ane Books Pvt. Ltd. New Delhi,2014
3. CPCB,Guidelines for the Measurement of Ambient Air Pollutants, Volume I, CentralPollution Control Board, Ministry of Environment and Forests, Government of India, 2001
4. Lee,C.C.andShundarLin."Handbook of Environmental Engineering Calculations", McGrawHill, NewYork,1999.
5. Metcalf & Eddy, Inc., G.Tchobanoglous, H.D.Stensel, R.Tsuchihashi and L.Burton. "Wastewater Engineering Treatment and Resource Recovery" 5th edition. McGraw Hill Company. 2014

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes(PSOs)														
COs	**Pos**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	3	2	2	1	2				2		3
CO2	2	3	3	3	3	2	1	2				2		3
CO3	3	3	2	2	2	2	1	2				3		3
CO4	3	3	2	3	3	2	1	2				2		3
CO5	3	3	2	3	3	2	1	2				2		3
	3	High				2	Medium					1	Low	

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [50 marks]**	**End Semester Examination [50 marks]**
Remember	30	30
Understand	70	70
Apply		
Analyze		
Evaluate		
Create		

Passed in Board of studies meeting on 25.02.2022 *Approved in Academic Council meeting on 09.03.2022*

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22PEE04	Environmental Policy and Legislation	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Principles of Professional Ethics				

Course Objectives

The course is intended

1. To impart knowledge on national environmental policies
2. To gain knowledge on national environmental legislations and the polices for water
3. To familiarize on national environmental legislations and the polices for air
4. To acquire knowledge on national environmental legislation and policies for environment
5. To become knowledgeable on national environmental legislation and the policies for other acts

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1	Gain Knowledge about the general National environmental legislations and the policies	Knowledge
CO2	Get Knowledge about the National environmental legislations and the policies for Water	Knowledge
CO3	Gain Knowledge about the National environmental legislations and the policies for Air	Knowledge
CO4	Get Knowledge about the National environmental legislations and the policies for Environment	Knowledge
CO5	Knowledge about the National environmental legislations and the policies for other topics	Knowledge

Course Contents:

Unit- I Introduction **9**

Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration – Environmental Protection Act, Water (P&CP) Act, Air (P&CP) Act – Institutional framework (SPCB/CPCB/MoEF)

Unit- II Water (P&Cp) Act, 1974 **8**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

Unit- III Air (P&Cp) Act, 1981 **8**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

Unit- IV Environment (Protection) Act 1986 **13**

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 – responsibilities of generators and role of Pollution Control Boards

Unit- V Other Topics **7**

Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

Total: 45 Periods

Reference Books:

1. Shyam Divan and Armin Roseneranz "Environmental law and policy in India "Oxford University Press, New Delhi,2001
2. GregerI.Megregor "Environmental law and enforcement", Lewis Publishers, London.1994
3. 1.CPCB "Pollution Control acts, Rules and Notifications issued there under "Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi,1997

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2			1			1					1	1	
CO2	3	2			2			1					1	2	
CO3	3	2			3			2					2	2	
CO4	3	2			3			2					2	2	
CO5	3	2			2			3					3	2	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Final Examination (60)**
	IAE 1 (7.5)	**IAE 2 (7.5)**	**IAE 3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PEE05	Environmental Quality Monitoring	L	T	P	C
		3	0	0	3
Nature of Course	Basic Environmental Engineering				
Pre requisites	Environmental Engineering				

Course Objectives

The course is intended

1. To impart knowledge on environmental chemistry
2. To familiarize on spectroscopic methods
3. To gain knowledge on chromatographic methods
4. To acquire knowledge on Electro and Radio Analytical Methods
5. To become knowledgeable on continuous monitoring instruments

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1	Understand the environmental chemistry	Understand
CO2	Apply the methods for spectroscopic analysis	Apply
CO3	Analyse the methods of chromatographic methods	Analyse
CO4	Gain knowledge on Electro and Radio Analytical Methods	Analyse
C05	Differentiate the Principles, techniques and applications of NDIR analyzer	Analyse

Course Contents:

Unit- I Introduction **9**

Wet Chemistry methods and their limitations-Instrumental Methods, Selection of method Precision and Accuracy, Error in measuring signals-Quality control & assurance Sample preservation, Sample preparation and analyte isolation.

Unit- II Spectroscopic Methods **12**

Principles, techniques and applications of spectrophotometry, fluorimetry, nephelometry and turbidimetry, Atomic Absorption Spectrometry (Flame, graphite furnace and hydride generation),Atomic Emission Spectrometry (AES) , flame and Inducted Coupled Plasma (ICP)-TOC Analyzer

Unit- III Chromatographic Methods **8**

Column, Paper and thin layer chromatography (TLC)-Principles, techniques and applications of GC, GC-MS, High performance liquid chromatography (HPLC) and Ion chromatograph (IC)-Hyphenated techniques for Environmental contaminant(trace organics) analysis.

Unit- IV Electro And Radio Analytical Methods **8**

Principles, techniques and applications of Conductometry, potentiometry, coulometry, AOX analyzer Amperometry, polarography, New Activation Analysis (NAA), X-ray Fluorescence (XRF)and X-ray Diffraction (XRD) methods.

Unit- V Continuous Monitoring Instruments **8**

Principles, techniques and applications of NDIR analyzer for CO, chemiluminescent analyzer for NOx Fluorescent analyzer for SO2 - Particulates analysis - Auto analyzer for water quality using flow injection analysis.

Total: 45 Periods

Passed in Board of studies meeting on 25.02.2022 *Approved in Academic Council meeting on 09.03.2022*

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Reference Books

1. Barceló, D.(editor), "Environmental analysis. Techniques, Applications and Quality Assurance", Elsevier, The Netherlands,1996
2. Ewing Instrumental Methods of Chemical Analysis, 5th Edition, McGraw Hill,NewYork.1985
3. Paul R. Loconto Trace Environmental Quantitative Analysis: Principles, Techniques, andApplications, Marcel Dekker; 1 edition (May2001),
4. Reeve, R.N., "Introduction to Environmental Analysis", Analytical Techniques in theSciences, John Wiley & Sons, Chichester, UK,2002.
5. Willard H. Merritt, L. Dean, D.A. and Settle, F.A. „Instrumental methods of analysis Edn.Words Worth, New York,2004.

MappingofCourseOutcomes(COs)withProgrammeOutcomes(POs)ProgrammeSpecific Outcomes(PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	
CO1	3	3	2			2	1					2		3	
CO2	2	3	2			2	2					2		2	
CO3	3	2	2			2	1					2		3	
CO4	3	3	2			2	1					2		3	
CO5	3	3	2			2	1					2		3	
	3	High				2	Medium				1	Low			

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Final Examination (60)**
	IAE 1 (7.5)	**IAE 2 (7.5)**	**IAE 3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PEE06	Climate Change and Adaptation	L	T	P	C
		3	0	0	3
Nature of Course	Basic Science				
Pre requisites	Environmental Science				

Course Objectives

The course is intended

1. To impart knowledge on types of climatic conditions
2. To gain knowledge on changes in climate
3. To familiarize on the impact of climatic changes
4. To acquire knowledge on climatic mitigation measurements
5. To become knowledgeable on clean technology

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Describe about types of climatic conditions	Understand
CO2	Understand about climate changes	Understand
CO3	Gain knowledge on the impact of Climatic Changes	Knowledge
CO4	Interpret the climatic mitigation measurements	Understand
CO5	Understand the Clean Technology	Understand

Course Contents:

Unit- I Earth's Climate System **9**

Introduction-Climate in the spot light-The Earth‟s Climate Machine-Climate Classification-Global Wind Systems- Trade Winds and the Hadley Cell-The Westerlies-Cloud Formation and Monsoon Rains-Storms and Hurricanes-The Hydrological Cycle – Global Ocean Circulation – ElNino and its Effect – Solar Radiation-The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.

Unit- II Observed Changes And Its Causes **9**

Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise –Observed effects of Climate Changes – Patterns of Large Scale Variability Drivers of Climate Change –Climate Sensitivity and Feedbacks – The Montreal Protocol UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India –climate change modeling.

Unit- III Impacts Of Climate Change **9**

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources –Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change –Risk of Irreversible Changes.

Unit- IV Climate Change Adaptation And Mitigation Measures **9**

Adaptation Strategy / Options in various sectors – Water – Agriculture – -Infrastructure and Settlement including coastal zones –Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry – Carbons equestration – Carbon capture and storage(CCS) – Waste (MSW & Bio waste, Bio medical, Industrial waste –International and Regional cooperation.

Unit- V Clean Technology And Energy **9**

Clean Development Mechanism – Carbon Trading – examples of future Clean Technology – Bio diesel –Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar

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Energy – Wind –Hydroelectric Power – Mitigation Efforts in India and Adaptation funding.

Total: 45 Periods

Reference Books

1. Alcore „in convenient truth " – videoform
2. Dash Sushil Kumar, "Climate Change –An Indian Perspective", Cambridge University Press India Pvt.Ltd, 20073.
3. IPCC Fourth Assessment Report –The AR4 SynthesisReport,
4. JanC.van Dam, Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press,2003

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes(PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3			2		1					2		3
CO2	3	3			3		1					2		3
CO3	3	3			3		1							
CO4	3	3			3		1					2		3
CO5	3	3			3		1					2		3
	3	High				2	Medium					1	Low	

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Final Examination (60)**
	IAE 1 (7.5)	**IAE 2 (7.5)**	**IAE 3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

22PEE07	Marine Pollution and Control	L	T	P	C
		3	0	0	3
Nature of Course	Pollution Control				
Pre requisites	Waste Water Engineering				

Course Objectives

The course is intended

1. To impart knowledge on the Marine and Coastal Environment
2. To gain knowledge on ocean hydro dynamics
3. To acquire knowledge on marine pollution sources and effects
4. To familiarize on methods of pollution monitoring
5. To become knowledgeable on coastal management

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1	Gain knowledge on the marine & Coastal environment	Understand
CO2	Attain knowledge on ocean hydrodynamics	Knowledge
CO3	Identify the pollution sources & effects	Understand
CO4	Interpret the methods for pollution monitoring	Apply
CO5	Evaluate the method for coastal management	Evaluate

Course Content

Unit - I Marine and coastal Environment **9**

Seas and oceans, Continental area, Coastal zone, Properties of sea water, Principles of Marine Geology, coastal features-Beaches, Estuaries, Lagoons-The oceans and climate

Unit- II Ocean Hydro Dynamics **9**

Wave Theory, Waves in shallow waters-Refraction, Diffraction and Shoaling, Approximations for deep and shallow water conditions-Tidal Classification-General circulation of ocean waters-Ocean currents-Coastal sediment transport-Onshore offshore sediment transport-Beach formation and coastal processes-Tsunamis, storm surge, El Niño effect.

