FACULTY OF ENGINEERING AND TECHNOLOGY

OUTCOME BASED EDUCATION

CURRICULUM & SYLLABUS

(2022 Regulation)

M.TECH

ENVIRONMENTAL ENGINEERING

(Full Time)

REGULATION – 2022
(For the Students admitted from 2025-26)

DEPARTMENT OF
CIVIL ENGINEERING

DECLARATION

I **Dr.T.Kavitha, Head of the Department of Civil Engineering**, hereby declare that this copy of the Syllabus from page number 1 to 100 (M.Tech-Environmental Engineering FULL TIME 2022 regulation) is the final version which is being taught in the class and uploaded in our University website. I assure that the syllabus available in our University web site is verified and found correct. The Curriculum and syllabi have been ratified by our Academic Council / Vice chancellor.

Date: **Signature**

Department Vision

To achieve the pinnacle of success in the area of sustainable constructions and green technologies, thus stimulating economic growth and making the society a better place to live in

Department Mission

The mission of the Department of Civil Engineering is:

M1: To produce graduates who possess technical competence in their chosen specialty area of Environmental Engineering with integrity and commitment

M2: To prepare them to serve and contribute as innovators, professional engineers, and leaders in the global community

Program Educational Objectives

The Educational Objectives of the Environmental Engineering program are designed to provide the engineering graduates with technical expertise in Environmental Engineering which will enable them to have a career and professional accomplishment in the public or private sector to:

PEO 1: Apply fundamental technical knowledge and skills to find creative solutions to technological challenges and problems in various areas of basic sciences and engineering.

PEO2: Provide the Engineering graduates with technical expertise in environmental engineering which will enable them to have a career and professional accomplishment in the public or private sector.

PEO 3: Address the complexities of real life Environmental Engineering problems related to water supply, sewerage, sewage treatment, waste management, environmental impact assessment, industrial pollution prevention and control.

PEO 4: Identify, formulate, analyze, develop processes and technologies to meet desired environmental protection needs of society and formulate solutions that are technically sound, economically feasible, and socially acceptable

PEO 5: Make students professionally competent by enhancing their communication skills, team spirit and leadership and also to prepare them for lifelong learning through innovative and research activities.

PROGRAM SPECIFIC OBJECTIVES

PSO 1: Acquiring sound knowledge on entire spectrum of activities associated with environmental engineering and develops ability to, evaluate analyze and integrate existing knowledge with the innovative knowledge

PSO 2: Understand the importance of societal, health, safety, legal and cultural considerations in carrying out environmental projects

PSO 3: Modelling environmental systems using modern tools and techniques

PROGRAM OUTCOMES OF ENVIRONMENTAL ENGINEERING

PO 1	To identify, formulate, and solve environmental engineering problems using the techniques, skills, and modern engineering tools necessary for environmental engineering practice
PO 2	To design systems, processes and equipment for control and remediation of water, air, and soil quality environment within realistic constraints of economic affordability and social acceptability
PO 3	To assess the potential environmental impacts of development projects and design mitigation measures
PO 4	To have basic knowledge about environment protection and operation of pollution control devices
PO 5	To design and conduct experiments, as well as interpret data and communicate effectively
PO 6	To function in multi-disciplinary teams and understand the ethical and professional responsibility
PO 7	To find professional level employment as Environmental Engineers or pursue higher studies
PO 8	Engage in critical thinking and contribute to research in solving contemporary environmental problems and function in multi-disciplinary groups
PO 9	To have a knowledge of contemporary environmental issues and an ability to engage in life-long learning

Mapping of Mission with PEO's

Mission/PEOs	PEO1	PEO2	PEO3	PEO4	PEO5
M1	1	3	3	3	2
M2	2	3	3	2	3

Mapping of PEOs with POs

PEO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
PEO1	2	1	2	3	2	1	2	3	2
PEO2	3	3	3	3	2	1	2	2	3
PEO3	2	3	3	2	3	2	2	3	3
PEO4	3	3	3	3	2	2	1	2	3
PEO5	2	2	2	1	3	3	2	3	3

Mapping of PEOs with PSOs

PEO/PSO	PSO1	PSO2	PSO3
PEO1	2	2	2
PEO2	3	3	3
PEO3	3	3	2
PEO4	3	3	3
PEO5	2	3	3

Correlation Strength: - 3: High, 2: Medium, 1: Low

Faculty of Engineering and Technology

M. TECH ENVIRONMENTAL ENGINEERING

Regulation 2022 – Framework

Total Credits: 68
Credit for I to IV Semesters: 68 Credits

Program Components

• Basic Science (Mathematics) include according to program - 1		
• Program Core theory	-	4
• Program Core Laboratory	-	4
• Program Elective	-	5
• Open Elective	-	1
• Open Lab	-	0
• Management paper	-	0
• Foreign Language	-	0
• Audit course	-	2
• Universal Human values	-	0
• Inter disciplinary theory	-	1
• Inter disciplinary Lab	-	0
• ETL	-	0
• Technical Skills	-	3
• Soft skill	-	0
• Project /mini project	-	2

Table 1: Credit Distribution for M.Tech - Environmental Engineering (Full Time)

S. No	Category	Description	No. of Courses	Credits	Total	Credit Weightage	Contact hours
1	CORE COURSES	Core Theory	4	14	22	32.35	210
		Core Lab	4	8			240
2	ELECTIVE COURSES	Department Core Electives/ Skill enhancement electives	5	15	15	22.05	225
3	OPEN ELECTIVES	Open Elective theory	1	3	3	4.41	45
		Open Elective Lab	0	0			0
4	INTERDISCIPLINARY / ALLIED COURSES	Theory	3	3	3	4.41	105
		Lab	0	0			0
5	HUMANITIES & SOCIAL SCIENCES , LIFE SKILLS &SOFT SKILLS	Language 1 & 2	0	0	0	0	0
		English 1 & 2	0	0			0
		Soft Skills	0	0			0
		Life Skill	0	0			0
		Foreign Language	0	0			0
		Environmental Studies	0	0			0
		Management Papers	0	0			0
		Entrepreneurship Development	0	0			0
6	PROJECTS/INTERNSHIP/ CORE SKILL	Project	2	15	21	30.88	90
		Core Skills	2	4			120
		Internship / NSS / NCC	1	2			60
7	ENGINEERING SCIENCES		1	4	4	5.88	60
8	ANY OTHER		-	-	-	-	-
Total			**38**		**68**	**100**	**1155**

Table 2: **Revision/modification done in syllabus content:**

S.No	Course (Subject) Code	Course (Subject) Name	Concept/ topic if any, removed in current curriculum	Concept/ topic added in the new curriculum	% of Revision/ Modification done
1	EMEE22002	SOLID AND HAZARDOUS WASTE MANAGEMENT	DESIGNATED WASTE LANDFILL REMEDIATION - INTEGRATED WASTE MANAGEMENT FACILITIES TOPIC REMOVED	-	20%
2	EMEE22005	ENVIRONMENTAL IMPACT ASSESSMENT	REMOVED TOPIC EIA FOR INFRASTRUCTURE PROJECTS – STP	ADDED TOPIC EIA FOR INFRASTRUCTURE PROJECTS – MUNICIPAL SOLID WASTE PROCESSING PLANT, AIRPORTS	20%

Table 3:

List of New courses/value added courses/life skills/Electives/interdisciplinary/courses focusing on employability/ entrepreneurship/ skill development.

S. No	New courses (Subjects)	Value added courses	Life skill	Electives	Inter Disciplinary	Focus on employability/ entrepreneurship/ skill development
1	ENVIRONMENTAL MANAGEMENT	RESEARCH PUBLICATION		PRINCIPLES AND DESIGN OF PHYSICO-CHEMICAL TREATMENT SYSTEMS	RESEARCH AND PUBLICATION ETHICS	TERM PAPER
2				ECOLOGICAL ENGINEERING		
3				CHEMISTRY OF ENVIRONMENT		
4				INSTRUMENTAL MONITORING OF ENVIRONMENT		
5				CLEANER PRODUCTION		
6				AIR POLLUTION AND CONTROL		
7				ENVIRONMENT, HEALTH AND SAFETY IN INDUSTRIES		
8				AIR AND WATER QUALITY MODELING		
9				MEMBRANE TECHNOLOGIES FOR WATER AND WASTEWATER TREATMENT		
10				GROUND WATER POLLUTION		
11				MARINE POLLUTION & CONTROL		
12				CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT		
13				ENVIRONMENTAL ENGINEERING STRUCTURES		
14				ENVIRONMENTAL POLICIES AND LEGISLATION		
15				BIO-REMEDIATION		

SEMESTER – I								
S. No	**Course Code**	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/S.Lr**	**P/R**	**C**	**Category**
1	EMMA22004	STATISTICAL METHODS FOR ENVIRONMENTAL ENGINEERS	Ty	3	1/0	0/0	4	BS
2	EMEE22002	SOLID AND HAZARDOUS WASTE MANAGEMENT	Ty	3	1/0	0/0	4	PC
3	EMEE22EXX	PROGRAM ELECTIVE I	Ty	3	0/0	0/0	3	PE
4	EMEE22EXX	PROGRAM ELECTIVE II	Ty	3	0/0	0/0	3	PE
5	EMEE22L02	WATER QUALITY ANALYSIS LAB	Lb	0	0/0	4/0	2	PC
6	EMEE22L03	AIR AND WATER QUALITY MODELING LAB	Lb	0	0/0	4/0	2	PC
7	EMCC22001	RESEARCH METHODOLOGY AND IPR	Ty	3	0/0	0/0	3	ID
8	EMCC22IXX	AUDIT COURSE - I	IE	2	0/0	0/0	0	ID
		TOTAL		**17**	**2/0**	**8/0**	**21**	

Credits Sub Total: 21

SEMESTER – II								
S. No	**Course Code**	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/S.Lr**	**P/R**	**C**	**Category**
1	EMEE22003	URBAN WATER RESOURCES MANAGEMENT	Ty	3	0/0	0/0	3	PC
2	EMEE22005	ENVIRONMENTAL IMPACT ASSESSMENT	Ty	3	1/0	0/0	4	PC
3	EMEE22EXX	PROGRAM ELECTIVE III	Ty	3	0/0	0/0	3	PE
4	EMEE22EXX	PROGRAM ELECTIVE IV	Ty	3	0/0	0/0	3	PE
5	EMEE22L01	ENVIRONMENTAL QUALITY MEASUREMENTS LAB	Lb	0	0/0	4/0	2	PC
6	EMEE22L04	GEOGRAPHICAL INFORMATION SYSTEM LAB	Lb	0	0/0	4/0	2	PC
7	EMCC22IXX	AUDIT COURSE - II	IE	2	0/0	0/0	0	ID
8	EMEE22I01	TERM PAPER	IE	0	0/0	0/4	2	PC
		TOTAL		**14**	**1/0**	**8/4**	**19**	

Credits Sub Total: 19

SEMESTER – III								
S. No	**Course Code**	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/S.Lr**	**P/R**	**C**	**Category**
1	EMEE22004	ENVIRONMENTAL MANAGEMENT	Ty	3	0/0	0/0	3	PC
2	EMEE22EXX	PROGRAM ELECTIVE V	Ty	3	0/0	0/0	3	PE
3	EMOL22I01	Open Elective (NPTEL/SWAYAM/Any MOOC Online courses approved by AICTE/UGC)	IE	3	0/0	0/0	3	ID
4	EMEE22I02	SUMMER INTERNSHIP	IE	0	0/0	4/0	2	PC
5	EMEE22L05	DISSERTATION PHASE I	Lb	0	0/0	0/10	5	P
		TOTAL		**9**	**0/0**	**4/10**	**16**	

Credits Sub Total: 16

SEMESTER – IV								
S. No	**Course Code**	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/S.Lr**	**P/R**	**C**	**Category**
1	EMEE22L06	DISSERTATION PHASE II	Lb	0	0/0	10/10	10	P
2	EMEE22I03	RESEARCH PUBLICATION	IE	0	0/0	2/2	2	PC
		TOTAL		**0**	**0/0**	**12/12**	**12**	

Credits Sub Total: 12

TOTALCREDITS = 21+19+16+12=68

LIST OF ELECTIVES

ELECTIVE I								
S. No	**Course Code**	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/S.Lr**	**P/R**	**C**	**Category**
1.	EMEE22E01	PRINCIPLES AND DESIGN OF PHYSICO-CHEMICAL TREATMENT SYSTEMS	Ty	3	0/0	0/0	3	PE
2.	EMEE22E02	ECOLOGICAL ENGINEERING	Ty	3	0/0	0/0	3	PE
3.	EMEE22E03	CHEMISTRY OF ENVIRONMENT	Ty	3	0/0	0/0	3	PE

ELECTIVE II								
S. No	**Course Code**	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/S.Lr**	**P/R**	**C**	**Category**
1.	EMEE22E04	INSTRUMENTAL MONITORING OF ENVIRONMENT	Ty	3	0/0	0/0	3	PE
2.	EMEE22E05	CLEANER PRODUCTION	Ty	3	0/0	0/0	3	PE
3.	EMEE22E06	AIR POLLUTION AND CONTROL	Ty	3	0/0	0/0	3	PE

ELECTIVE III								
S. No	**Course Code**	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/S.Lr**	**P/R**	**C**	**Category**
1.	EMEE22E07	ENVIRONMENT, HEALTH AND SAFETY IN INDUSTRIES	Ty	3	0/0	0/0	3	PE
2.	EMEE22E08	AIR AND WATER QUALITY MODELING	Ty	3	0/0	0/0	3	PE
3.	EMEE22E09	MEMBRANE TECHNOLOGIES FOR WATER AND WASTEWATER TREATMENT	Ty	3	0/0	0/0	3	PE

ELECTIVE IV								
S. No	**Course Code**	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/S.Lr**	**P/R**	**C**	**Category**
1.	EMEE22E10	GROUND WATER POLLUTION	Ty	3	0/0	0/0	3	PE
2.	EMEE22E11	MARINE POLLUTION & CONTROL	Ty	3	0/0	0/0	3	PE
3.	EMEE22E12	CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT	Ty	3	0/0	0/0	3	PE

ELECTIVE V								
S. No	**Course Code**	**Course Title**	**Ty/Lb/ETL/IE**	**L**	**T/S.Lr**	**P/R**	**C**	**Category**
1.	EMEE22E13	ENVIRONMENTAL ENGINEERING STRUCTURES	Ty	3	0/0	0/0	3	PE
2.	EMEE22E14	ENVIRONMENTAL POLICIES AND LEGISLATION	Ty	3	0/0	0/0	3	PE
3.	EMEE22E15	BIO-REMEDIATION	Ty	3	0/0	0/0	3	PE

AUDIT COURSE I & II								
Sl.No	**Course Code**	**Course Title**	**Ty/Lb/ETL/IE**	**Teaching Scheme**				**Category**
				L	**T/S.Lr**	**P**	**C**	
1	EMCC22I01	ENGLISH FOR RESEARCH PAPER WRITING	IE	2	0/0	0/0	0	ID
2	EMCC22I02	DISASTER MANAGEMENT	IE	2	0/0	0/0	0	ID
3	EMCC22I03	SANSKRIT FOR TECHNICAL KNOWLEDGE	IE	2	0/0	0/0	0	ID
4	EMCC22I04	VALUE EDUCATION	IE	2	0/0	0/0	0	ID
5	EMCC22I05	CONSTITUTION OF INDIA	IE	2	0/0	0/0	0	ID
6	EMCC22I06	PEDAGOGY STUDIES	IE	2	0/0	0/0	0	ID
7	EMCC22I07	STRESS MANAGEMENT BY YOGA	IE	2	0/0	0/0	0	ID
8	EMCC22I08	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	IE	2	0/0	0/0	0	ID
9	EMCC22I09	RESEARCH AND PUBLICATION ETHICS	IE	2	0/0	0/0	0	ID

SEMESTER-I

Course Code: EMMA22004	Course Name: STATISTICAL METHODS FOR ENVIRONMENTAL ENGINEERS	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: UG level Statistics and Optimization Techniques	Ty	3	1/0	0/0	4
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To provide the solid foundation on topics in various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling
- To address the issues and the principles of estimation theory, testing of hypothesis, correlation and regression, design of experiments and multivariate analysis

COURSE OUTCOMES (COs)

CO1	Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
CO2	Use statistical tests in testing hypotheses on data.
CO3	Concept of linear regression, correlation, and its applications.
CO4	List the guidelines for designing experiments and recognize the key historical figures in design of experiments.
CO5	Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1	1	1	3	1	-	1	1
CO2	2	2	1	1	3	1	-	2	1
CO3	1	1	3	1	3	1	-	1	1
CO4	2	2	2	2	3	1	-	1	2
CO5	1	1	1	1	1	1	-	1	1

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
	√								

Course Code: EMMA22004	Course Name: STATISTICAL METHODS FOR ENVIRONMENTAL ENGINEERS	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: UG level Statistics and Optimization Techniques	Ty	3	1/0	0/0	4
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I ESTIMATION THEORY **12 Hrs**

Estimators: Unbiasedness, Consistency, Efficiency and sufficiency – Maximum likelihood estimation – Method of moments.

UNIT II TESTING OF HYPOTHESIS **12 Hrs**

Sampling distributions - Small and large samples -Tests based on Normal, t, Chi square, and F distributions for testing of means, variance and proportions – Analysis of r x c tables – Goodness of fit.

UNIT III CORRELATION AND REGRESSION **12 Hrs**

Multiple and partial correlation – Method of least squares – Plane of regression – Properties of residuals – Coefficient of multiple correlation – Coefficient of partial correlation – Multiple correlation with total and partial correlations – Regression and partial correlations in terms of lower order co - efficient.

UNIT IV DESIGN OF EXPERIMENTS **12 Hrs**

Analysis of variance – One way and two way classifications – Completely randomized design – Randomized block design – Latin square design - 2^2 Factorial design.

UNIT V MULTIVARIATE ANALYSIS **12 Hrs**

Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components : Population principal components – Principal components from standardized variables.

Total no. of hrs: 60

REFERENCES

1. Gupta.S.C., and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, 11th Edition, 2002.
2. Jay L. Devore, “Probability and statistics for Engineering and the Sciences”, 8th Edition, Cengage Learning, 2014.
3. Johnson, R.A. and Wichern, D. W. “Applied Multivariate Statistical Analysis”, Pearson Education, Asia, 6th Edition, 2007.
4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund’s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
5. Rice, J.A. "Mathematical Statistics and Data Analysis", 3rd Edition, Cengage Learning, 2015.

Course Code: EMEE22002	Course Name: SOLID AND HAZARDOUS WASTE MANAGEMENT	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	1/0	0/0	4
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To impart knowledge and skills in the collection, storage, transport, treatment, disposal and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipments.

COURSE OUTCOMES (COs)

CO1	Understand health and environmental issues related to solid waste management
CO2	Principles involved in the management of municipal, hazardous and biomedical solid waste from source identification up to secured disposal
CO3	Apply steps in solid waste management-waste reduction at source, collection techniques, materials and resource recovery/recycling, transport, optimization of solid waste transport, treatment and disposal techniques
CO4	Laboratory practices involved in the sampling and characterization of solid wastes
CO5	Understand the role legislation and policy drivers play in stakeholders' response to the waste and apply the basic scientific principles for solving practical waste management challenges

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	3	2	1	1	1	3
CO2	3	3	3	3	2	3	2	3	3
CO3	3	3	3	3	2	2	2	3	3
CO4	3	3	3	2	2	1	1	1	1
CO5	3	3	3	3	3	2	2	2	2

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
				√					

Course Code: EMEE22002	Course Name: SOLID AND HAZARDOUS WASTE MANAGEMENT	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	1/0	0/0	4
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I MUNICIPAL SOLID WASTE MANAGMENET **12 Hrs**

Definition of solid waste - sources and types of solid waste - sampling and characterization –waste generation in a technological society – composition of MSW- storage and handling - Legal and Organizational management - legislations, monitoring responsibilities.

UNIT II COLLECTION AND TRANSPORTATION OF SOLID WASTE **12 Hrs**

Type of solid waste collection systems, analysis of collection system - alternative techniques for collection system - unit operations used for separation and processing, Materials Recovery facilities, Waste transformation through combustion and anaerobic composting, anaerobic methods for materials recovery and treatment - Energy recovery – Incinerators - need for waste transfer operation, transportation methods, transfer station types. Landfills Site selection, design and operation, leachate collection systems.

UNIT III HAZARDOUS WASTE MANAGEMENT **12 Hrs**

Definition and identification of hazardous wastes - sources and characteristics - hazardous wastes in MSW - regulations -minimization of Hazardous Waste- compatibility, handling and storage of hazardous waste - collection and transport.

UNIT IV HAZARDOUS WASTE TREATMENTS AND DESIGN **12 Hrs**

Hazardous waste treatment technologies - Design and operation of facilities for physical, chemical and thermal treatment of hazardous waste - Solidification, chemical fixation and encapsulation, incineration. Hazardous waste landfill site selection, design and operation- remediation of hazardous waste disposal sites.

UNIT V CHARACTERISATION OF SOLID AND HAZARDOUS WASTE **12 Hrs**

Sampling and characterization of Solid Wastes; TCLP tests and Lechatelier's studies

Total No. of Hours: 60

REFERENCES

1. *George Techobanoglous et al, "Integrated Solid Waste Management ", Mc Graw- Hill Publication Washington, 1993.*
2. *Charles A. Wentz; "Hazardous Waste Management ", Mc Graw-Hill Publication, Washington, 1995.*

Course Code: EMEE22L02	Course Name: WATER QUALITY ANALYSIS LAB	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Lb	0	0/0	4/0	2
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To educate on the analysis of characteristics of water/wastewater samples

COURSE OUTCOMES (COs)

CO1	To understand the quality of water
CO2	Able to perform physical analysis test
CO3	Able to perform field oriented testing of water for microbial contamination
CO4	Knowledgeable to perform toxicity test
CO5	Able to observe and identify the microbes in the contaminated environment

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3	2	2	2	3	3
CO2	3	3	3	2	3	2	2	2	2
CO3	3	3	3	2	3	2	2	2	2
CO4	3	3	3	2	2	2	2	2	2
CO5	3	3	3	2	2	2	2	2	2

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
									√

Course Code: EMEE22L02	Course Name: WATER QUALITY ANALYSIS LAB	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Lb	0	0/0	4/0	2
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

LIST OF EXPERIMENTS

Physical Analysis
Determination of pH
Turbidity
Electrical conductivity
Optimum Coagulant Dosage
Chemical analysis
Determination of Dissolved Oxygen
Hardness
Alkalinity
BOD & COD Analysis of wastewater
Biological analysis
Culture media preparation
Preparation, distribution and sterilization
Inoculation, streaking, colony observation

Total No of Hours: 60

REFERENCES

1. Standard methods for the examination of water and waste water, American public health association 1996, New York.
2. F.W. Fifield and P.J. Haines, Environmental Analytical Chemistry, Blackie Academic and professional, Glasgow, UK
3. Vogel's qualitative inorganic analysis, 7th edition
4. Guide manual: Water and Wastewater, CPCB Delhi, India
5. Guidelines for the measurement of ambient air pollutants, CPCB Delhi, India

Course Code: EMEE22L03	Course Name: AIR AND WATER QUALITY MODELING LAB	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Lb	0	0/0	4/0	2
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To educate on the analysis of characteristics of air and water samples

COURSE OUTCOMES (COs)

CO1	To understand the quality of air and water
CO2	Understand the basics of modelling using softwares
CO3	To know air quality modelling methods
CO4	To analyse water quality modelling for water bodies
CO5	Ability to incorporate air and water quality models with computer applications.