Unit - III Marine Pollution Sources And Effects **9**

Sources of Marine Pollution-Point and non-point sources, Pollution caused by Oil Exploration, Dredging, Offshore Structures, Agriculture Impacts of pollution on water quality and coastal ecosystems-Marine discharges and effluent standards.

Unit- IV Marine Pollution Monitoring **9**

Basic measurements-Sounding boat, lead lines, echo sounders-current meters-tide gauge-use of GPS- Measurement of coastal water characteristics-sea bed sampling-Modeling of Pollutant transport and dispersion- Oil Spill Models-Ocean Monitoring satellites-Applications of Remote Sensing and GIS in monitoring marine pollution

Unit- V Coastal Management **9**

Pollution Control strategies-Selection of optimal Outfall locations-National and International Treaties, Coastal Zone Regulation-Total Maximum Daily Load applications-Protocols in Marine Pollution-ICZM and Sustainable Development

Total: 45 Periods

Reference Boos:

1. Laws, E.A., "Aquatic pollution", an introductory text. John Wiley and Sons, Inc., New York,2000.
2. 2."Marine Pollution R.B. Clark, C. Frid and M Atttrill, Oxford Science Publications,5thEdition, 2005.
3. 3.Marine pollution Dr.P. C.Sinha , Anmol Publications Pvt. Ltd, 1998.Marine Pollution: New Research-Tobias N. Hofer, Nova Publishers,2008
4. PracticalHandbookofEstuarineandMarinePollution,MichaelJ.Kennish,Volume10 CRCMarineScience, CRCPress,1996

MappingofCourseOutcomes(COs)withProgrammeOutcomes(POs)ProgrammeSpecificOutcomes(PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3			2	2		2				2		3
CO2		3						2						1
CO3	3	3			3	2						2		2
CO4	3				3	2		2				2		3
CO5	3	3			3	2		2				2		3
	3	High				2	Medium					1	Low	

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Final Examination (60)**
	IAE 1 (7.5)	**IAE 2 (7.5)**	**IAE 3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

SEMESTER VII
ELECTIVE – III

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CE8006	Pavement Engineering	PE	3	3	0	0	3
2.	CE8007	Traffic Engineering and Management	PE	3	3	0	0	3
3.	CE8008	Transport and Environment	PE	3	3	0	0	3
4.	CE8009	Industrial Structures	PE	3	3	0	0	3
5.	CE8010	Environmental and Social Impact Assessment	PE	3	3	0	0	3
6.	CE8011	Design of Prestressed Concrete Structures	PE	3	3	0	0	3
7.	CE8012	Construction Planning and Scheduling	PE	3	3	0	0	3
8.	EN8591	Municipal Solid Waste Management	PE	3	3	0	0	3
9.	GE8077	Total Quality Management	PE	3	3	0	0	3
10.	GE8072	Foundation Skills In Integrated Product Development	PE	3	3	0	0	3

SEMESTER VIII
ELECTIVE – IV

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CE8013	Coastal Engineering	PE	3	3	0	0	3
2.	CE8014	Participatory Water Resources Management	PE	3	3	0	0	3
3.	CE8015	Integrated Water Resources Management	PE	3	3	0	0	3
4.	CE8016	Groundwater Engineering	PE	3	3	0	0	3
5.	CE8017	Water Resources Systems Engineering	PE	3	3	0	0	3
6.	CE8018	Geo-Environmental Engineering	PE	3	3	0	0	3
7.	CE8091	Hydrology and Water Resources Engineering	PE	3	3	0	0	3
8.	GE8076	Professional Ethics in Engineering	PE	3	3	0	0	3

SEMESTER VIII
ELECTIVE – V

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CE8019	Computer Aided Design of Structures	PE	3	3	0	0	3
2.	CE8020	Maintenance, Repair and Rehabilitation of Structures	PE	3	3	0	0	3
3.	CE8021	Structural Dynamics and Earthquake Engineering	PE	3	3	0	0	3
4.	CE8022	Prefabricated Structures	PE	3	3	0	0	3
5.	CE8023	Bridge Engineering	PE	3	3	0	0	3
6.	GE8073	Fundamentals of Nano Science	PE	3	3	0	0	3

REFERENCES :

1. R.Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
2. Laurila, S.H. Electronic Surveying in Practice, John Wiley and Sons Inc, 1993.
3. Guocheng Xu, GPS Theory, Algorithms and Applications, Springer - Verlag, Berlin, 2003.
4. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 3rd Edition, 2004.
5. Seeber G, Satellite Geodesy, Walter De Gruyter, Berlin, 1998

GE8071 DISASTER MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS **9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster damage assessment and management.

TEXTBOOKS:

1. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13**:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES:

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

GE8074 HUMAN RIGHTS L T P C
3 0 0 3

OBJECTIVE:

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I **9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II **9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III **9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV **9**

Human Rights in India – Constitutional Provisions / Guarantees.

REFERENCES:

1. Tamil Nadu Town and Country Planning Act 1971, Government of Tamil Nadu, Chennai
2. Goel S.L., Urban Development and Management, Deep and Deep Publications, New Delhi, 2002
3. Thooyavan, K.R., Human Settlements – A Planning Guide to Beginners, M.A Publications, Chennai, 2005
4. CMDA, Second Master Plan for Chennai, Chennai 2008

CE8005 AIR POLLUTION AND CONTROL ENGINEERING

L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge on the principle and design of control of Indoor/ particulate/ gaseous air pollutant and its emerging trends.

UNIT I INTRODUCTION 7

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards –Ambient and stack sampling and Analysis of Particulate and Gaseous Pollutants.

UNIT II METEOROLOGY 6

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.

UNIT III CONTROL OF PARTICULATE CONTAMINANTS 11

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle, Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations.

UNIT IV CONTROL OF GASEOUS CONTAMINANTS 11

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations.

UNIT V INDOOR AIR QUALITY MANAGEMENT 10

Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness- Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

TOTAL: 45 PERIODS

OUTCOMES:

The students completing the course will have

- an understanding of the nature and characteristics of air pollutants, noise pollution and basic concepts of air quality management
- ability to identify, formulate and solve air and noise pollution problems
- ability to design stacks and particulate air pollution control devices to meet applicable standards.
- Ability to select control equipments.
- Ability to ensure quality, control and preventive measures.

OUTCOMES:
Upon completion of this course, students will be able to

- Know the requirements of various industries and get an idea about the materials used and planning of various industrial components
- Understand the functional requirements for industrial structures.
- Design special steel structures like bunkers, silos, crane girders, chimneys and pre-engineered buildings.
- Design special RC structures like corbels, silos, bunkers, chimneys, plates and shells.
- Understand the principles of prefabrication and prestressing

TEXTBOOKS:

1. Ramamrutham.S., Design of Reinforced Concrete Structures, Dhanpat Rai Publishing Company, 2007.
2. Varghese.P.C., Advanced Reinforced Concrete Design, PHI, Eastern Economy Editions, Second Edition, 2005.
3. Subramanian, N., Design of Steel Structures, Oxford University Press, 2008.
4. Ramachandra and Virendra Gehlot, Design of steel structures –Vol. 2, Scientific Publishers, 2012.

REFERENCES:

1. Henn W. Buildings for Industry, Vol.I and II, London Hill Books, 1995
2. Handbook on Functional Requirements of Industrial buildings, SP32–1986, Bureau of Indian Standards, 1990.
3. Handbook of Industrial Lighting, Stanley L.Lyons, Butterworths, London.1981
4. Koncz, J., Manual of Precast Construction Vol. I and II, Bauverlay GMBH, 1971.
5. Handbook on Precast Construction, An Indian Concrete Institute Publication, 2016

CE8010 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT L T P C
3 0 0 3

OBJECTIVE:

- To impart the knowledge and skills to identify, assess and mitigate the environmental and social impacts of developmental projects

UNIT I INTRODUCTION 9

Impacts of Development on Environment – Rio Principles of Sustainable Development-Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –EIA Notification and Legal Framework–Stakeholders and their Role in EIA–Selection & Registration Criteria for EIA Consultants

UNIT II ENVIRONMENTAL ASSESSMENT 9

Screening and Scoping in EIA – Drafting of Terms of Reference,Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna - Matrices – Networks – Checklist Methods - Mathematical models for Impact prediction – Analysis of alternatives

UNIT III ENVIRONMENTAL MANAGEMENT PLAN 9

Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna – Environmental Monitoring Plan – EIA Report Preparation – Review of EIA Reports – Public Hearing-Environmental Clearance Post Project Monitoring

UNIT II UNDERSTANDING FARMERS PARTICIPATION 10

Farmers participation –need and benefits – Comparisons of cost and benefit -Sustained system performance - Kinds of participation – Context of participation, factors in the environment – WUA - Constraints in organizing FA – Role of Community Organiser – Case Studies.

UNIT III ISSUES IN WATER MANAGEMENT 9

Multiple use of water – Issues in Inter-sectoral Water Allocation - domestic, irrigation, industrial sectors - modernization techniques – Rehabilitation – Command Area Development - Water delivery systems

UNIT IV PARTICIPATORY WATER CONSERVATION 10

Global Challenges -Social – Economic – Environmental - Solutions –Political - Water Marketing – Water Rights -Consumer education – Success Stories Case Studies

UNIT V PARTICIPATORY WATERSHED DEVELOPMENT 10

Concept and significance of watershed - Basic factors influencing watershed development –- Principles of watershed management - Definition of watershed management – Identification of problems - Watershed approach in Government programmes –- People's participation – Entry point activities - Evaluation of watershed management measures.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Gain knowledge on various processes involved in participatory water resource management.
- Understand famers participation in water resources management.
- Aware of the issues related to water conservation and watershed Development
- Get knowledge in participatory water conservation
- Understand concept, principle , approach of watershed management.