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	3	2	2	2	3	2
CO2	3	3	3	3	2	2	2	3	2
CO3	3	3	3	3	2	2	2	3	2
CO4	3	3	3	3	2	2	2	3	2
CO5	3	3	3	3	2	2	2	3	2

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
									√

Course Code: EMEE22L03	Course Name: AIR AND WATER QUALITY MODELING LAB	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Lb	0	0/0	4/0	2
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

LIST OF EXPERIMENTS

1. Air quality measurement
2. Modelling of ambient air quality for a locality
3. Water quality modelling for pathogens
4. Water quality modelling for ground water
5. Water quality modelling for contaminant movement

Total No. of Hours: 60

REFERENCES

1. Steven C.Chapra, “Surface Water quality modeling ", The McGraw-Hill- Companies, Inc., New York, 1997.
2. R.W.Boubel, D.L. Fox, D.B. Turner & A.C. Stern, “Fundamentals of Air pollution ", Academic Press, New York, 1994.
3. Ralph A. Wurbs, “Water Management Models - A Guide to Software ", Prentice Hall PTR, New Jersey, 1995.

Course Code: EMCC22001	Course Name: RESEARCH METHODOLOGY AND IPR	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Core subject	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

- The goal is to emphasize the importance of innovation and creativity by understanding the research concepts and ethics which will aid to build the nation IPR status.

COURSE OUTCOMES (COs)

CO1	Understand research problem formulation by Analyzing research related information and its execution by following research ethics
CO2	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
CO3	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
CO4	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	3	3	3	2	3	3	2
CO2	2	3	3	3	3	2	3	3	2
CO3	2	3	3	3	3	2	3	3	2
CO4	2	3	3	3	3	2	3	3	2

COs /PSOs	PSO1	PSO2	
CO1	3	3	
CO2	3	3	
CO3	3	3	
CO4	3	3	

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
				√					

Course Code: EMCC22001	Course Name: RESEARCH METHODOLOGY AND IPR	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Core subject	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT 1 SELECTION, ANALYSIS AND STATEMENT OF THE RESEARCH PROBLEM 9 Hrs

Literature Review and Formulation of Objectives – using the following Critical thinking Skills – Drawing a Concept map, Oral Communication, Debating, Questioning, Collaborating, Evaluation and Reasoning.

UNIT 2 RESEARCH DESIGN 9 Hrs

Types of Study, Types of Data, Measures of Variablility, Setting up the Hypotheses, data collection techniques and tools, sampling, Describing data – Charts and graphs ; Data processing – Categorization, coding, summarization.

UNIT 3 DATA ANALYSIS AND REPORT WRITING 9 Hrs

Statistical measures, Regression and correlation, significance test; Report writing – Purpose, format, content, editing and evaluation. Using Citation tools; Report for specific purposes – Theses, Journals, Grant application. Oral presentation to an audience; use of project management digital tools and plagiarism checking.

UNIT 4 INTRODUCTION TO INTELLECTUAL PROPERTY 9 Hrs

Types of intellectual property rights – Patent, Copyright, Trade Mark, Industrial Design, Geographical Indication, Trade Secrets - Traditional Knowledge. Elements of Patentability - Novelty, Non Obviousness (Inventive Steps), Industrial Application – Non patentable inventions – Process of patenting – National and International – Form and Fees for IP India

UNIT 5 PRIOR ART SEARCH, PATENT DRAFTING 9 Hrs

Drafting patent Claims – Types of claims - Registration Procedure, Rights and Duties of Patentee; Patent infringement; Licensing – Franchising - Joint ventures; Non-Disclosure Agreements (NDAs) - Material Transfer Agreements (MTAs).

Total No of Hours: 45

REFERENCES

- C. Vijayalakshmi and C. Sivapragasam (2011) Research Methods – Tips and Techniques, , MJP Publishers
- Deboraj Rumsey (2010) Statistics Essentials for Dummies, Wiley Publishing Incorporated
- Bouchoux (2013) Intellectual Property, DELMAR CENGAGE Learning, USA
- V K Ahuja (2017) Law Relating to Intellectual Property Rights, LexisNexis Butterworths India

IMPORTANT WEB LINKS

- https://www.wipo.int/portal/en/index.html
- http://ipindia.nic.in/
- https://www.epo.org
- https://www.uspto.gov

SEMESTER-II

Course Code: EMEE22003	Course Name: URBAN WATER RESOURCES MANAGEMENT	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To promote new approaches to slum improvements focusing on integrated urban water services.

COURSE OUTCOMES (COs)

CO1	To impart knowledge on urban water quality models
CO2	Understanding of the complexities of dealing with water resources problems
CO3	Able to apply appropriate management techniques for planning, operating and maintaining the different components of urban and drainage system
CO4	To manage, plan and design urban water system
CO5	To gain knowledge about economic aspects of water

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	2	3	2	2	2	2
CO2	3	3	3	2	3	2	2	2	2
CO3	3	3	3	2	3	2	2	3	3
CO4	3	3	3	2	3	2	2	2	2
CO5	3	3	3	2	3	2	2	2	2

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
				√					

Course Code: EMEE22003	Course Name: URBAN WATER RESOURCES MANAGEMENT	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I NTRODUCTION **9 Hrs**

Water in the urban eco-system-Urban water resources-Four major problems-Urban hydrological cycle-Storm water management objectives and limitations-Storm water policies-Feasibility consideration.

UNIT II URBAN WATER RESOURCES MANAGEMENT MODELS **9Hrs**

Types of models-Physically based-Conceptual or unit hydrograph based-Urban surface runoff models-Management models for flow rate and volume control rate-Quality models.

UNIT III URBAN STORM WATER MANAGEMENT **9Hrs**

Storm water management practices (Structural and Non-Structural Management measures)-Detention and Retention concepts-Types of storage-Magnitude of storage-Hydraulics analysis -Flow and storage capacity of urban components-Temple tanks.

UNIT IV MASTER PLANS **9 Hrs**

Planning and organizational aspects-Inter dependency of planning and implementation of goals and measures-Measures of Urban drainage and flood control benefits-Effective urban water user organizations.

UNIT V OPERATIONS AND MAINTENANCE **9 Hrs**

General approaches to operations and maintenance-Complexity of operations and need for diagnostic analysis-Operation and Maintenance in urban water system-Maintenance management systems -Social awareness and involvement.

Total No. of Hours: 45

REFERENCES

1. Geiger.W.F.,Marsalek F., Rawls.W.J., and Zuidena.F.C., (Ed), " Manual on Drainage in rbanised areas-Vol-1 and Vol.II ", UNESCO, Academic Press,NewYork, 1987.
2. Hengeveld H. and De Voch.t(Ed)., " Role of Water in Urban Ecology ", 1982.
3. Martin P.Wanelista and Yousef., " Storm Water Management and Operations ",JohnWiley and Sons, 1993.
4. Neil S. Grigg., " Urban Water Infrastructure Planning - Management and Operations ", John Wiley and Sons, 1986.
5. Overtens D.E. and Meadows M.E., “Storm Water Modelling ", Academic Press, NewYork, 1976.

Course Code: EMEE22005	Course Name: ENVIRONMENTAL IMPACT ASSESSMENT	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	1/0	0/0	4
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To educate the students on the scope, steps involved and various methods related to assessment of environmental impact due to development projects

COURSE OUTCOMES (COs)

CO1	To know the scope and steps involved in the assessment of environmental impact
CO2	To understand various methods involved in assessment of environmental impact
CO3	Ability to understand the trends in EIA practice and evaluation criteria
CO4	Diagnosis the documentation and monitoring strategies
CO5	To prepare the EIA reports for various developmental projects

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	2	3	1	2	2	2	3
CO2	3	2	2	3	1	2	2	2	3
CO3	3	3	3	3	3	2	2	2	3
CO4	3	3	3	3	3	2	2	2	3
CO5	3	3	3	3	3	2	2	2	3

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
				√					

Course Code: EMEE22005	Course Name: ENVIRONMENTAL IMPACT ASSESSMENT	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	1/0	0/0	4
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I INTRODUCTION **12 Hrs**

Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS) - Environmental Risk Assesment (ERA) - Legal and Regulatory aspects in India - Types and limitations of EIA - Terms of Reference in EIA- Issues in EIA.

UNIT II COMPONENTS AND METHODS **12 Hrs**

Components - screening - setting - analysis - prediction of impacts - mitigation. Matrices - Networks - Checklists. Importance of assessment techniques - cost benefit analysis - analysis of alternatives - methods for Prediction and assessment of impacts - air - water - soil - noise - biological - cultural - social - economic environments. Standards and guidelines for evaluation. Public Participation in environmental decision making.

UNIT III QUALITY CONTROL **12 Hrs**

Trends in EIA practice and evaluation criteria - capacity building for quality assurance. Expert System in EIA – use of regulations and AQM.

UNIT IV DOCUMENTATION AND MONITORING **12 Hrs**

Document planning - collection and organization of relevant information – team writing - reminder checklists. Environmental monitoring - guidelines - policies - planning of monitoring programmes. Environmental Management plan. Post project audit.

UNIT V CASE STUDIES **12 Hrs**

Case studies of EIA of developmental projects -EIA for infrastructure projects – Dams – Highways – Multi-storey Buildings – Water Supply Projects – Waste water treatment plants, Municipal Solid waste processing plant, Airports.

Total No. of Hours: 60

REFERENCES

1. Canter, L.W., “Environmental Impact Assessment ", and McGraw Hill, New York, 1996.
2. Petts, J., “Handbook of Environmental Impact Assessment Vol. II and Blackwell Science “, London, 1999, I
3. The World Bank Group. “Environmental Assessment Sourcebook Vol. I, II and III ", the World Bank, Washington, 1991.

Course Code: EMEE22L01	Course Name: ENVIRONMENTAL QUALITY MEASUREMENTS LAB	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Lb	0	0/0	4/0	2
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- The experimental work involved in this laboratory shall make the student understand the basic concepts and train them in sampling and preservation methods as well as in the determination of pollutants present in air, water

COURSE OUTCOMES (COs)

CO1	To understand the quality of environment
CO2	To develop the skill for conducting treatability studies of water and wastewater treatment
CO3	To assess the physico-chemical parameters with various source
CO4	To assess the biological parameters with various source
CO5	To design and analyze various models on treatment units

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	3	3	2	2	3	2	3
CO2	3	2	3	3	3	2	3	3	2
CO3	3	3	3	3	3	2	2	2	1
CO4	3	3	3	3	3	2	3	1	2
CO5	3	3	3	3	3	2	3	1	1

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
									√

Course Code: EMEE22L01	Course Name: ENVIRONMENTAL QUALITY MEASUREMENTS LAB	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Lb	0	0/0	4/0	2
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

LIST OF EXPERIMENTS

1. Determination of fluorides
2. Determination of sulphates
3. Determination of residual chlorine
4. Determination of heavy metals
5. Coagulation and Flocculation
6. Water softening
7. Filter media characteristics
8. Disinfection for drinking water

Total No of Hours: 60

REFERENCES

1. Metcalf & Eddy, Inc. “Wastewater Engineering - Treatment ", Disposa and Reuse, Third Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi 1995.
2. Rich, L.G. “Unit Processes in Sanitary Engineering ", John Wiley & Sons, Inc.,New York, 1963
3. Willard. H., Merritt, L., Dean. D.A. and Settle. F.A. “Instrumental methods of analysis", CSS publishers, New Delhi, 1986.
4. C.W.Ewing “Instrumental Methods of Chemical Analyser ", 5th Edi., McGraw-Hill, New York ,1995
5. " Standard Methods for the examination of water and wastewater ", 20th Edition, APHA, Washington, 1998.

Course Code: EMEE22L04	Course Name: GEOGRAPHICAL INFORMATION SYSTEM LAB	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Lb	0	0/0	4/0	2
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To educate data analyses and data output capabilities of a standard GIS software.

COURSE OUTCOMES (COs)

CO1	To know the basics of GIS software
CO2	To give practical exposure to the students to data input, data storage
CO3	To know the data analysis using GIS
CO4	Ability to get data output using standard GIS software
CO5	To know the various applications of GIS

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	3	2	2	3	3
CO2	3	2	2	3	3	2	1	1	2
CO3	3	2	2	3	3	2	1	1	2
CO4	3	2	2	3	3	2	1	1	2
CO5	3	2	2	3	3	2	1	1	2

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
									√

Course Code: EMEE22L04	Course Name: GEOGRAPHICAL INFORMATION SYSTEM LAB	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Lb	0	0/0	4/0	2
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

LIST OF EXERCISES

1. Digitization-Point, line, polygon and surface data
2. Building topology-measuring distance and area
3. Adding attribute data
4. Digitization-Data conversion-vector to raster, raster to vector
5. Generation of DEM from contours, spot heights
6. Buffering and overlay analysis
7. Case studies with environmental quality models

Total No. of Hours: 60

REFERENCES

1. QGIS-1.8-UserGuide, http://docs.qgis.org/pdf/QGIS-1.8-UserGuide-en.pdf,2013
2. Getting to Know ArcGIS for Desktop,ISBN: 9781589483088 2013
3. Understanding GIS: An ArcGIS Project Workbook, ISBN: 9781589482425, 2011

Course Code EMEE22I01	Course Name TERM PAPER	T / L/ ETP/IE	L	T / S.Lr	P/ R	C
	Prerequisite : Nil	IE	0	0/0	0/4	2

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

A term paper is an elaborate research-based work on a particular topic in the domain of study. The student must choose a topic of his interest from the domain of study for a term paper. The term paper can be an original research article or review article. In case of review article, the student must refer at least 50 research/review articles and critically review other researcher's work. The term paper may be 10 -20 pages in length. The general guidelines for writing the term paper as follows:

1. Abstract
2. Introduction to explain about the broad and general statement on the topic chosen.
3. Aim /Objective of the term paper.
4. Description of methodology, concepts and arguments.
5. Identify the research gap and suggest possible future works.
6. Conclusion

Three reviews will be conducted to monitor the progress of the work. At the end of the semester, presentation must be made by the student and Viva-Voce examination will be conducted by the internal Examiner duly appointed by the Head of the department and the students will be evaluated.

SEMESTER-III

Course Code: EMEE22004	Course Name: ENVIRONMENTAL MANAGEMENT	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To educate the students on the management of water, air and solid waste in compliance with pollution laws

COURSE OUTCOMES (COs)

CO1	Understand the principles of pollution and its impacts
CO2	To know water quality management techniques
CO3	To understand air quality management techniques
CO4	Able to understand solid waste management techniques
CO5	Emphasise on environmental laws and environmental audits

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	3	2	2	2	2	2
CO2	3	2	2	3	2	2	2	2	2
CO3	3	2	2	3	2	2	2	2	2
CO4	3	2	2	3	2	2	2	2	2
CO5	3	2	2	3	2	2	2	3	3

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
				√					

Course Code: EMEE22004	Course Name: ENVIRONMENTAL MANAGEMENT	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I INTRODUCTION **9 Hrs**

Introduction – pollution control agencies – aims and objectives – legislative background– cost benefit analysis in Environmental Problems. Components of environment, land, water and air – natural quality – pollution and pollutants – sources – degree of pollution -efforts to prevent / control pollution.

UNIT II WATER QUALITY MANAGEMENT **9 Hrs**

Water quality management – concepts – components of water quality management – water uses – monitoring programmers – technology transfer – water treatment.

UNIT III AIR QUALITY MANAGEMENT **9 Hrs**

Air Quality management – emission inventory – ambient air quality– spotting of violations – corrective measures – technology transfer

UNIT IV SOLID WASTE MANAGEMENT **9 Hrs**

Solid waste management – land pollution from solid and liquid wastes – spotting of violations – corrective measures – technology transfer.

UNIT V ENVIRONMENTAL LAWS AND AUDIT **9 Hrs**

Environmental law – provisions in the law for initiating action – categories of violations - action – pollution control enforcement strategies – inspections. Environmental Audit – role of auditing – history – definitions - audit methodology – evaluating audit results - audit reports – case studies.

Total No. of Hours: 45

REFERENCES

1. “Water Quality Criteria”, Mekee and Welf., The Resources Agency of California, State Water Quality Control Board, California, 1963.
2. “Environmental Modeling Analysis and Management “, Dates, and Pan tell McGraw Hill, New York 1978.
3. “Manual on Urban Air Quality management’. Suess and Graxpord, Who Geneva, 1979.
4. “Environmental Analysis an Assessment”’ Suriyakumaran Co., UNEP UNAPDI, Bangkok, 1979.
5. “Background material on Environmental Audit”,Confederation of Indian Industry, New Delhi 1979.

Course Code: EMOL22I01	Course Name: OPEN ELECTIVE (NPTEL/SWAYAM/Any MOOC Online courses approved by AICTE/UGC)	Ty/Lb/ ETL	L	T/S.Lr	P/R	C
	Prerequisite: Nil	IE	3	0/0	0	3
L: Lecture T:Tutorial SLr: Supervised Learning P :Project R:ResearchC: Credits T/L/ETL: Theory/Lab/Embedded Theory and Lab						

Students should register for the online course with a minimum course duration of 8 weeks through the online portals such as NPTEL/SWAYAM/Any MOOC in the beginning of the semester. The course can be core/interdisciplinary in such a way that the same course is not repeated during the course of his study.

Students are expected to attend the online classes regularly and submit the weekly assignments before the due dates. Students should appear for the online examination and submit the certificate at the end of the semester. Internal examination will be conducted by the examiners duly appointed by the head of the department.

Course Code: EMEE22I02	Course Name: SUMMER INTERNSHIP	Ty/Lb/ ETL	L	T/S.Lr	P/R	C
	Prerequisite: UG Level In plant training	IE	0	0/0	4/0	2

L: LectureT:Tutorial SLr:SupervisedLearningP :ProjectR:ResearchC: CreditsT/L/ETL:Theory/Lab/EmbeddedTheoryandLab

OBJECTIVE : Students have to undergo three – week practical training in Civil Engineering related organizations sothat theybecome awareof the practical applicationsoftheoreticalconcepts studiedinthe classrooms.

COURSEOUTCOMES(COs) : (3-5)

CO1	Student will possess sound knowledge and experience in core
CO2	Student can correlate theoretical knowledge with practical experience
CO3	Student will be able to prepare report based on the experience gained
CO4	To make them understand the practical difficulties in the field
CO5	To make them understand on how to prepare the report for a particular area of Specialization

MappingofCourseOutcomeswithProgramOutcomes(POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9			
CO1	2	3	2	3	1	3	3	2	3			
CO2	2	3	2	3	1	3	3	2	3			
C03	2	3	2	3	1	3	3	2	2			
CO4	3	3	2	3	1	3	3	2	2			
CO5	3	3	3	3	3	3	3	2	2			

COs/PSOs	PSO1	PSO2	PSO3					
CO1	3	2	3					
CO2	2	2	3					
C03	2	2	3					
CO4	3	3	1					
CO5	3	3	1					

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	BasicSciences	EngineeringSciences	HumanitiesandSocialSciences	ProgramCore	ProgramElectives	OpenElectives	Interdisciplinary	Skill component	Practical / Project			
								√				
Approval												

Course Code: EMEE22I02	Course Name: SUMMER INTERNSHIP	Ty/Lb/ ETL	L	T/S.Lr	P/R	C
	Prerequisite: UG Level In plant training	IE	0	0/0	4/0	2
L: LectureT:Tutorial SLr:SupervisedLearningP :ProjectR:ResearchC: CreditsT/L/ETL:Theory/Lab/EmbeddedTheoryandLab						

OBJECTIVES

Students have to undergo three week practical training in Civil Engineering related organizations so that they become aware of the practical applications of theoretical concepts studied in the classrooms.

Students have to undergo three week practical training in Civil Engineering related organizations of their choice but with the approval of the department. At the end of the training, students will submit a report as per the prescribed format to the department.

Assessment process

This course is mandatory and a student has to pass the course to become eligible for the award of degree. The student shall make a presentation before a committee constituted by the department which will assess the student based on the report submitted and the presentation made. Marks will be awarded out of 100 and appropriate grades assigned as per the regulations.

Course Code EMEE22L05	Course Name DISSERTATION PHASE I	Ty/Lb/ ETL	L	T/S.Lr	P/R	C
	Pre requisite: UG Level Project	Lb	0	0/0	0/10	5
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To be capable of identifying a problem related to the program of study and carryout wholesome research on it leading to findings which will facilitate development of a new/improved product, process for the benefit of the society

COURSE OUTCOMES (COs)

CO1	Work in a team and develop multidisciplinary, research skills
CO2	Identifying the challenges and issues of the industry
CO3	Explore innovative ideas in civil engineering field
CO4	Develop projects based on industrial and field requirements
CO5	Develop design projects based on industrial requirements

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	2	2	3	3	3	3
CO2	2	3	3	2	2	3	2	3	3
CO3	3	3	3	3	2	3	3	3	3
CO4	3	3	3	2	2	2	3	3	3
CO5	3	3	3	2	2	2	3	3	3

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
									√

Course Code EMEE22L05	Course Name DISSERTATION PHASE I	Ty/Lb/ ETL	L	T/S.Lr	P/R	C
	Pre requisite: UG Level Project	Lb	0	0/0	0/10	5
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVE

Students should select the area of the project work and complete the literature survey. Student should identify the problem of study and start the work. Students are expected to do the project work **individually**. A guide will be allotted to each student based on the area of the Project work. Project reviews will be conducted once in a fortnight to assess the development of the project work.

At the end of the semester students should submit a report of the work completed and should appear for a Project Viva- voce examination conducted by the internal examiner.

Continuous assessment mark (50 marks) will be awarded based on the performance in the reviews.

End semester mark (50 marks) will be awarded for project viva voce examination.