TEXTBOOKS:

1. Sivasubramaniyan, K. Water Management, SIMRES Publication, Chennai, 2011
2. Uphoff.N., Improving International Irrigation management with Farmer Participation – Getting the process Right – Studies in water Policy and management, No.11, Westview press, Boulder,CO, 1986.
3. Tideman, E.M., "Watershed Management", Omega Scientific Publishers, New Delhi, 1996.

REFERENCE:

1. Chambers Robert, Managing canal irrigation, Cambridge University Press, 1989

CE8015 INTEGRATED WATER RESOURCES MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To introduce the students to the interdisciplinary analysis of water and conceptual design of intervention strategies.
- To develop a knowledge-base on capacity building on IWRM.

UNIT I IWRM FRAMEWORK 9

Definition – Objectives – Principles - Evolution of IWRM - IWRM relevance in water resources management – Paradigm shift : Processes and prospective outcomes

UNIT II CONTEXTUALIZING IWRM 9

UN formulations - SDG goals - IWRM in Global, Regional and Local water partnership – Institutional transformation - Bureaucratic reforms - Inclusive development

UNIT III EMERGING ISSUES IN WATER MANAGEMENT 9

Emerging Issues -– Drinking water management in the context of climate change - IWRM and irrigation - Flood – Drought – Pollution – Linkages between water, health and poverty

UNIT IV IWRM AND WATER RESOURCES DEVELOPMENT IN INDIA 9

Rural Development - Ecological sustainability- -Watershed development and conservation - Ecosystem regeneration – Wastewater reuse - Sustainable livelihood - Food security

UNIT V ASPECTS OF INTEGRATED DEVELOPMENT 9

Capacity building - Conceptual framework of IWRM – Problems and policy issues - Solutions for effective integrated water management - Case studies

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Understand objectives, principles and evolution of integrated water resources management.
- Have an idea of contextualizing IWRM
- Gain knowledge in emerging issues in water management, flood, drought, pollution and poverty.
- Understand the water resources development in India and wastewater reuse.
- Gain knowledge on integrated development of water management.

TEXTBOOKS:

1. Mollinga P. *et al.* "Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006.
2. Sithamparanathan, Rangasamy, A., and Arunachalam, N., "Ecosystem Principles and Sustainable Agriculture", Scitech Publications (India) Pvt.Lt, Chennai, 1999.

REFERENCES:

1. Cech Thomas V., Principles of Water Resources: History, Development, Management and Policy. John Wiley and Sons Inc., New York. 2003.
2. Murthy, J.V.S., "Watershed Management in India", Wiley Eastern Ltd., New York, 1995.
3. Dalte, S.J.C., "Soil Conservation and Land Management", International Book Distribution, India, 1986.

CE8016 GROUNDWATER ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To introduce the student to the principles of Groundwater governing Equations and Characteristics of different aquifers,
- To understand the techniques of development and management of groundwater.

UNIT I HYDROGEOLOGICAL PARAMETERS 9

Introduction – Water bearing Properties of Rock – Type of aquifers - Aquifer properties – permeability, specific yield, transmissivity and storage coefficient – Methods of Estimation – GEC

norms - Steady state flow - Darcy's Law - Groundwater Velocity –- Dupuit Forchheimer assumption – Steady Radial Flow into a Well

UNIT II WELL HYDRAULICS 9

Unsteady state flow - Theis method - Jacob method – Chow's method – Law of Times – Theis Recovery – Bailer method – Slug method - tests - Image well theory – Partial penetrations of wells – Well losses – Specific Capacity and Safe yield - Collector well and Infiltration gallery

UNIT III GROUNDWATER MANAGEMENT 9

Need for Management Model – Database for Groundwater Management – Groundwater balance study – Introduction to Mathematical model – Model Conceptualization – Initial and Boundary Condition – Calibration – Validation – Future Prediction – Sensitivity Analysis – Uncertainty – Development of a model

UNIT IV GROUNDWATER QUALITY 9

Ground water chemistry - Origin, movement and quality - Water quality standards – Drinking water – Industrial water – Irrigation water - Ground water Pollution and legislation - Environmental Regulatory requirements

UNIT V GROUNDWATER CONSERVATION 9

Artificial recharge techniques – Reclaimed wastewater recharge – Soil aquifer treatment (SAT) – Aquifer Storage and Recovery (ASR)Seawater Intrusion and Remediation – Ground water Basin management and Conjunctive use – Protection zone delineation, Contamination source inventory and remediation schemes

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Understand aquifer properties and its dynamics
- Get an exposure towards well design and practical problems
- Develop a model for groundwater management.
- Students will be able to understand the importance of artificial recharge and groundwater quality concepts
- Gain knowledge on conservation of groundwater.

TEXTBOOKS:

1. Raghunath H.M., "Ground Water Hydrology", New Age International (P) Limited, New Delhi, 2010.
2. Todd D.K., "Ground Water Hydrology", John Wiley and Sons, New York, 2000.

REFERENCES:

1. Fitts R Charles, "Groundwater Science". Elsevier, Academic Press, 2002.
2. Ramakrishnan, S, Ground Water, K.J. Graph arts, Chennai, 1998.

CE8017 WATER RESOURCES SYSTEMS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To introduce the student to the concept of Mathematical approaches for managing the water resources system.
- To make the students apply an appropriate system approach to optimally operate a water resource system.

UNIT I SYSTEM APPROACH 9

Definition, classification, and characteristics of systems - Philosophy of modelling – Goals and Objectives – Basics of system analysis concept – steps in systems engineering.

UNIT II LINEAR PROGRAMMING 9

Introduction to Operation research - Linear programming Problem Formulation-graphical solution-Simplex method –Sensitivity analysis - application to operation of single purpose reservoir

UNIT III DYNAMIC PROGRAMMING 9

Bellman's optimality criteria, problem formulation and solutions – Water Allocation for three state (user), Forward and Backward Recursion techniques in Dynamic Programming - Shortest pipe line route problem - Application to reservoirs capacity expansion

UNIT IV SIMULATION 9

Basic principles and concepts – Monte Carlo techniques – Model development – Inputs and outputs – Single and multipurpose reservoir simulation models – Deterministic simulation – Rule Curve development for reservoir

UNIT V ADVANCED OPTIMIZATION TECHNIQUES 9

Integer and parametric linear programming – Goal programming types – Applications to reservoir release optimization – application of evolutionary algorithms like Genetic algorithm, Particle swarm, Simulated Annealing to reservoir release optimization

TOTAL: 45 PERIODS

OUTCOMES:

The students will be

- Eexposed to the economic aspects and analysis of water resources systems by which they will get an idea of comprehensive and integrated planning of a water resources project.
- Understanding the concept of linear programming and apply in water resource system.
- Understanding the concept of dynamic programming and apply in water resource system.
- Develops simulation models.
- Ddeveloping skills in solving problems in operations research through LP, DP and Simulation techniques.

TEXTBOOK:

1. Vedula, S., and Majumdar, P.P. "Water Resources Systems" – Modeling Techniques and Analysis Tata McGraw Hill, 5th reprint, New Delhi, 2010.

REFERENCES:

1. Hall Warren, A. and John A. Dracup., "Water Resources System Engineering", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1998
2. Chadurvedi M.C., "Water resource Systems Planning and Management", Tata McGraw Hill inc., New Delhi,1997
3. Taha H.A., "Operation Research", McMillan Publication Co., New York, 1995.
4. Maass A., Husfchimidt M.M., ,Dorfman R., ThomasH A., Marglin S.A and Fair G. M., "Design of Water Resources System", Hardward University Press, Cambridge, Mass.,1995.
5. Goodman Aluvin S., "Principles of Water Resources Planning", Prentice Hall of India, 1984

CE8018 GEO-ENVIRONMENTAL ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- The student acquires the knowledge on the Geotechnical engineering problems associated with soil contamination, safe disposal of waste and remediate the contaminated soils by different techniques thereby protecting environment.

UNIT I GENERATION OF WASTES AND CONSQUENCES OF SOIL POLLUTION 8

Introduction to Geo environmental engineering – Environmental cycle – Sources, production and classification of waste – Causes of soil pollution – Factors governing soil pollution interaction clay minerals - Failures of foundation due to waste movement.

UNIT II SITE SELECTION AND SAFE DISPOSAL OF WASTE 10

Safe disposal of waste – Site selection for landfills – Characterization of land fill sites and waste – Risk assessment – Stability of landfills – Current practice of waste disposal – Monitoring facilities – Passive containment system – Application of geosynthetics in solid waste management – Rigid or flexible liners.

UNIT III TRANSPORT OF CONTAMINANTS 8

Contaminant transport in sub surface – Advection, Diffusion, Dispersion – Governing equations – Contaminant transformation – Sorption – Biodegradation – Ion exchange – Precipitation – Hydrological consideration in land fill design – Ground water pollution.

UNIT IV WASTE STABILIZATION 10

Stabilization - Solidification of wastes – Micro and macro encapsulation – Absorption, Adsorption, Precipitation – Detoxification – Mechanism of stabilization – Organic and inorganic stabilization – Utilization of solid waste for soil improvement – case studies.

UNIT V REMEDIATION OF CONTAMINATED SOILS 9

Exsitu and Insitu remediation-Solidification, bio-remediation, incineration, soil washing, phyto remediation, soil heating, vetrification, bio-venting.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Assess the contamination in the soil
- Understand the current practice of waste disposal
- To prepare the suitable disposal system for particular waste.
- Stabilize the waste and utilization of solid waste for soil improvement.
- Select suitable remediation methods based on contamination.