SEMESTER-IV

Course Code EMEE22L06	Course Name DISSERTATION PHASE II	Ty/Lb/ ETL	L	T/S.Lr	P/R	C
	Pre requisite: Dissertation Phase I	Lb	0	0/0	10/10	10
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- The student shall be capable of identifying a problem related to the program of study and carry out wholesome research on it leading to findings which will facilitate development of a new/improved product, process for the benefit of the society

COURSE OUTCOMES (COs)

CO1	Work in a team and develop multidisciplinary, research skills
CO2	Identifying the challenges and issues of the industry
CO3	Explore innovative ideas in civil engineering field
CO4	Develop projects based on industrial and field requirements
CO5	Develop design projects based on industrial requirements

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	2	2	3	3	3	3
CO2	2	3	3	2	2	3	2	3	3
CO3	3	3	3	3	2	3	3	3	3
CO4	3	3	3	2	2	2	3	3	3
CO5	3	3	3	2	2	2	3	3	3

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
									√

Course Code EMEE22L06	Course Name DISSERTATION PHASE II	Ty/Lb/ ETL	L	T/S.Lr	P/R	C
	Pre requisite: Dissertation Phase I	Lb	0	0/0	10/10	10
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVE

Students are expected to do a Project work either in an Industry or at the University in the area of specialization individually. Each student will be allotted a guide based on the area of Project work

Number of reviews will be conducted during the semester to monitor the development of project. Students have to submit the thesis at the end of the semester and appear for the Project Viva-Voce examination conducted by one internal examiner and one external examiner.

It is mandatory that the student should have presented his project work as a technical paper in National/international conference /Journals. A copy of the certificate in proof of paper presentation should be enclosed in the project report.

50% weightage (100 marks) will be given for the continuous assessment and 50% weightage (100 marks) for the Project viva a voce examination.

Course Code: EMEE22I03	Course Name: RESEARCH PUBLICATION	Ty/Lb/ ETL	L	T/S.Lr	P/R	C
	Prerequisite: Nil	IE	0	0/0	2/2	2

L: LectureT:Tutorial SLr:SupervisedLearningP :ProjectR:ResearchC: CreditsT/L/ETL:Theory/Lab/EmbeddedTheoryandLab

Students are supposed to prepare and publish the article based on either his term paper or area of research in peer reviewed referred journal. Code of research publication ethics should be followed. After publishing the article students should present a seminar in presence of department faculties and PG students. At the end of semester viva examination will be conducted by the examiners appointed by the Head of the department.

PROGRAM ELECTIVE-I

Course Code EMEE22E01	Course Name PRINCIPLES AND DESIGN OF PHYSICO-CHEMICAL TREATMENT SYSTEMS	Ty/Lb /ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To educate the students on the working principles and design of various physical and chemical treatment systems for water and wastewater

COURSE OUTCOMES (COs)

CO1	To know various classifications of pollutants
CO2	To understand the design principles of aerobic and anaerobic treatments
CO3	To understand the physical and chemical treatments systems of water and waste water
CO4	To know the process of sludge management processes
CO5	To effectively manage multiple water and waste water quality objectives while maintaining regulatory compliance and their field application

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	2	3	2	3	2	1	1
CO2	3	3	3	2	3	2	1	1	1
CO3	3	3	3	2	3	2	1	1	1
CO4	2	3	2	2	3	2	1	1	1
CO5	2	3	2	2	3	2	1	2	1

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
					√				

Course Code EMEE22E01	Course Name PRINCIPLES AND DESIGN OF PHYSICO-CHEMICAL TREATMENT SYSTEMS	Ty/Lb /ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I CLASSIFICATION OF POLLUTANTS **9 Hrs**

Water and wastewater pollutants– pollutant characteristics, quality standards, significance of physico-chemical treatment – selection criteria-types of reactor- reactor selection-batch-continuous type.

UNIT II PHYSICAL TREATMENT **9 Hrs**

Principles of Screening – Sedimentation – Filtration –back washing – Evaporation – Incineration – gas transfer – mass transfer - Adsorption –Reverse Osmosis, Nano filtration, ultra filtration and hyper filtration – electro dialysis, distillation –Recent Advances.

UNIT III CHEMICAL TREATMENT **9 Hrs**

Principles of Chemical treatment – Coagulation & flocculation – Precipitation – flotation -solidification and stabilization – Disinfection, Ion exchange, Electrolytic methods.

UNIT IV DESIGN OF WATER TREATMENT PLANTS **9 Hrs**

Selection of Treatment process– Aerators – chemical feeding – Flocculation – clarifiers – Tube settlers – Rapid sand filters - slow sand filter, pressure filter. Design of municipal water treatment units, Selection of Water Treatment Units for Industries – Design of softeners – Design of Industrial Water Treatment Units -flow charts – Layouts.

UNIT V DESIGN OF WASTEWATER TREATMENT PLANTS **9 Hrs**

Design of municipal wastewater treatment units-screens-detritus tank-grit chamber-settling tanks-sludge thickening-sludge dewatering-sludge drying beds - Design of Industrial Wastewater Treatment Units-Equalization-Neutralization-Chemical Feeding Devices-mixers-floatation units-oil skimmer.

Total No of Hours: 45

REFERENCES

1. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw Hill, New Delhi, 2003.
2. Qasim, S.R., Motley, E.M. and Zhu.G. Water works Engineering – Planning, Design and Operation, Prentice Hall, New Delhi, 2002.
3. Lee, C.C. and Shun dar Lin, Handbook of Environmental Engineering Calculations, Mc Graw Hill, New York, 1999.
4. Hendricks, D. ‘Water Treatment Unit Processes – Physical and Chemical’ CRC Press, New York 2006

Course Code EMEE22E02	Course Name ECOLOGICAL ENGINEERING	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To understand the basic concepts of environmental issues, evolution, biodiversity and impact on various environments such as water, wastewater, human health, climatic change, internal and external earth structures.

COURSE OUTCOMES (COs)

CO1	To understand the basic concepts of environmental issues, evolution, biodiversity,etc
CO2	To know the impact on various environments such as water, wastewater, human health, climatic change, internal and external earth structures
CO3	Creates knowledge about ecology, ecosystems and its types, ecological engineered systems and the various biogeochemical cycles
CO4	To have knowledge on eco technology for waste treatment
CO5	To know integrated ecological engineering systems

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	2	1	2	3	2
CO2	3	3	3	3	2	1	1	2	1
CO3	2	3	3	3	3	2	1	2	1
CO4	2	3	2	3	2	1	1	1	1
CO5	3	3	3	3	3	1	1	2	1

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
					√				

Course Code EMEE22E02	Course Name ECOLOGICAL ENGINEERING	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I INTRODUCTION TO ECOLOGY AND ECOLOGICAL ENGINEERING **9 Hrs**

Aim - scope and applications of Ecology, Ecological Engineering and Ecotechnology and their relevance to human civilization - Development and evolution of ecosystems - Principles and concepts pertaining to communities in ecosystem - Energy flow and material cycling in ecosystems - Productivity in ecosystems.

UNIT II SYSTEMS APPORACH IN ECOLOGICAL ENGINNERING **9 Hrs**

Classification of ecotechnology - Principles and components of Systems and Modeling - Structural and functional interactions in environmental systems - Human modifications of environmental systems.

UNIT III ECOLOGICAL ENGINEERING PROCESSES **9 Hrs**

Self organizing processes - Multiple seeded microcosms- Interface coupling in ecological systems - Concept of energy - Adapting ecological engineering systems to potentially catastrophic events - Agro ecosystems – Determination of sustainable loading of ecosystems.

UNIT IV ECOTECHNOLOGY FOR WASTE TREATMENT **9 Hrs**

Principles and operation of soil infiltration systems - wetlands and ponds - source separation systems-aqua cultural systems - detritus based treatment for solid wastes - Applications of ecological engineering marine systems.

UNIT V CASE STUDIES **9 Hrs**

Case studies of integrated ecological engineering systems.

Total No of Hours: 45

REFERENCES

1. Mitsch, J.W. & Jorgensen, S.E., Ecological Engg - “An Introduction to Ecotechnology ", John Wiley & Sons, New York, 1989.
2. White, I.D, Mottershed, D.N and Harrison, S.J., “Environmental Systems” – An, Chapman, Hall, London, 1994.

Course Code EMEE22E03	Course Name CHEMISTRY OF ENVIRONMENT	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To educate the students in the area of organic, water, air and chemistry

COURSE OUTCOMES (COs)

CO1	Theoretical basis and observational methods for study of contaminants and interactions in the environment
CO2	Gain competency in solving environmental issues of chemicals based pollution
CO3	Ability to determine chemicals mobility in aquatic systems
CO4	Understand the type of heavy metals and provide remediation
CO5	Identify emerging environmental contaminants including speciation

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	2	1	2	3	2
CO2	3	3	3	3	2	1	1	2	1
CO3	2	3	3	3	3	2	1	2	1
CO4	2	3	2	3	2	1	1	1	1
CO5	3	3	3	3	3	1	1	2	1

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
					√				

Course Code EMEE22E03	Course Name CHEMISTRY OF ENVIRONMENT	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I FUNDAMENTAL PHYSICAL CHEMISTRY **9 Hrs**

Law of mass action - Chemical equilibria - Chemical kinetics-Zero , First, Second orders - Chemistry of colloids – Stability - Redox potential - Partition coefficient - Photo catalysis.

UNIT II ORGANIC AND BIOCHEMISTRY **9 Hrs**

Common organic reactions - Enzymes and factors influencing enzymic reactions - Biodegradability –QSAR

UNIT III AQUATIC CHEMISTRY **9 Hrs**

Abiotic and biotic interactions in aqueous system - Exchange process - Speciation - Transformation and degradation - IRC priority compounds - Risk evaluation of environmental chemicals.

UNIT IV ATMOSPHERIC CHEMISTRY **9 Hrs**

Chemical and photochemical reactions - Ozone - PAN - Acid rain - Ozone layer depletion - Green house gases and global warming.

UNIT V ENVIRONMENTAL CHEMICALS **9 Hrs**

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 No of Hours: 45

REFERENCES

1. Sawyer, C.N. and McCarty, P.L., and Parkin, G.F. “Chemistry for Environmental Engineers ", 4th Edn. McGraw Hill, New Delhi, 1994
2. De.A.K. “Environmental Chemistry ", New Age International Ltd., New Delhi, 1995
3. " Standard Methods for the Examination of Water and Wastewater ", 20th Edn., American 1998
4. Public Health Association, Washington. D.C. 1998 of Hazardous waste treatment and Disposal, 2nd Edition, McGraw-Hill, New York, 1997

PROGRAM ELECTIVE–II

Course Code EMEE22E04	Course Name INSTRUMENTAL MONITORING OF ENVIRONMENT	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To educate the students about instrumental monitoring of environment

COURSE OUTCOMES (COs)

CO1	To know various instruments used for analysis of air water and soil.
CO2	To gain basic knowledge about the instrumental monitoring of environment and apply the same in the field application.
CO3	Understand the concept of various instrumentation techniques
CO4	To adopt the methodologies involved in air quality monitoring
CO5	To analyse electro and radio analytical methods

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	3	1	2	3	2
CO2	3	3	3	3	2	1	1	2	1
CO3	3	3	3	3	3	2	1	2	1
CO4	2	3	2	3	2	1	1	1	1
CO5	3	3	3	3	3	1	1	2	1

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
					√				

Course Code EMEE22E04	Course Name INSTRUMENTAL MONITORING OF ENVIRONMENT	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I SPECTRO ANALYTICAL METHODS **9 Hrs**

Colorimetry and spectrophotometry, fluorimetry, nephelometry and turbidimetry, flame absorption spectrometry and emission spectrometry. Instrumental Methods, Selection of method, Precision and Accuracy, Errors in measuring signals**.**

UNIT II CHROMATOGRAPHIC METHODS **9 Hrs**

Classical methods, Gas chromatography, HPLC and Ion chromatography.

UNIT III ELECTRO AND RADIO ANALYTICAL METHODS **9 Hrs**

Conductometry, potentiometry, calorimetry, polarography, NAA and XRF.

UNIT IV CONTINUOUS MONITORING INSTRUMENTS **9 Hrs**

NDIR for CO, chemiluminescent analyzer for NOx, Fluorescent analyser for SO_2, Auto analyser for water quality using flow injection analysis.