TEXTBOOKS:

1. Hari D. Sharma and Krishna R. Reddy, “Geo-Environmental Engineering” –John Wiley and Sons, INC, USA, 2004.
2. Daniel B.E., “Geotechnical Practice for waste disposal”, Chapman & Hall, London 1993.
3. Manoj Datta,” Waste Disposal in Engineered landfills”, Narosa Publishing House, 1997.
4. Manoj Datta, B.P. Parida, B.K. Guha, “Industrial Solid Waste Management and Landfilling Practice”, Narosa Publishing House, 1999.

REFERENCES:

1. Westlake, K, “Landfill Waste pollution and Control”, Albion Publishing Ltd., England, 1995.
2. Wentz, C.A., “Hazardous Waste Management”, McGraw Hill, Singapore, 1989

3. Proceedings of the International symposium on “Environmental Geotechnology” (Vol.I and II). Environmental Publishing Company, 1986 and 1989.
4. Ott, W.R., “Environmental indices, Theory and Practice”, Ann Arbor, 1978.
5. Fried, J.J., “Ground Water Pollution”, Elsevier, 1975.
6. ASTM Special Tech. Publication 874, Hydraulic Barrier in Soil and Rock, 1985.
7. Lagrega, M.D., Buckinham, P.L. and Evans, J.C., “Hazardous Waste Management” McGraw Hill Inc. Singapore, 1994.

CE8091 HYDROLOGY AND WATER RESOURCES ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To introduce the student to the concept of hydrological aspects of water availability and requirements and should be able to quantify, control and regulate the water resources.

UNIT I PRECIPITATION AND ABSTRACTIONS 10

Hydrological cycle- Meteorological measurements – Requirements, types and forms of precipitation - Rain gauges-Spatial analysis of rainfall data using Thiessen and Isohyetal methods-Interception - Evaporation. Horton‟s equation, pan evaporation measurements and evaporation suppression - Infiltration-Horton‟s equation - double ring infiltrometer, infiltration indices.

UNIT II RUNOFF 8

Watershed, catchment and basin - Catchment characteristics - factors affecting runoff - Run off estimation using empirical - Strange‟s table and SCS methods – Stage discharge relationships-flow measurements- Hydrograph – Unit Hydrograph – IUH

UNIT III FLOOD AND DROUGHT 9

Natural Disasters-Flood Estimation- Frequency analysis- Flood control- Definitions of droughts-Meteorological, hydrological and agricultural droughts- IMD method-NDVI analysis- Drought Prone Area Programme (DPAP)

UNIT IV RESERVOIRS 8

Classification of reservoirs, General principles of design, site selection, spillways, elevation – area - capacity - storage estimation, sedimentation - life of reservoirs – rule curve

UNIT V GROUNDWATER AND MANAGEMENT 10

Origin- Classification and types - properties of aquifers- governing equations – steady and unsteady flow - artificial recharge - RWH in rural and urban areas

TOTAL: 45 PERIODS

OUTCOMES:

The students completing the course will have

- an understanding of the key drivers on water resources, hydrological processes and their integrated behaviour in catchments,
- ability to construct and apply a range of hydrological models to surface water and groundwater problems including Hydrograph, Flood/Drought management, artificial recharge
- ability to conduct Spatial analysis of rainfall data and design water storage reservoirs
- Understand the concept and methods of ground water management.

TEXTBOOKS:

1. Subramanya .K. "Engineering Hydrology"- Tata McGraw Hill, 2010
2. Jayarami Reddy .P. "Hydrology", Tata McGraw Hill, 2008.

3. Linsley, R.K. and Franzini, J.B. "Water Resources Engineering", McGraw Hill International Book Company, 1995.

REFERENCES:

1. David Keith Todd. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007
2. Ven Te Chow, Maidment, D.R. and Mays, L.W. "Applied Hydrology", McGraw Hill International Book Company, 1998.
3. Raghunath .H.M., "Hydrology", Wiley Eastern Ltd., 1998.

GE8076 PROFESSIONAL ETHICS IN ENGINEERING LT P C
3 0 0 3

OBJECTIVE:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 10

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES 8

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

OUTCOME:

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

20MA202	Mathematics - II for Building Sciences	BS	3	2	0	4	40	60	100
20ME201	Engineering Mechanics	ES	3	2	0	4	40	60	100
Theory with Practical Course (s)									
20ENEXX	Language Elective - II*	HSS	2	0	2	3	50	50	100
20PH202	Physics for Building Sciences	BS	3	0	2	4	50	50	100
20CS201	Problem Solving using Python	ES	3	0	2	4	50	50	100
Practical Course (s)									
20CE201	Computer Aided Building Drawing Laboratory	PC	0	0	4	2	50	50	100
Mandatory Course (s)									
20MC201	Environmental Sciences	MC	2	0	0	0	100	0	100
		Total	**16**	**4**	**10**	**21**	**380**	**320**	**700**
***Language Electives - II**									
20ENE02	Advanced Communicative English	HSS	2	0	2	3	50	50	100
20ENE03	Hindi	HSS	2	0	2	3	50	50	100
20ENE04	French	HSS	2	0	2	3	50	50	100
20ENE05	German	HSS	2	0	2	3	50	50	100

SEMESTER III									
Sub Code	**Course**	**Category**	**Periods/Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Course (s)									
20MA301	Transforms and Boundary Value Problems	BS	3	2	0	4	40	60	100
20CE301	Mechanics of Solids I	ES	3	2	0	4	40	60	100
20CE302	Fluid Mechanics	ES	3	0	0	3	40	60	100
20CE303	Engineering Geology	PC	3	0	0	3	40	60	100
Theory with Practical Course (s)									
20CE304	Surveying I	PC	3	0	2	4	50	50	100
20CE305	Construction Materials	PC	3	0	2	4	50	50	100
Mandatory Course (s)									

20YYOXX	Open Elective-I	OE	3	0	0	3	40	60	100
Theory with Practical Course (s)									
20CE503	Environmental Engineering I	PC	3	0	2	4	50	50	100
20CE504	Geotechnical Engineering II	PC	3	0	2	4	50	50	100
Practical Course (s)									
20CE505	Survey Camp	PC	1 Week			1	100	0	100
		Total	**18**	**2**	**4**	**22**	**360**	**340**	**700**

SEMESTER VI									
Sub Code	**Course**	**Category**	**Periods/Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
Theory Course (s)									
20CE601	Design of Steel Structural Elements	PC	3	2	0	4	40	60	100
20CE602	Structural Analysis II	PC	3	0	0	3	40	60	100
20CE603	Environmental Engineering II	PC	3	0	0	3	40	60	100
20CEEXX	Professional Elective-II	PE	3	0	0	3	40	60	100
20YYOXX	Open Elective-II	OE	3	0	0	3	40	60	100
Theory with Practical Course (s)									
20CE604	Highway Engineering	PC	3	0	2	4	50	50	100
Employment Enhancement Course (s)									
20CE605	Mini Project	EEC	0	0	2	1	50	50	100
20CE606	Internship	EEC	2 weeks			1	100	0	100
		Total	**18**	**2**	**4**	**22**	**400**	**400**	**800**

CHAIRMAN - BOARD OF STUDIES

CHAIRMAN - BOARD OF STUDIES

PROFESSIONAL ELECTIVES (PE)									
STREAM-I : ENVIRONMENTAL AND WATER RESOURCE ENGINEERING									
Sub Code	**Course**	**Category**	**Periods/Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
20CEE01	Hydrology	PE	3	0	0	3	40	60	100
20CEE02	Ground Water Engineering	PE	3	0	0	3	40	60	100
20CEE03	Air Pollution and Control Engineering	PE	3	0	0	3	40	60	100
20CEE04	Water Resources Systems Analysis	PE	3	0	0	3	40	60	100
20CEE05	Integrated Water Resources Management	PE	3	0	0	3	40	60	100
20CEE06	Hospital Waste Management	PE	3	0	0	3	40	60	100
20CEE07	Municipal Solid Waste Management	PE	3	0	0	3	40	60	100
20CEE08	Participatory Water Resources Management	PE	3	0	0	3	40	60	100
20CEE09	Air Pollution Management	PE	3	0	0	3	40	60	100
20CEE10	Industrial Waste Management	PE	3	0	0	3	40	60	100
20CEE11	Environmental and Social Impact Assessment	PE	3	0	0	3	40	60	100
20CEE12	Geo- Environmental Engineering	PE	3	0	0	3	40	60	100

STREAM-II : STRUCTURAL ENGINEERING									
Sub Code	**Course**	**Category**	**Periods/Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
20CEE21	Building Services	PE	3	0	0	3	40	60	100
20CEE22	Disaster Management	PE	3	0	0	3	40	60	100
20CEE23	Industrial Structures	PE	3	0	0	3	40	60	100
20CEE24	Maintenance, Repair and Rehabilitation of Structures	PE	3	0	0	3	40	60	100
20CEE25	Design of Prestressed Concrete Structures	PE	3	0	0	3	40	60	100
20CEE26	Experimental Analysis of Stress	PE	3	0	0	3	40	60	100
20CEE27	Bridge Structures	PE	3	0	0	3	40	60	100

20CEE52	Project Safety Management	PE	3	0	0	3	40	60	100
20CEE53	Railway, Airport, Docks and Harbor Engineering	PE	3	0	0	3	40	60	100

OPEN ELECTIVE COURSES (For Other Branches)									
Sub Code	**Course**	**Category**	**Periods/Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
20CEO01	Energy Conservation and Management	OE	3	0	0	3	40	60	100
20CEO02	Environment and Agriculture	OE	3	0	0	3	40	60	100
20CEO03	Renewable Energy Sources	OE	3	0	0	3	40	60	100
20CEO04	Vibration and Noise Control	OE	3	0	0	3	40	60	100
20CEO05	Climate Change and its Impacts	OE	3	0	0	3	40	60	100
20CEO06	Green Building Design	OE	3	0	0	3	40	60	100
20CEO07	Selection of Materials	OE	3	0	0	3	40	60	100
20CEO08	Testing of Materials	OE	3	0	0	3	40	60	100

ONE CREDIT COURSES									
Sub Code	**Course**	**Category**	**Periods/Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
20CEA01	Drafting and Documentation of Construction Projects	PC	1	0	0	1	100	0	100
20CEA02	3D Modeling Techniques of BIM	PC	1	0	0	1	100	0	100
20CEA03	3DModelling of Buildings	PC	1	0	0	1	100	0	100
20CEA04	Total Station Survey	PC	1	0	0	1	100	0	100
20CEA05	Tekla	PC	1	0	0	1	100	0	100
20CEA06	Vasthu	PC	1	0	0	1	100	0	100
20CEA07	Pre-Engineered Building	PC	1	0	0	1	100	0	100

20MC201	**Environmental Science** (Common to Agriculture, Food Technology, Aero, Civil, Mechanical and Fire and Safety Engineering)	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**
Nature of Course	Mandatory				
Prerequisites	Nil				

Course Objectives

The course is intended to

1. Understand the concept of eco system and environment.
2. Become conversant with ecological balance and values of bio diversity.
3. Know the role of human in prevention of pollution and making a clean environment.
4. Get knowledge about conservation of non conventional energy resources.
5. Study about the nature and management of e-waste and solid waste.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Describe the ecosystem and environment	Understand
CO2	Understand the ecological balance and preservation of bio diversity	Understand
CO3	Demonstrate various types of pollution in order tocontrol pollution	Apply
CO4	Classify the energy sources for the conservation of non conventional energy sources	Understand
CO5	Identify the nature and management of e-waste and solid waste	Apply

Course Contents

Unit-I Ecosystem **6**

Eco system-Food chains, Food webs and Ecological pyramids. Ecosystem-(a) Forest eco system,(b) Aquatic eco system(pond ecosystem and marine ecosystem).

Unit-II Biodiversity **6**

Introduction to Bio diversity, Values of Bio diversity**,** Threads to Bio diversity**,** Endangered and Endemic species of India, Hotspots of biodiversity. Conservation of Bio diversity: In-Situ and Ex-Situ conservation of bio diversity.

Unit-III Environmental Pollution **6**

Definition Causes, Effects and Control of (a) Air pollution (b) Water pollution (c) Soil pollution. Electrostatic Precipitator for controlling air pollution.

Unit-IV Non Conventional Energy Resources **6**

Introduction, Types: Solar Energy, Wind Energy and Geo Thermal Energy.

Unit-V Environmental Management **6**

Sustainable Development, Role of Information technology in Environment and Human.HIV and AIDS: causes and control measures. Green chemistry: Definition and Principles

Activity Component

S.No	Name of the Experiment	CO Mapping	RBT
1	Field study of simple eco system: pond, river and hill slopes	CO1	Understand
2	Case study regarding environmental management	CO5	Apply

Total: 30 periods

Textbooks

1. AnubhaKaushik and C.P. Kaushik, “Environmental Science and Engineering, New Age International Publishers, New Delhi, 2nd Edition, 2015.
2. V. Kumar, “An Introduction to Green Chemistry” Vishal publishing Co. Reprint Edition,2010.

Reference Books

1. Masters, Gilbert M, “Introduction to Environmental Engineering and Science”, Pearson Education, New Delhi, 2nd Edition, 2012.
2. Santosh Kumar Garg andRajeshwariGarg“Ecological and Environmental Studies”,Khanna Publishers, NaiSarak, Delhi, 2nd Edition, 2014.

Additional Resources

1. https://nptel.ac.in/courses/122103039/38
2. https://bch.cbd.int/cms/ui/collaboration/download/download.aspx?id=909
3. https://nptel.ac.in/courses/105102089/air%20pollution%20(Civil)/Module-3/3a.htm
4. www.vssut.ac.in/lecture_notes/lecture1428910296.pdf
5. nptel.ac.in/courses/120108004/module7/lecture8.pdf

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1							3					3			
CO2							3					3			
CO3							3					3			
CO4							3					3			
CO5							3					3			
	3	High					2	Medium				1	Low		

Bloom’s Level	**Continuous Assessment**				
	IAE1 [20]	**IAE 2 [20]**	**IAE 3 [20]**	**Attendance [10]**	**Activity [30]**
Remember	30	20	20		
Understand	10	20	20		
Apply	10	10	10		
Analyze					
Evaluate					
Create					

EXCEL ENGINEERING COLLEGE
(Autonomous)
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KOMARAPALAYAM - 637303

DEPARTMENT OF CIVIL ENGINEERING
M.E ENVIRONMENTAL ENGINEERING
REGULATION -2020
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULUM

SEMESTER I									
Code No.	Course	Category	Periods /Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course (s)									
20PMA102	Statistical Methods for Engineers	FC	3	2	0	4	40	60	100
20PEE101	Environmental Chemistry	FC	3	0	0	3	40	60	100
20PEE102	Environmental Microbiology	FC	3	0	0	3	40	60	100
20PEE103	Design of Physico- Chemical Treatment Systems	PC	3	0	0	3	40	60	100
20PEE104	Transport of Water and Wastewater	PC	3	0	0	3	40	60	100
Practical Course (s)									
20PEE105	Environmental Chemistry Laboratory	FC	0	0	4	2	50	50	100
20PEE106	Environmental Microbiology Laboratory	FC	0	0	4	2	50	50	100
Total			**15**	**2**	**8**	**20**	**300**	**400**	**700**

SEMESTER II									
Code No.	Course	Category	Periods /Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course (s)									
20PEE201	Design of Biological Treatment systems	PC	3	0	0	3	40	60	100
20PEE202	Industrial Wastewater Management	PC	3	0	0	3	40	60	100
20PEE203	Air and Noise Pollution Control Engineering	PC	3	0	0	3	40	60	100
20PEEEXX	Professional Elective I	PE	3	0	0	3	40	60	100
20PEEEXX	Professional Elective II	PE	3	0	0	3	40	60	100
20PEEEXX	Professional Elective III	PE	3	0	0	3	40	60	100
Practical Course (s)									
20PEE204	Environmental Process Monitoring Laboratory	PC	0	0	6	3	50	50	100
Employability Enhancement Course EEC									
20PEE205	Seminar	EEC	0	0	2	1	100	0	100
Total			**18**	**0**	**8**	**22**	**340**	**460**	**800**

Passed by the board of Studies

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PROFESSIONAL ELECTIVES I ,II& III									
SEMESTER II									
Sub code	**Course**	**Category**	**Periods /Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
20PEEE01	Ecological Engineering	PE	3	0	0	3	40	60	100
20PEEE02	Solid and Hazardous Waste Management	PE	3	0	0	3	40	60	100
20PEEE03	Operation and Maintenance of Treatment Systems	PE	3	0	0	3	40	60	100
20PEEE04	Environmental Policy and Legislation	PE	3	0	0	3	40	60	100
20PEEE05	Environmental Quality Monitoring	PE	3	0	0	3	40	60	100
20PEEE06	Climate change and adaptation	PE	3	0	0	3	40	60	100
20PEEE07	Marine Pollution and Control	PE	3	0	0	3	40	60	100

PROFESSSIONAL ELECTIVES IV & V									
SEMESTER III									
Sub code	**Course**	**Category**	**Periods /Week**			**C**	**Maximum Marks**		
			L	**T**	**P**		**CA**	**FE**	**Total**
20PEEE11	Air and Water Quality Modeling	PE	3	0	0	3	40	60	100
20PEEE12	Membrane Separation for Water and Wastewater Treatment	PE	3	0	0	3	40	60	100
20PEEE13	Computing Techniques in Environmental Engineering	PE	3	0	0	3	40	60	100
20PEEE14	Landfill Engineering and Remediation Technology	PE	3	0	0	3	40	60	100
20PEEE15	Environmental Risk Assessment	PE	3	0	0	3	40	60	100
20PEEE16	Remote Sensing and GIS Applications in Environmental Management	PE	3	0	0	3	40	60	100
20PEEE17	Environmental Impact Assessment	PE	3	0	0	3	40	60	100

20PEE101	Environmental Chemistry	L	T	P	C
		3	0	0	3

Nature of Course	Foundation Course
Pre requisites	NIL

Course Objectives

The course is intended

1. To educate the students in the area of water, air and soil chemistry
2. To impart knowledge on the transformation of chemicals in the environment
3. To gain knowledge on atmospheric chemistry
4. To understand the nature and composition of soil
5. To acquire knowledge on environmental chemicals

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	To understand the essential theoretical background of the principles of chemistry applied to the solutions of environmental problems.	Understand
CO2	To apply the principles of chemistry in solving water and wastewater treatment problems.	Apply
CO3	To analyses the chemistry related issues in water and wastewater treatment.	Analyse
CO4	To evaluate the characteristics of raw water, treated water, products of biodegradation of wastewaters and the performance of different units of water and wastewater treatment.	Apply
CO5	To impart knowledge on the transformation of chemicals in the environment	Apply

Course Contents:

Unit- I Introduction **9**

Stoichiometry and mass balance-Chemical equilibrium, acid base, solubility product (Ksp) ,heavy metal Precipitation, hydroxides, CO2 solubility in water and species Distribution – Chemical kinetics , First order- 12 Principles of green chemistry**.**

Unit- II Aquatic Chemistry **9**

Water quality parameters- environmental significance and determination; Fate of chemicals in aquatic environment, volatilization, partitioning, hydrolysis, photochemical transformation- Degradation of synthetic chemicals-Metals, complex formation, oxidation and reduction , pE – pH diagrams, redox zones – sorption- Colloids, electrical properties, double layer theory, environmental significance of colloids, coagulation ..