UNIT V APPLICATION OF METHODS **9 Hrs**

Use of Nephelometer, ion meter, spectrophotometer, AAS, Flame photometer, GC, for analyses of environmental samples.

Total No of Hours: 45

REFERENCES

1. Willard. H., Merritt, L., Dean. D.A. and Settle. F.A. “Instrumental methods of analysis", CSS publishers, New Delhi, 1986.
2. C.W.Ewing “Instrumental Methods of Chemical Analyser ", 5th Edi., McGraw-Hill, New York, 1995
3. " Standard Methods for the examination of water and wastewater ", 20th Edition, APHA, Washington, 1998

Course Code EMEE22E05	Course Name CLEANER PRODUCTION	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To develop a basic knowledge about sustainability and cleaner production for industrial applications.

COURSE OUTCOMES (COs)

CO1	To know management principles related to cleaner production pollution prevention, environmental policies and legislations
CO2	Understand sustainable development and its related environmental legislations
CO3	To know cleaner production concepts and its industrial applications
CO4	Outline and Articulate CP, LCA, EMS and EA for industrial applications
CO5	To assess life cycle assessment and environmental management systems

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	3	3	2	1	1	2	2
CO2	2	2	3	2	3	1	1	2	3
CO3	2	3	3	3	2	2	1	1	3
CO4	3	2	2	3	3	1	1	3	3
CO5	3	3	3	3	2	2	2	2	2

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
					√				

Course Code EMEE22E05	Course Name CLEANER PRODUCTION	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I INTRODUCTION **9 Hrs**

Sustainable Development - Sustainability Indicators - Sustainability Strategies - Barriers to Sustainability – Industrial activity and Environment - Industrialization and sustainable development - Industrial Ecology – Cleaner Production (CP) in Achieving Sustainability - Prevention versus Control of industrial Pollution – Environmental Policies and Legislations

UNIT II CLEANER PRODUCTION CONCEPT **9 Hrs**

Definition - Importance - Historical evolution - Benefits - Promotion - Barriers - Role of Industry, Government and Institutions - Environmental Management Hierarchy - Source Reduction Techniques - Process and equipment optimization, reuse, recovery, recycle, raw material substitution.

UNIT III CLEANER PRODUCTION PROJECT DEVELOPMENTAND IMPLEMENTATION 9 Hrs

Overview of CP Assessment -Steps and Skills, Site Visits, Information Gathering - Process Flow Diagram, Material Balance, CP Option Generation - Technical and Environmental Feasibility analysis – Economic valuation of alternatives - Total Cost analysis - CP Financing - Cleaner Production Awareness Plan - Waste audit.

UNIT IV LIFE CYCLE ASSESSMENT AND ENVIRONMENTAL MANAGEMENT SYSTEMS 9 Hrs

Elements of LCA - Life Cycle Costing - Eco Labelling – International Environmental Standards - ISO 14001 - Environmental audit.

UNIT V CASE STUDIES **9 Hrs**

Industrial applications of CP, LCA, EMS and Environmental Audits – Audit report preparation.

Total No of Hours : 45

REFERENCES

1. Paul L Bishop (2000) " Pollution Prevention: Fundamentals and Practice “ McGraw-Hill International New York.
2. World Bank Group (1998) “Pollution Prevention and Abatement Handbook” “Towards Cleaner Production ", World Bank and UNEP, Washington D.C.
3. Prasad modak, C.Viswanathan and Mandarparasnis (1995)"Cleaner Production Audit ", Environmental System Reviews, No.38, Asian Institute of Technology, Bangkok.

Course Code EMEE22E06	Course Name AIR POLLUTION AND CONTROL	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

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

COURSE OUTCOMES (COs)

CO1	Understand the causes and effects of air pollution
CO2	To understand the various interrelated aspects of air pollution control and the basic terminologies
CO3	To analyse control methods for gaseous and particulate pollutants
CO4	Air and noise control measures for industrial applications
CO5	Understanding of some of the technical aspects of regulating, measuring, and controlling air pollution

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	3	1	2	3	2
CO2	3	3	3	3	2	1	1	2	1
CO3	3	3	3	3	3	2	1	2	1
CO4	2	3	2	3	2	1	1	1	1
CO5	3	3	3	3	3	1	1	2	1

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
					√				

Course Code EMEE22E06	Course Name AIR POLLUTION AND CONTROL	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I INTRODUCTION **9 Hrs**

Sources and classification of Air Pollutants -Natural contaminants - aerosol -gases and vapour. Air quality standards - Meteorology and Air pollution - Atmospheric stability and inversions-mixing height-plume behavior –plume rise estimation - effluent dispersion theories-Isokinetic sampling- Modeling.

UNIT II CONTROL OF PARTICULATES **9 Hrs**

Objectives - Filters, gravitational, centrifugal-multiple type cyclones, prediction of collection efficiency, pressure drop, wet collectors, Electrostatic Precipitation theory-particle charging-particle collection-ESP design procedure.

UNIT III GASEOUS POLLUTANT CONTROL **9 Hrs**

Absorption: principles, description of equipment-packed and plate columns, design and performance equations. Adsorption: principal adsorbents, equipment descriptions-PSA-adsorption cycle-solvent recovery system-continuous rotary bed-fluidized bed, Design and performance equations. Condensation: contact condensers-shell and tube condensers, design and performance equation. Incineration: hydrocarbon incineration kinetics, equipment description, design and performance equations.

UNIT IV AIR POLLUTION CONTROL MEASURES FOR INDUSTRIAL APPLICATIONS **9 Hrs**

Control methods - Processes based control mechanisms - mineral products -asphalt concrete, cement plants and glass manufacturing plants; Thermal power plants, Petroleum refining and storage plants, Fertilizers, Pharmaceuticals and wood processing industry. Field Study.

UNIT V NOISE CONTROL **9 Hrs**

Noise Standards, measurement, control and preventive measures.

Total No of Hours: 45

REFERENCE

1. Richard w. Boubel et al, “Fundamentals of Air Pollution ", Academic Press, New York, 1994.
2. Noel de Nevers, “Air Pollution control Engg. “ McGraw-Hill, New York, 1995.
3. M. N. Rao et al, “Air Pollution ", Tata McGraw Hill, New York, 1989.

PROGRAM ELECTIVE-III

Course Code EMEE22E07	Course Name ENVIRONMENT, HEALTH AND SAFETY IN INDUSTRIES	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To understand the basic needs of safety in human health, environmental safety, etc

COURSE OUTCOMES (COs)

CO1	To understand the needs of safety in human health, environmental safety, electrical safety, safety against accidents and fire safety in various industries
CO2	To know the need for safe environment and safety systems in work place
CO3	To summarize occupational health hazards, hazard exposures and environmental monitoring
CO4	To know about various techniques used in environmental safety aspects
CO5	Outline the techniques of environmental safety and training programs for industries

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	3	3	3	1	2	3	2
CO2	3	3	3	3	2	1	1	2	1
CO3	3	2	3	3	3	2	1	2	1
CO4	2	3	2	3	2	1	1	1	1
CO5	3	3	3	3	3	1	1	2	3

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
					√				

Course Code EMEE22E07	Course Name ENVIRONMENT, HEALTH AND SAFETY IN INDUSTRIES	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I INTRODUCTION **9 Hrs**

Need for developing Environment, Health and Safety systems in work places, Status and relationship of Acts, Regulations and Codes of Practice, Role of trade union safety representatives - International initiatives, Ergonomics and work place.

UNIT II OCCUPATIONAL HEALTH AND HYGIENE **9 Hrs**

Definition of occupational health and hygiene, Categories of health hazards, Exposure pathways and human responses to hazardous and toxic substances, Advantages and limitations of environmental monitoring and occupational exposure limits, Hierarchy of control measures for occupational health risks, Role of personal protective equipment and the selection criteria.

UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS **9 Hrs**

Features of the satisfactory design of work premises HVAC, ventilation. Safe installation and use of electrical supplies, Fire safety and first aid provision, Safe systems of work for manual handling operations, Control methods to eliminate or reduce the risks arising from the use of work equipment, Procedures and precautionary measures necessary when handling hazardous substances.

UNIT IV TECHNIQUES OF ENVIRONMENTAL SAFETY **9 Hrs**

Elements of a health and safety policy and effective methods of implementation and review, Functions and techniques of risk assessment, inspections and audits, Investigation of accidents- Principles of quality management systems in health and safety management, safety policies and risk assessments, Records and other documentation required by an organisation for health and safety.

UNIT V EDUCATION AND TRAINING **9 Hrs**

Requirements for and benefits of the provision of information, instruction, training and supervision, Factors to be considered in the development of effective training programmes, Principles and methods of effective training, Feedback and evaluation mechanism.

Total No. of Hours: 45

REFERENCES

1. Environmental and Health and Safety Management by Nicholas P. Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995
2. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ. Effective Environmental, Health, and Safety Management Using theTeam Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services 2005

Course Code EMEE22E08	Course Name AIR AND WATER QUALITY MODELING	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To educate the students in air and water quality modelling

COURSE OUTCOMES (COs)

CO1	To have a basic modelling knowledge
CO2	To understand mathematical models and modelling methodologies
CO3	To summarize water and air quality models
CO4	To have a wide knowledge on surface and ground water quality modelling
CO5	Development and application of air and water quality models with computer applications

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	3	3	3	1	2	3	2
CO2	3	3	3	3	2	1	1	2	1
CO3	3	2	3	3	3	2	1	2	1
CO4	3	3	2	3	2	1	1	1	1
CO5	3	3	3	3	3	1	2	2	3

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
					√				

Course Code EMEE22E08	Course Name AIR AND WATER QUALITY MODELING	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I SYSTEMS APPROACH **9 Hrs**

Water and air quality management - Role of mathematical models; systems approach - systems and models – kinds of mathematical models - model development and validation effluent and stream standards; ambient air quality standards.

UNIT II SURFACE WATER QUALITY MODELLING **9 Hrs**

Historical development of water quality models; rivers and streams water quality modeling - river hydrology and flow - low flow analysis - dispersion and mixing - flow, depth, and velocity - estuaries - estuarine transport, net estuation flow, estuary dispersion coefficient; Lakes and impoundments - water quality response to inputs; water quality modeling process - model sensitivity - assessing model performance ; Models for dissolved oxygen, pathogens; Streeter - Phelps models.

UNIT III AIR QUALITY MODELLING **9 Hrs**

Transport and dispersion of air pollutants - wind velocity, wind speed and turbulence; estimating concentrations from point sources - the Gaussian Equation - determination of dispersion parameters, atmospheric stability; dispersion instrumentation - Atmospheric traces; concentration variation with averaging time; Air pollution modeling and prediction - Plume rise, modeling techniques, modeling for noncreative pollutants, single source – short term impact; multiple sources and area sources; model performance, accuracy and utilization; computer models.

UNIT IV GROUNDWATER QUALITY MODELLING **9 Hrs**

Mass transport of solutes, degradation of organic compounds, application of concepts to predict groundwater contaminant movement.

UNIT V COMPUTER MODELS **9 Hrs**

Exposure to computer models for surface water quality, groundwater quality and air quality.

Total No. of Hours: 45

REFERENCES

1. Steven C.Chapra, “Surface Water quality modeling ", The McGraw-Hill- Companies, Inc., New York, 1997.
2. R.W.Boubel, D.L. Fox, D.B. Turner & A.C. Stern, “Fundamentals of Air pollution ", Academic Press, New York, 1994.
3. Ralph A. Wurbs, “Water Management Models - A Guide to Software ", Prentice Hall PTR, New Jersey, 1995.