Unit- III Atmospheric Chemistry **9**

Atmospheric structure –-chemical and photochemical reactions – photochemical smog. Ozone layer depletion- greenhouse gases and global warming, CO2 capture and sequestration – Acid rain- origin and composition of particulates Air quality parameters-effects and determination

Unit - IV Soil Chemistry **9**

Nature and composition of soil-Clays- cation exchange capacity-acid base and ion exchange reactions in soil -Agricultural chemicals in soil-Reclamation of contaminated land; salt by leaching-Heavy metals by electro kinetic remediation**.**

Unit- V Environmental Chemicals **9**

Heavy metals-Chemical speciation -Speciation of Hg &As- Organic chemicals- Pesticides, Dioxins, PCBs,PAHs and endocrine disruptors and their Toxicity- Nano materials, CNT, titania, composites ,environmental applications**.**

Total: 45 Periods

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Reference Books:

1. Colin Baird„ Environmental Chemistry", Freeman and company, New York, 5th Edition,2012..
2. Sawyer, C.N., Mac Carty, P.L. and Parkin, G.F., "Chemistry for Environmental Engineering and Science", Tata McGraw – Hill, , New Delhi 5th Edition 2003**.**
3. Manahan, S.E., "Environmental Chemistry", , CRC press,9th Edition 2009.

Additional References:

1. Ronald A. Hites ,"Elements of Environmental Chemistry",Wiley, 2nd Edition,2012.
2. Web basedsources

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3									1	1		
CO2	3	3	3									1	1		
CO3	3	3	3									1	1		
CO4	3	3	3									1	1		
CO5	3	3	3									1	1		
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Final Examination (60)**
	IAE 1 (7.5)	**IAE2 (7.5)**	**IAE 3 (10)**	
Remember	0	0	0	0
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	10	10	10	20
Evaluate	0	0	0	0
Create	0	0	0	0

20PEE102	Environmental Microbiology	L	T	P	C
		3	0	0	3

Nature of Course	Foundation Course
Pre requisites	NIL

Course Objectives

The course is intended

1. To provide a basic understanding on microbiology relevant to environment
2. To outline the morphology, behavior and biochemistry of bacteria, fungi, protozoa, viruses, and algae
3. To provide The microbiology of wastewater, sewage sludge and solid waste treatment processes
4. To gain the knowledge on the pathogens in waste water
5. To provide an exposure to toxicology due to industrial products are also covered

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Have the basic understanding on the basics of microbiology and their diversity and on the genetic material in the living cell.	Understand
CO2	Understand and describe the type of microorganisms in the environment and the role of microorganisms in the cycling of nutrients in an ecosystem.	Understand
CO3	Understand the role microbial metabolism in a wastewater treatment plant.	Understand
CO4	Know the role of microorganisms in a contaminated water and the diseases caused.	Apply
CO5	Conduct and test the toxicity due to various natural and synthetic products in the environment	Apply

Course Contents:

Unit- I Classification And Characteristics **9**

Classification of microorganisms – prokaryotic, eukaryotic, cell structure, characteristics, Preservation of microorganisms, DNA, RNA, replication, Recombinant DNA technology.

Unit- II Microbes And Nutrient Cycles **9**

Distribution of microorganisms - Distribution / diversity of Microorganisms - fresh and marine, terrestrial- microbes in surface soil, Air - outdoor and Indoor, aerosols, bio safety in Laboratory - Extreme Environment - archae bacteria - Significance in water supplies - problems and control. Transmissible diseases. Biogeochemical cycles-----Hydrological - Nitrogen, Carbon, Phosphorus, Sulphur, Cycle – Role of Microorganism in nutrient cycle.

Unit- III Metabolism Of Microorganisms **9**

Nutrition and metabolism in microorganisms, growth phases, carbohydrate, protein, lipid metabolism – respiration, aerobic and anaerobic-fermentation, glycolysis, Kreb's cycle, hexose monophosphate pathway, electron transport system, oxidative phosphorylation, environmental factors, enzymes, Bioenergetics

Unit- IV Pathogens In Wastewater **9**

Introduction to Water Borne pathogens and Parasites and their effects on Human, Animal and Plant health, Transmission of pathogens – Bacterial, Viral, Protozoan, and Helminthes, Indicator organisms of water – Coli forms - total coli forms, E- coli, Streptococcus, Clostridium, Concentration and detection of virus. Control of microorganisms; Microbiology of biological Treatment processes – aerobic and anaerobic, a-oxidation, β-oxidation, nitrification and gentrification, eutrophication. Nutrients Removal – BOD , Nitrogen, Phosphate. Microbiology of Sewage Sludge.

Unit - V Toxicology **9**

Eco toxicology – toxicants and toxicity, Factors influencing toxicity. Effects – acute, chronic, Test organisms – toxicity Testing, Bio-concentration – Bioaccumulation, biomagnifications, bioassay, bio-monitoring, bioleaching.

Total: 45 Periods

Reference Books:

1. Frank C. Lu and Sam Kacew, LU's" Basic Toxicology", Taylor & Francis, London 5thEdition ,2003
2. Hurst, C.J. Manual of "Environmental Microbiology". 3rd Edition. ASM PRESS, Washington, D.C. ISBN 1-55581 - 199 -X.2007
3. Grerard J. Tortora, Berdell R. Funke, Christine and L. Case. Microbiology: An Introduction.Benjamin Cummings, U.S.A.2004
4. Stanley E. Manahan, "Environmental Science and Technology", LewisPublishers.2000
5. Prescott, L.M., Harley, J.P. and Klein, D.A. Microbiology. McGraw Hill, Newyork2006.
6. SVS. Rana, "Essentials of Ecology and Environmental Science", 3rd revised Edition, Prentice Hall of India
   Private Limited,2007.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3									1	1		
CO2	3	3	3									1	1		
CO3	3	3	3									1	1		
CO4	3	3	3									1	1		
CO5	3	3	3									1	1		
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Final Examination (60)**
	IAE I (7.5)	**IAE 2 (7.5)**	**IAE 3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

20PEE105	Environmental Chemistry Laboratory	L	T	P	C
		0	0	4	2
Nature of Course	Foundation Course				
Pre requisites	NA				

Course Objectives

The course is intended

1. To understand on quality control aspects
2. To impart knowledge on sampling of water
3. To familiarize on analysis of water
4. To understand the waste water analysis
5. To gain knowledge on sampling and characteristics of soil

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1	Familiarize on quality control aspects	Apply
CO2	Develop skills on the determination of physical and chemical characteristics of water and wastewater	Understand
CO3	Carry out the various treatment techniques for pollutant removal	Apply
CO4	Gain knowledge on simplifying of soil	Understand
CO5	Acquire knowledge on characteristics of soil	Understand

S.No	List of Exercises	CO Mapping	RBT
1	Good Laboratory Practices, Quality control and calibration	CO1	Understand
2	Sampling and Analysis of water (pH, alkalinity, hardness, chloride, Sulphate , turbidity EC, TDS,TS, nitrate, fluoride)'	CO2	Understand
3	Wastewater analysis (BOD, COD, Phosphate, TKN, Oil & Grease, Surfactant and heavy metals).	CO2	Understand
4	Sampling and characterization of soil (CEC & SAR, pH and K).	CO4	Understand

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1		3			3			2					3	1	
2		3			3			2					3	1	
3		3			3			2					3	1	
4		3			3			2					3	1	
5		3			3			2					3	1	
	3	High				2	Medium					1	Low		

Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [50 marks]**	**End Semester Examination [50 marks]**
Remember	30	30
Understand	70	70
Apply		
Analyze		
Evaluate		
Create		

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20EE106	Environmental Microbiology Laboratory	L	T	P	C
		0	0	4	2

Nature of Course	Foundation Course
Pre requisites	NA

Course Objectives

The course is intended

1. To impart knowledge on microbial contamination
2. To acquire knowledgeable on toxicity
3. To gain knowledge on microbes in the contaminated environment
4. To familiarize on assay of enzymes involved in biotransformation
5. To understand the on effect of pesticides on soil microorganisms

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Gain knowledge on microbial contamination of water, wastewater and solid waste	Apply
CO2	Become knowledgeable on toxicity	Apply
CO3	Observe and identify the microbes in the contaminated environment	Apply
CO4	Identify assay of enzymes involved in biotransformation	Apply
CO5	Gain knowledge on effect of pesticides on soil microorganisms.	Understand

S.No	List of Exercises	CO Mapping	RBT
1	Preparation of culture media,	3	Understand
2	Isolation, culturing and Identification of Microorganisms	3	Understand
3	Microorganisms from polluted habitats (soil, water and air)	3	Understand
4	Measurement of growth of microorganisms,	1	Understand
5	Assay of enzymes involved in biotransformation	2	Understand
6	Biodegradation of organic matter in waste water	1	Understand
7	Analysis of air borne microorganisms,	3	Understand
8	Staining of bacteria	3	Understand
9	Effect of pH, temperature on microbial growth	1	Understand
10	Pollutant removal using microbes from industrial effluent.	2	Understand
11	Effect of pesticides on soil microorganisms.	2	Understand

12	Bacteriological analysis of wastewater (Coliforms, *E.coli, Streptococcus*) – MPN	3	Understand
13	Bacteriological analysis of wastewater (Coliforms, *Streptococcus)* - MF techniques, Effect of Heavy metals on microbial growth.	3	Understand
14	Detection of Anaerobic bacteria (*Clostridium* sp.)	3	Understand
15	Bioreactors(cultivation of microorganisms)	1	Understand

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1		3			3			2					3	1	
2		3			3			2					3	1	
3		3			3			2					3	1	
4		3			3			2					3	1	
5		3			3			2					3	1	
	3	High				2	Medium					1	Low		

Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [50 marks]**	**End Semester Examination [50 marks]**
Remember	30	30
Understand	70	70
Apply		
Analyze		
Evaluate		
Create		

20PEE204	Environmental Processes Monitoring Laboratory	L	T	P	C
		0	0	6	3
Nature of Course	Professional Core				
Pre requisites	Waste Water Engineering				

Course Objectives

The course is intended

1. To develop knowledge coagulation, flocculation , settling
2. To impart knowledge on filtration and softening
3. To gain knowledge about the saturation index
4. To familiarize about the interpret about sludge test
5. To gain knowledge about tge ambience level

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1	Understand about basics of coagulation, flocculation , settling	Understand
CO2	Analyse about filtration and softening	Apply
CO3	Understand about saturation index	Understand
CO4	Interpret about Sludge test	Understand
CO5	Analyse ambience level	Apply

Course Content

S.No	List of Experiments	CO MAPPING	RBT
1.	Coagulation and Flocculation	CO1	Understand
2.	Batch studies on settling	CO1	Understand
3.	Studies on Filtration-Characteristics of Filter media	CO2	Apply
4.	Water softening	CO2	Apply
5.	Adsorption studies/Kinetics	CO2	Apply
6.	Langelier Saturation Index and Silt Density Index-For Membrane Filtration	CO3	Understand
7.	Kinetics of suspended growth process(activated sludge process)-and Sludge volume Index	CO3	Understand
8.	Sludge Filterability Test	CO4	Understand
9.	Anaerobic Reactor systems/kinetics(Demonstration)	CO4	Understand
10.	Advanced Oxidation Processes-(Photo catalysis)	CO5	Apply
11.	Disinfection for Drinking water (Chlorination)	CO2	Apply
12.	Ambient Air Sampling-Determination of PM10, PM2.5, SO2and NO2	CO5	Apply
13.	Noise Monitoring-Determination of Equivalent Noise Level	CO5	Apply

Total: 45 Periods

Reference Books:

1. AEESP Environmental Processes Laboratory Manual, Association of Environmental Engineering and Science Professors Foundation,Washington, 2002.
2. Aery N C., "Manual of Environmental Analysis", Ane Books Pvt. Ltd. New Delhi,2014
3. CPCB,Guidelines for the Measurement of Ambient Air Pollutants, Volume I, CentralPollution Control Board, Ministry of Environment and Forests, Government of India, 2001
4. Lee,C.C.andShundarLin."Handbook of Environmental Engineering Calculations", McGrawHill, NewYork,1999.
5. Metcalf & Eddy, Inc., G.Tchobanoglous, H.D.Stensel, R.Tsuchihashi and L.Burton. "Wastewater Engineering Treatment and Resource Recovery" 5th edition. McGraw Hill Company. 2014

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Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes(PSOs)														
COs	**Pos**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	3	2	2	1	2				2		3
CO2	2	3	3	3	3	2	1	2				2		3
CO3	3	3	2	2	2	2	1	2				3		3
CO4	3	3	2	3	3	2	1	2				2		3
CO5	3	3	2	3	3	2	1	2				2		3
	3	High				2	Medium					1	Low	

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [50 marks]**	**End Semester Examination [50 marks]**
Remember	30	30
Understand	70	70
Apply		
Analyze		
Evaluate		
Create		

20PEE04	Environmental Policy and Legislation	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Principles of Professional Ethics				

Course Objectives

The course is intended

1. To impart knowledge on national environmental policies
2. To gain knowledge on national environmental legislations and the polices for water
3. To familiarize on national environmental legislations and the polices for air
4. To acquire knowledge on national environmental legislation and policies for environment
5. To become knowledgeable on national environmental legislation and the policies for other acts

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1	Gain Knowledge about the general National environmental legislations and the policies	Knowledge
CO2	Get Knowledge about the National environmental legislations and the policies for Water	Knowledge
CO3	Gain Knowledge about the National environmental legislations and the policies for Air	Knowledge
CO4	Get Knowledge about the National environmental legislations and the policies for Environment	Knowledge
CO5	Knowledge about the National environmental legislations and the policies for other topics	Knowledge

Course Contents:

Unit- I Introduction **9**

Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle - Concept of absolute liability - multilateral environmental agreements and Protocols - Montreal Protocol, Kyoto agreement, Rio declaration - Environmental Protection Act, Water (P&CP) Act, Air (P&CP) Act - Institutional framework (SPCB/CPCB/MoEF)

Unit- II Water (P&Cp) Act, 1974 **8**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

Unit- III Air (P&Cp) Act, 1981 **8**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

Unit- IV Environment (Protection) Act 1986 **13**

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 – responsibilities of generators and role of Pollution Control Boards

Unit- V Other Topics **7**

Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

Total: 45 Periods

Reference Books:

1. Shyam Divan and Armin Roseneranz "Environmental law and policy in India "Oxford University Press, New Delhi,2001
2. GregerI.Megregor "Environmental law and enforcement", Lewis Publishers, London.1994
3. 1.CPCB "Pollution Control acts, Rules and Notifications issued there under "Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi,1997

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2			1			1					1	1	
CO2	3	2			2			1					1	2	
CO3	3	2			3			2					2	2	
CO4	3	2			3			2					2	2	
CO5	3	2			2			3					3	2	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Continuous Assessment Tests**			**Final Examination (60)**
	IAE 1 (7.5)	**IAE 2 (7.5)**	**IAE 3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

20PEE05	Environmental Quality Monitoring	L	T	P	C
		3	0	0	3
Nature of Course	Basic Environmental Engineering				
Pre requisites	Environmental Engineering				

Course Objectives

The course is intended

1. To impart knowledge on environmental chemistry
2. To familiarize on spectroscopic methods
3. To gain knowledge on chromatographic methods
4. To acquire knowledge on Electro and Radio Analytical Methods
5. To become knowledgeable on continuous monitoring instruments

Course Outcomes

On successful completion of the course, students will be able to

CO.No.	Course Outcome	Bloom's Level
CO1	Understand the environmental chemistry	Understand
CO2	Apply the methods for spectroscopic analysis	Apply
CO3	Analyse the methods of chromatographic methods	Analyse
CO4	Gain knowledge on Electro and Radio Analytical Methods	Analyse
C05	Differentiate the Principles, techniques and applications of NDIR analyzer	Analyse

Course Contents:

Unit- I Introduction **9**

Wet Chemistry methods and their limitations-Instrumental Methods, Selection of method Precision and Accuracy, Error in measuring signals-Quality control & assurance Sample preservation, Sample preparation and analyte isolation.

Unit- II Spectroscopic Methods **12**

Principles, techniques and applications of spectrophotometry, fluorimetry, nephelometry and turbidimetry, Atomic Absorption Spectrometry (Flame, graphite furnace and hydride generation),Atomic Emission Spectrometry (AES) , flame and Inducted Coupled Plasma (ICP)-TOC Analyzer

Unit- III Chromatographic Methods **8**

Column, Paper and thin layer chromatography (TLC)-Principles, techniques and applications of GC, GC-MS, High performance liquid chromatography (HPLC) and Ion chromatograph (IC)-Hyphenated techniques for Environmental contaminant(trace organics) analysis.

Unit- IV Electro And Radio Analytical Methods **8**

Principles, techniques and applications of Conductometry, potentiometry, coulometry, AOX analyzer Amperometry, polarography, New Activation Analysis (NAA), X-ray Fluorescence (XRF)and X-ray Diffraction (XRD) methods.

Unit- V Continuous Monitoring Instruments **8**

Principles, techniques and applications of NDIR analyzer for CO, chemiluminescent analyzer for NOx Fluorescent analyzer for SO2 - Particulates analysis - Auto analyzer for water quality using flow injection analysis.

Total: 45 Periods

Reference Books

1. Barceló, D.(editor), “Environmental analysis. Techniques, Applications and Quality Assurance”, Elsevier, The Netherlands,1996
2. Ewing Instrumental Methods of Chemical Analysis, 5th Edition, McGraw Hill,NewYork.1985
3. Paul R. Loconto Trace Environmental Quantitative Analysis: Principles, Techniques, andApplications, Marcel Dekker; 1 edition (May2001),
4. Reeve, R.N., “Introduction to Environmental Analysis”, Analytical Techniques in theSciences, John Wiley & Sons, Chichester, UK,2002.
5. Willard H. Merritt, L. Dean, D.A. and Settle, F.A. „Instrumental methods of analysis Edn.Words Worth, New York,2004.

MappingofCourseOutcomes(COs)withProgrammeOutcomes(POs)ProgrammeSpecific Outcomes(PSOs)															
COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	
CO1	3	3	2			2	1					2		3	
CO2	2	3	2			2	2					2		2	
CO3	3	2	2			2	1					2		3	
CO4	3	3	2			2	1					2		3	
CO5	3	3	2			2	1					2		3	
	3	High				2	Medium				1	Low			

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Classroom or Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Continuous Assessment Tests**			**Final Examination (60)**
	IAE 1 (7.5)	**IAE 2 (7.5)**	**IAE 3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

20PEEE13	Computing Techniques In Environmental Engineering	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Knowledge in Environmental Engineering				

Course Objectives

The course is intended to

1. Educate the students to know about computing techniques
2. Gain knowledge on different numerical technique and logic like ANN, Fuzzy
3. Educate the students on various aspects of data management
4. Acquire knowledge on the model applications for monitoring and management of environment
5. Identify the modeling concepts using MATLAB.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Understand the computing techniques	Understand
CO2	Apply the principle of soft computing for solving Environmental problems.	Apply
CO3	Assess the Environmental Impacts using ANN and Fuzzy logic.	Apply
CO4	Employ modern advanced computing tools in environmental studies	Apply
CO5	Acquire knowledge on Environmental Modeling Using MATLAB	Understand

Course Contents:

Unit- I Computing Principles **9**

Introduction to Computing techniques – Algorithms and Flowcharts, Numerical methods - Solution to ordinary and partial differential equation using Finite difference and Finite element method , Numerical integration and differentiation, Design of digital models for Environmental applications.

Unit- II Artificial Intelligence **9**

Knowledge based Expert system concepts - Principle of Artificial Neural Network (ANN) – Neural Network Structure – Neural Network Operations – ANN Algorithm - Application of ANN Model to Environmental field – Genetic Algorithms

Unit - III Fuzzy Logic **9**

Fuzzy sets, fuzzy numbers, fuzzy relations, fuzzy measures, fuzzy logic and the theory of uncertainty and information; applications of the theory to inference and control, clustering, and image processing - Network analysis models

Unit- IV Data Management **9**

Data base structure - Data acquisition - Data warehouse - Data retrieval-Data format Attribute - RDBMS - Data analysis - Network data sharing - Statistical Analysis (SYSTAT) - Regression - factor analysis - histogram - scatter diagram - Goodness of fit.

Unit- V Environmental Modeling Using MATLAB **9**

Introduction to MATLAB Software – MATLAB applications in environmental – pollutants transport, decay and degradation modeling using MIKE 21 – MODFLOW - case studies.