Course Code EMEE22E09	Course Name MEMBRANE TECHNOLOGIES FOR WATER AND WASTEWATER TREATMENT	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To educate the concept and principles of membrane separation

COURSE OUTCOMES (COs)

CO1	To understand the principles and theory behind membrane separation
CO2	To have knowledge on the membrane processes and systems
CO3	To study basic fundamentals and principles of membrane bioreactor
CO4	To know different pretreatment systems
CO5	To know the design aspects of pre-treatment systems and emphasis on zero discharge concept

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	3	3	3	1	2	3	1
CO2	3	3	3	3	2	1	1	2	1
CO3	3	2	3	3	3	2	1	2	1
CO4	3	3	2	3	2	1	1	1	1
CO5	3	3	3	3	3	1	2	2	1

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
					√				

Course Code EMEE22E09	Course Name MEMBRANE TECHNOLOGIES FOR WATER AND WASTEWATER TREATMENT	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I INTRODUCTION **9 Hrs**

Solid Liquid separation systems-Filtration systems- Theory of Membrane separation – mass Transport Characteristics Cross Flow filtration-Membrane Filtration- Types and choice of membranes, porous, non porous, symmetric and asymmetric – Plate and Frame, spiral wound and hollow fiber membranes – Liquid Membranes.

UNIT II MEMBRANE PROCESSES AND SYSTEMS **9 Hrs**

Microfiltration – Ultrafiltration - Nano Filtration – Reverse Osmosis – Electro dialysis Pervaporation -Membrane manufactures – Membrane Module/Element designs – Membrane System components – Design of Membrane systems - pump types and Pump selection – Plant operations – Economics of Membrane systems.

UNIT III MEMBRANE BIOREACTORS **9 Hrs**

Introduction and Historical Perspective of MBRs, Biotreatment Fundamentals, Biomass Separation MBR Principles, Fouling and Fouling Control, MBR Design Principles, Design Assignment, Alternative MBR Configurations, Commercial Technologies, Case Studies.

UNIT IV PRETREATMENT SYSTEMS **9 Hrs**

Membrane Fouling – Pretreatment methods and strategies – monitoring of Pretreatment – Langlier Index, Silt Density Index, Chemical cleaning, Bio foulant control.

UNIT V CASE STUDIES **9 Hrs**

Case studies on the design of membrane-based water and wastewater treatment systems – zero Liquid effluent discharge Plants.

Total No. of Hours: 45

REFERENCES

1. Water Environment Federation (WEF), Membrane Systems for Wastewater Treatment, McGraw-Hill, USA, 2005
2. Symon Jud, MBR Book – Principles and application of MBR in water and wastewater treatment, Elservier, 2006
3. K. Yamamoto and Urase T, Membrane Technology in Environmental management, special issue, Water Science and technology, Vol.41, IWAPublishing, 2000
4. Jorgen Wagner, Membrane Filtration handbook, Practical Tips and Hints, Second Edition, Revision2, Osmonics Inc., 2001
5. Mulder, M., Basic Principle of Membrane Technology, Kluwer Academic Publishers, 1996
6. Noble, R.D. and Stern, S.A., Membrane Separations Technology: Principles and Applications, Elservier, 1995

PROGRAM ELECTIVE– IV

Course Code EMEE22E10	Course Name GROUND WATER POLLUTION	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To impart knowledge on ground water properties, flow nets, solute transport, ground water contamination and modeling of ground water systems

COURSE OUTCOMES (COs)

CO1	To get knowledge on ground water properties, flow nets, solute transport, etc
CO2	To know about ground water contamination and prevention methods
CO3	Better understanding level in hydrologic cycle
CO4	To have a knowledge on modelling of ground water systems
CO5	To know chemical properties and principles associate with ground water pollution

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3	3	1	2	3	1
CO2	3	3	3	3	2	1	1	2	1
CO3	3	2	3	3	3	2	1	2	1
CO4	3	3	3	2	2	1	1	1	1
CO5	3	3	3	3	3	1	2	2	1

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
					√				

Course Code EMEE22E10	Course Name GROUND WATER POLLUTION	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I INTRODUCTION **9 Hrs**

Ground water and the hydrologic cycles-Ground water as a resource-Ground water contamination-Ground water as a Geotechnical Problem-Ground water and geologic processes. Physical properties and principles-Darcy's Law-Hydraulic Head and Fluid Potential-piezometers and Nests. Hydraulic conductivity and permeability-Homogeneity and Anisotropy-porosity and voids Ratio-Unsaturated flow and the water table-Steady state flow and Transient Flow-compressibility and effective stress-Transmissivity and storability-Equations of Ground water flow-Limitations of Darcian Approach-hydro dynamic dispersion.

UNIT II HYDROLOGIC CYCLE AND FLOWNET **9 Hrs**

Flow nets-Graphical construction-Flow nets by numerical simulation, steady state Regional Ground water Flow-Steady state hydrologic-budgets-Fluctuations in ground water levels.

UNIT III RESOURCE EVALUTION **9 Hrs**

Development of Ground water Resources-Exploration for Aquifers-the response of Ideal acquirers to pumping-Measurement of parameters -Laboratory tests-Piezometer test-pumping tests-Estimation of saturated hydraulic conductivity-Numerical simulation for aquifers yield prediction-Artificial recharge and induced infiltration-Land subsidence-sea water intrusion

UNIT IV CHEMICAL PROPERTIES AND PRINCIPLES **9 Hrs**

Constituents-chemical equilibrium-Association and Dissociation of dissolved species-effects of concentration Gradients-Mineral dissolution and solubility-Oxidation and Reduction Process-Ion exchange and Adsorption-Environmental isotopes-Field Measurement of Index parameters. Chemical Evolution: Hydro Chemical Facies-Ground water in carbonate terrain-Ground water in crystalline rocks-Ground Water in complex sedimentary systems-Geo chemical interpretation of 14C Dates-process rates and molecular diffusion.

UNIT V SOLUTE TRANSPORT **9 Hrs**

Water quality standards-Transport process-nonreactive constituents in homogeneous media and Heterogenous media-Transport in Fracture media- Hydrochemicalbehaviour of contaminants-Trace metals-Nitrogen-Trace nonmetals organic substances-Measurement of parameters-velocity-dispersivity-chemical partitioning-Sources of contamination-Land disposal of solid wastes-Sewage disposal on Land.

Total No. of Hours: 45

REFERENCES

1. Randall J. Charbeneau, “Ground Water Hydraulics and Pollutant Transport “Prentice Hall.Inc New Delhi, 2000
2. Allen Freeze, R. and John A. Cherry, "Ground Water ". Prentice Hall.Inc New Delhi.1979

Course Code EMEE22E11	Course Name MARINE POLLUTION & CONTROL	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To educate marine pollution and methods for monitoring, modeling and control.

COURSE OUTCOMES (COs)

CO1	To educate the coastal and marine environment
CO2	Ability to know about the physical concepts lying behind the oceanic currents and natural processes of various activities happening over the marine environment
CO3	To acquire knowledge on the marine pollution and the effect of the same on the ecology
CO4	Should have gained knowledge on remote sensing and various other techniques for measuring and monitoring oceanic environment parameters
CO5	Should have acquired knowledge on control of marine pollution and sustainable development

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	3	3	2	1	2	2	1
CO2	2	3	3	3	2	1	1	2	1
CO3	3	2	3	3	3	2	1	2	1
CO4	3	3	3	2	2	1	1	1	1
CO5	3	3	2	3	3	1	2	2	1

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
					√				

Course Code EMEE22E11	Course Name MARINE POLLUTION & CONTROL	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I MARINE ENVIRONMENT **9 Hrs**

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 HYDRODYNAMICS **9 Hrs**

Wave Theory, Waves in shallow waters – Refraction, Diffraction and Shoaling, Approximations for ndeep and shallow water conditions – Tidal Classification - General circulation of ocean waters -mOcean currents - Coastal sediment transport - Onshore offshore sediment transport - Beach mformation and coastal processes - Tsunamis, storm surge.

UNIT III MARINE POLLUTION SOURCES AND EFFECTS **9 Hrs**

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 m ecosystems – Marine discharges and effluent standards

UNIT IV MONITORING OF MARINE POLLUTION **9 Hrs**

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 MARINE POLLUTION CONTROL AND ICZM **9 Hrs**

Design of out falls-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 No. of Hours: 45

REFERENCES

1. "Marine Pollution (5th Edition) R.B. Clark, C. Frid and M Atttrill Oxford Science Publications, 2001
2. Marine pollution Dr.P.C.Sinha , Anmol Publications Pvt. Ltd, 1998
3. "Problems of Marine Pollution" : India and Canada, Raghavan, Sudha , Eastern Book Corporation, Delhi, India
4. Laws, E.A., "Aquatic pollution", an introductory text. John Wiley and Sons, Inc., New York, 2000

Course Code EMEE22E12	Course Name CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To understand the concept of Global Warming, the impact of climate change on society and its mitigation measures

COURSE OUTCOMES (COs)

CO1	To understand the concept of climate change and its consequences
CO2	To adopt the methodologies in finding the changes in climate
CO3	To recall global climate changing process by understanding the natural systems, classify climate change adaptations and its mitigation measures
CO4	To know climate change observations and international initiatives to abate it
CO5	To analyse the impacts of climate change, clean technology and energy

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	2	3	2	1	1	1	1
CO2	3	3	3	3	3	1	1	2	1
CO3	3	2	3	3	3	2	1	2	1
CO4	2	3	3	2	2	1	1	1	1
CO5	3	3	2	3	3	1	2	2	1

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
					√				

Course Code EMEE22E12	Course Name CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I EARTH'S CLIMATE SYSTEM **9 Hrs**

Introduction-Climate in the spotlight - 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 – El Nino and its Effect - Solar Radiation –The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.

UNIT II CAUSES OF CLIMATE CHANGE **9 Hrs**

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 EFFECTS OF CLIMATE CHANGE **9 Hrs**

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methododology 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 Hrs**

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 - Carbon sequestration – Carbon capture and storage (CCS)- Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

UNIT V CLEAN TECHNOLOGY AND ENERGY **9 Hrs**

Clean Development Mechanism –Carbon Trading- future Clean Technology – Biodiesel – Natural Compost – Eco-Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding.

Total No. of Hours: 45

REFERENCES

1. Anil Markandya , Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002
2. Heal, G. M., Interpreting Sustainability, in Sustainability: Dynamics and Uncertainty, Kluwer Academic Publ., 1998
3. Jepma, C.J., and Munasinghe, M., Climate Change Policy – Facts, Issues and Analysis, Cambridge Press, 1998
4. Munasinghe, M., Sustainable Energy Development: Issues and Policy in Energy, Environment and Economy: Asian Perspective, Kleindorfor P. R. et. al (ed.), Edward Elgar, 1996
5. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge Press India Pvt. Ltd, 2007

PROGRAM ELECTIVE– V

Course Code EMEE22E13	Course Name ENVIRONMENTAL ENGINEERING STRUCTURES	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To develop a basic knowledge about the environmental engineering structures and apply the same in the field application

COURSE OUTCOMES (COs)

CO1	To educate the structural design principles
CO2	To know the aspects of water retaining structures design
CO3	To have knowledge on design of masonry and steel structures used in environmental engineering
CO4	Ability to do structural design of concrete and steel pipes
CO5	Ability to design underground water storage structures

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	2	1	1	1	1
CO2	3	3	3	3	3	1	1	2	2
CO3	3	2	3	3	3	2	2	2	1
CO4	3	3	3	2	2	1	1	1	1
CO5	3	3	2	3	3	1	2	2	2

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
					√				

Course Code EMEE22E13	Course Name ENVIRONMENTAL ENGINEERING STRUCTURES	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I DESIGN OF PIPES **9 Hrs**

Structural design of a) Concrete b) Prestressed Concrete c) Steel and d) Cast-iron piping mains, sewerage tanks design - anchorage for pipes - massive outfalls - structural design and laying - hydrodynamic considerations. Advances in the manufacture of pipes.