Total: 45 Periods

Reference Books:

1. Data-Driven Modeling: Using MATLAB in Water Resources and Environmental Engineering, Springer; 2014 edition.
2. Kotteguda, N.T., and Renzo Resso, Statistics, "Probability and Reliability for Civil and Environmental Engineers", McGraw Hill Companies Inc., New York, 2008.
3. Mathews J. H. and Fink K.D. , "Numerical methods using MATLAB", Pearson Education 2010.
4. Aliev R. A, and Aliev Rashad, "Soft Computing and its Applications", World Scientific Publications Co. Pte. Ltd. Singapore, 2014.
5. Chepra S. C. and Canele R. P., "Numerical Methods for Engineers", McGraw-Hill, a business unit of The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020. 6th Edition 2014.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1											3
CO2	3	3	2	2	3			2		3		3		3
CO3	3	3	2			2		2		3		3		3
CO4	2	2	1				2	2			3			3
CO5	2	1				1	2		2	3				3
	3	High				2	Medium					1	Low	

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examination**			**Final Examination (60)**
	IAE- I (7.5)	**IAE-II (7.5)**	**IAE-III (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyse				
Evaluate				
Create				

20PEEE15	Environmental Risk Assessment	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Knowledge in Environmental pollution				

Course Objectives

The course is intended to

1. Impart knowledge on environmental and ecological risks.
2. Gain knowledge on fate and behavior of toxics and persistent substances in the environment.
3. Understand the tools and methods of risk assessment
4. Acquire knowledge on risk management
5. Become knowledgeable on risk management from case studies.

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Identify the sources of environmental hazards	Knowledge
CO2	Identify fate and behavior of toxics and persistent substances in the environment.	Understand
CO3	Adopt HAZOP and FEMA methods based on the nature of risks	Apply
CO4	Apply the principle of risk management for solving Environmental problems	Apply
CO5	Select a methodology for risk assessment and management	Apply

Course Contents:

Unit- I Introduction **9**

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 Elements of Environmental Risk Assessment **9**

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 - Vulnerability assessment - Uncertainty analysis.

Unit - III Tools and Methods for Risk Assessment **9**

HAZOP and FEMA methods - Cause failure analysis - Event tree and fault tree modeling and analysis - Multimedia and multipath way exposure modeling 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 - Methods in Ecological risk assessment Probabilistic risk assessments - radiation risk assessment - Data sources and evaluation.

Unit- IV Risk Management **9**

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.

Unit- V Applications **9**

Case studies on risk assessment and management for hazardous chemical storage – Chemical industries – Tanneries – Textile industries – Mineral processing and Petrochemical plants – Hazardous waste disposal facilities – nuclear power plants – contaminated site remediation – Case histories on Bhopal, Chernobyl, Seveso, Three Mile Island.

Total: 45 Periods

Reference Books:

1. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff, "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.
2. Mark Burman "Risks and Decisions for Conservation and environmental management", , Cambridge University Press.2003
3. Susan L |Cutter, "Environmental Risks and Hazards" Prentice Hall of India, New Delhi, 1999
4. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control, 4th Edition, Butterworth Heineman, 2012.
5. Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., Global Environmental Risks, V.N.University Press, New York, 2003.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1					3					2	
CO2	3	2	1	1		1	1						2	
CO3	3	2	2	2		2	2					3	2	
CO4	3	2	2										2	
CO5	3	2	1		3								2	
	3	High				2	Medium					1	Low	

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examination**			**Final Examination (60)**
	IAE -1 (7.5)	**IAE-2 (7.5)**	**IAE-3 (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyse				
Evaluate				
Create				

20PEEE16	Remote Sensing and GIS Applications In Environmental Management	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Knowledge in remote sensing and GIS				

Course Objectives

The course is intended to

1. Educate the students on principles of Remote Sensing
2. Learn the different remote sensing technique
3. Impart knowledge on Satellite Remote Sensing
4. Gain knowledge on image processing and geographical information system
5. Become knowledgeable on Remote Sensing and GIS Applications

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Execute the principles of remote sensing	Apply
CO2	Identify a suitable remote sensing technology	Understand
CO3	Explain the concepts of satellite remote sensing	Understand
CO4	Apply suitable image processing and geographical information system	Evaluate
CO5	Interpret the remote sensing and GIS applications	Apply

Course Contents:

Unit- I Remote Sensing Elements **9**

Historical Perspective, Principles of remote sensing, components of Remote Sensing, Energy source and electromagnetic radiation, Electromagnetic spectrum, Energy interaction, Spectral response pattern of earth surface features, Energy recording technology

Unit- II Remote Sensing Technology **9**

Classification of Remote Sensing Systems, , Aerial photographs, Photographic systems – Across track and along track scanning, Multispectral remote sensing, Thermal remote sensing, Microwave remote sensing – Active and passive sensors, RADAR, LIDAR

Unit - III Satellite Remote Sensing **9**

Satellites and their sensors, satellite orbits, Indian space programme - Research and development - ISRO satellites, LANDSAT, ERS, SPOT, TERRA and NOOA satellite series, Characteristics of Remote Sensing data ,Satellite data Products

Unit- IV Image Processing and Geographical Information System **9**

Photogrammetry – Visual image interpretation, Digital image processing – Image rectification, enhancement, transformation, Classification, Data merging, GIS Concepts – Spatial and non spatial data, Vector and raster data structures, Data analysis, Database management – RS – GIS Integration, Image processing software, GIS software

Unit- V Remote Sensing and GIS Applications **9**

Monitoring and management of environment, Conservation of resources, Sustainable land use, Coastal zone management – Limitations

Total: 45 Periods

Reference Books:

1. Lillesand, T.M. and Kiefer, R.W, "Remote sensing and image interpretation", John Wiley and sons, New York, 2004.
2. Lintz, J.and Simonet," Remote sensing of Environment", Addison Wesley Publishing Company, New Jersey, 1998.
3. Pmapler and Applications of Imaging RADAR, Manual of Remote Sensing, Vol.2, ASPR, 2001.
4. Burrough, P.A. and McDonnell, R.A., "Principles of Geographic Information systems" Oxford University Press, New York, 2001.
5. Golfried Konechy, Geoinformation: "Remote sensing, Photogrammetry and Geographical Information Systems", CRC press, 1st Edition, 2002.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2										3	
CO2	3	2	1						2	3			3	
CO3	3	2	2	3	3				2	3		3	3	
CO4	3	2	2		3					3		3	3	
CO5	3	2	2	3		3	3					3	3	
	3	High				2	Medium					1	Low	

Formative assessment			
Bloom's Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	**Internal Assessment Examination**			**Final Examination (60)**
	IAE- II (7.5)	**IAE-II (7.5)**	**IAE-III (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyse				
Evaluate				
Create				

20PEEE17	Environmental Impact Assessment	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Knowledge in Environmental Engineering				

Course Objectives

The course is intended to

1. Gain knowledge on Legal and Regulatory aspects in India
2. Impart knowledge on Impact Identification and Prediction
3. Acquire knowledge on Social Impact Assessment and EIA Documentation
4. Prepare plan for environmental management
5. Utilize tools for environmental risk assessment and management

Course Outcomes

On successful completion of the course, students will be able to

CO. No.	Course Outcome	Bloom's Level
CO1	Identify the types and limitations of Environmental Impact Assessment	Understand
CO2	Select a methodology for EIA by using software packages	Understand
CO3	Prepare documentation for EIA findings	Apply
CO4	Prepare EIA report and Environmental management plan	Apply
CO5	Apply tools for Environmental risk assessment and management	Apply

Course Contents:

Unit- I Introduction **9**

Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. - Types and limitations of EIA -.EIA process- screening - scoping - setting – analysis – mitigation. Cross sectoral issues and terms of reference in EIA – Public Participation in EIA-EIA Consultant Accreditation.

Unit- II Impact Identification and Prediction **9**

Matrices - Networks - Checklists -Cost benefit analysis - Analysis of alternatives - Software packages for EIA - Expert systems in EIA. Prediction tools for EIA - Mathematical modeling for impact prediction - Assessment of impacts - air - water - soil - noise - biological – Cumulative Impact Assessment

Unit - III Social Impact Assessment and EIA Documentation **9**

Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials.

Unit- IV Environmental Management Plan **9**

EIA Report preparation. Environmental Management Plan - preparation, implementation and review - Mitigation and Rehabilitation Plans - Policy and guidelines for planning and monitoring programmes - Post project audit - Ethical and Quality aspects of Environmental Impact Assessment- Case Studies

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Unit- V Environmental Risk Assessment and Management **9**

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment- HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipath way exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs

Total: 45 Periods

Reference Books:

1. Rao. S.S., "Optimisation Theory and Applications ", Wiley Eastern Limited, New Delhi, 2009.
2. Richard Forsyth (Ed.), “Expert System Principles and Case Studies”, Chapman and Hall, 1996.
3. Shah V.L. “Computer Aided Design in Reinforced Concrete” Structural Publishers, 2014.
4. Lawrence, D.P., "Environmental Impact Assessment – Practical solutions to recurrent problems", Wiley-Interscience, New Jersey. 2003
5. Sam Mannan, "Lees' Loss “Prevention in the Process Industries, Hazard Identification, Assessment and Control” 4th Edition, Butterworth Heineman, 2012.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2				3	3	3	2				2	
CO2	3	3				3	3	3	2			3	2	
CO3	3	3		3					2	2			2	
CO4	3	3		3				3	2	2			2	
CO5	3	2	2		3				2			3	2	
	3	High				2	Medium					1	Low	

Formative assessment			
Bloom’s Level	**Assessment Component**	**Marks**	**Total marks**
Remember	Online Quiz	5	15
Understand	Class Presentation/Power point presentation	5	
	Attendance	5	

Summative Assessment				
Bloom’s Category	**Internal Assessment Examination**			**Final Examination (60)**
	IAE- I (7.5)	**IAE-II (7.5)**	**IAE-III (10)**	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyse				
Evaluate				
Create				