UNIT II ANALYSIS AND DESIGN OF WATER TANKS **9 Hrs**

Design of concrete roofing systems a) Cylindrical b) Spherical and c) Conical shapes using membrane theory and design of various types of folded plates for roofing with concrete. IS Codes for the design of water retaining Structures. Design of circular, rectangular, spherical and Intel type of tanks using concrete. Design of prestressed concrete cylindrical tanks - Economic analysis - introduction to computer aided design and packages.

UNIT III DESIGN OF SPECIAL PURPOSE STRUCTURES **9 Hrs**

Underground reservoirs and swimming pools, Intake towers, Structural design including foundation of water retaining structures such as settling tanks, clarifloculators, aeration tanks etc. - effect of earth pressure and uplift considerations - selection of materials of construction.

UNIT IV REPAIR AND REHABILITATION OF STRUCTURES **9 Hrs**

Underground reservoirs and swimming pools, Intake towers, Structural design including foundation of water retaining structures such as settling tanks, clarifloculators, aeration tanks etc. - effect of earth pressure and uplift considerations - selection of materials of construction. Diagnosing the cause and damage, identification of different types of structural and non-structural cracks – repair and rehabilitation methods for Masonry, Concrete and Steel Structures.

UNIT V EXPOSURE ON STEEL, LATTICE STRUCTURES USED IN WATER AND SEWERAGE WORKS **9 Hrs**

Diagnosing the cause and damage, identification of different types of structural and non-structural cracks – repair and rehabilitation methods for Masonry, Concrete and Steel Structures.

Total No of Hours: 45

REFERENCES

1. Reinforced Concrete by P.Dayaratnam .S.Chand and Co.New Delhi 1985
2. Prestressed Concrete by Krishna Raju, Tata McGraw Hill Publishing Co. 2nd Edition New Delhi, 1988
3. Reinforced Concrete by N.C.Sinha&S.K.Roy - S.Chand and Co.New Delhi 1985
4. Hulse R., and Mosley, W.H., “Reinforced Concrete Design by Computer ", Macmillan Education Ltd., UK 1986
5. Ramaswamy, G.S., “Design and Construction of Concrete shell roofs ", CBS Publishers, India, 1986
6. Green, J.K. and Perkins, P.H., “Concrete liquid retaining structures ", Applied Science Publishers, India 1981

Course Code EMEE22E14	Course Name ENVIRONMENTAL POLICIES AND LEGISLATION	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To develop a basic knowledge about the environmental policies and legislation

COURSE OUTCOMES (COs)

CO1	To educate the students on pollution control laws
CO2	To know about various environmental agreements and protocols
CO3	To have a knowledge on policy initiatives for environmental protection and upgradation
CO4	To study environment protection act, water and air act
CO5	To know about the legal implications of environmental protection

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	2	3	2	1	1	1	1
CO2	2	2	3	3	2	1	1	1	1
CO3	2	2	3	3	2	2	1	2	1
CO4	2	2	3	2	2	1	1	1	1
CO5	2	2	2	3	2	1	1	2	1

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
					√				

Course Code EMEE22E14	Course Name ENVIRONMENTAL POLICIES AND LEGISLATION	Ty/Lb /ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I INTRODUCTION **9 Hrs**

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 **9 Hrs**

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 - Provisions for closure/directions in apprehended pollution situation.

UNIT III AIR (P&CP) ACT, 1981 **9 Hrs**

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 - Provisions for closure/directions in apprehended pollution situation.

UNIT IV ENVIRONMENT (PROTECTION) ACT 1986 **9 Hrs**

Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Siting of Industries – Coastal Zone Regulation - Responsibilities of local bodies and mitigation scheme for Municipal Solid Waste Management -Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorisation – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

UNIT V LEGISLATIONS **9 Hrs**

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

Total No of Hours: 45

REFERENCES

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

Course Code EMEE22E15	Course Name BIO-REMEDIATION	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

OBJECTIVES

The student should be made to:

- To identify ethical, environmental, societal and safety issues related to bioremediation using genetically engineered bacteria

COURSE OUTCOMES (COs)

CO1	To understand fundamental principles of bioremediation processes
CO2	To identify the bioremediation processes for different pollutants
CO3	To understand bioremediation systems and process
CO4	To know environmental, societal and safety issues related to bioremediation using genetically engineered bacteria
CO5	To design the process for enhancing biodegradation

Mapping of Course Outcome with Program Outcome (POs)

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	2	3	2	1	1	1	1
CO2	3	3	3	3	3	1	1	2	1
CO3	3	2	3	3	3	2	1	2	1
CO4	2	3	3	2	2	1	1	1	1
CO5	3	3	2	3	3	1	2	2	1

COs /PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

3/2/1 Indicates Strength of Correlation, 3 -High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Interdisciplinary	Skill component	Practical / Project
					√				

Course Code EMEE22E15	Course Name BIO-REMEDIATION	Ty/Lb/ ETL/ IE	L	T /S.Lr	P/R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3
	L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab					

UNIT I FUNDAMENTALS OF ENVIRONMENTAL MICROBIOLOGY **9 Hrs**

Structure and Functions of Procaryotic Cells -Structure and Functions of Eucaryotic Cells. Bacteria- Algae, Fungi and Protozoa -Study of Microbial Structure -Light Microscopy -Dark-field and Phase-contrast Microscopy - Electron Microscopy -Environmental Significance of Bacteria, Fungi, and Algae - Microbial Metabolism, Growth and Biokinetics - Microbial Nutrition and Metabolism - Microbial Growth and Energy - Enzymes and Their structures - Biokinetic Models - Batch and Continuous Chemostat Studies - Determination of Biokinetic Parameters .

UNIT II MICROBIOLOGY REACTIONS **9 Hrs**

Suspended Growth Reactors - Biofilm Reactors - Batch Reactors - Completely Stirred Tank Reactors - Plug Flow Reactors - Reactors in Series - Engineering Design of Reactors.

UNIT III BIOFLIM PROCESSES **9 Hrs**

Trickling Filters and Biological Towers -Rotating Biological Contactors - Granular Media Filters - Fluidized-bed Reactors -Hybrid Biofllm Processes.

UNIT IV BIOREMEDIATION FOR SOIL ENVIRONMENT **9 Hrs**

Environment of Soil Microorganisms -Soil Organic Matter and Characteristics -Soil Microorganisms Association with Plants - Pesticides and Microorganisms -Petroleum Hydrocarbons and Microorganisms -Industrial solvents and Microorganisms - Biotechnologies for Ex-Situ Remediation of Soil - Biotechnologies for in-Situ Remediation of Soil - Phytoremediation Technology for Soil Decontamination.

UNIT V BIOTREATMENT OF METALS **9 Hrs**

Microbial Transformation of Metals -Biological Treatment Technologies for Metals Remediation -Bioleaching and Biobenificiation -Bioaccumulation -Oxidation/Reduction Processes -Biological Methylation -Case studies Emerging Environmental Biotechnologies Phytoremediation -Sequestering Carbon Dioxide -Biomonitoring - Application of Microbial Enzymes -Biomembrane Reactors

Total No. of Hours: 45

REFERENCES

1. Ergas, S.J., Chang, D.P.Y., Schreoder, E.D., and Eweis J.B., Bioremediation Principles , CB/McGraw-Hill, 1998
2. Rittmann, B.E., and McCarty, P.L., Environmental Biotechnology : Principles and Applications, McGraw Hill, 2001

AUDIT COURSE
I & II

Course Code	Course Name	T / L/ ETP/IE	L	T/S.Lr	P/ R	C
EMCC22I01	ENGLISH FOR RESEARCH PAPER WRITING					
	Prerequisite: Nil	IE	2	0/0	0/0	0

L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab

Objectives To know the art of writing the research paper and thesis to Ensure the good quality of paper at very first-time submission.

COURSE OUTCOMES (COs) : At the end of this course the students would be able to

CO1	Understand that how to improve your writing skills and level of readability
CO2	Learn about what to write in each section
CO3	Understand the skills needed when writing a Title

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9			
CO1	1	1	1	1	1	3	1	1	1			
CO2	1	1	1	1	1	3	1	1	1			
CO3	1	1	1	1	1	3	1	1	1			
COs / PSOs	PSO1		PSO2		PSO3							
CO1	1		1		1							
CO2	1		1		1							
CO3	1		1		1							

1/2/3 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Audit course		
										✓		

Course Code EMCC22I01	Course Name ENGLISH FOR RESEARCH PAPER WRITING	T / L/ ETP/IE	L	T/S.Lr	P/ R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0

UNIT I: **5 Hrs**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II: **5 Hrs**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT III: **5 Hrs**

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

UNIT IV: **5Hrs**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction,skills needed when writing a Review of the Literature

UNIT V: **5Hrs**

skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT VI: **5Hrs**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Total no of Hours: 30

TEXT / REFERENCE BOOKS

- Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
- Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
- Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
- Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Course Code EMCC22I02	Course Name DISASTER MANAGEMENT	T / L/ ETP/IE	L	T/S.Lr	P/ R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0

L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab

Objectives: Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

COURSE OUTCOMES (COs) : At the end of this course the students would be able to

CO1	Evaluate disaster risk reduction and humanitarian response policy and practice from Multiple perspectives.
CO2	Develop an understanding of standards of humanitarian response and practical relevance in Specific types of disasters and conflict situations.
CO3	Understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	3	1	1	1			
CO2	1	1	1	1	1	3	1	1	1			
CO3	1	1	1	1	1	3	1	1	1			

COs / PSOs	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1

1/2/3 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Audit course		
										✓		

Course Code EMCC22I02	Course Name DISASTER MANAGEMENT	T / L/ ETP/IE	L	T/S.Lr	P/ R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0

UNIT I INTRODUCTION **5 Hrs**

Disaster: Definition, Factors and Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS: **5 Hrs**

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA **5 Hrs**

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT **5 Hrs**

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application of remote sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT V RISK ASSESSMENT **5 Hrs**

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT VI DISASTER MITIGATION **5 Hrs**

Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Total No. of Hours: 30

SUGGESTED READINGS:

- R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
- Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
- Goel S. L., Disaster Administration And Management Text And Case Studies",Deep &Deep Publication Pvt. Ltd., New Delhi.

Course Code EMCC22I03	Course Name SANSKRIT FOR TECHNICAL KNOWLEDGE	T / L/ ETP/IE	L	T/S.Lr	P/ R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0

L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab

Objectives To get a working knowledge in illustrious Sanskrit, the scientific language in the world Learning of Sanskrit to improve brain functioning, to develop the logic in mathematics, science & other subjects enhancing the memorypower. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

COURSE OUTCOMES (COs) : At the end of this course the students would be able to

CO1	Understanding basic Sanskrit language
CO2	Ancient Sanskrit literature about science & technology can be understood
CO3	Being a logical language will help to develop logic in students

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9			
CO1	1	1	1	1	1	3	1	1	1			
CO2	1	1	1	1	1	3	1	1	1			
CO3	1	1	1	1	1	3	1	1	1			
COs / PSOs	**PSO1**		**PSO2**		**PSO3**							
CO1	1		1		1							
CO2	1		1		1							
CO3	1		1		1							

1/**2/3 indicates Strength of Correlation 3- High, 2- Medium, 1-Low**

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Audit course		
										✓		

Course Code EMCC22I03	Course Name SANSKRIT FOR TECHNICAL KNOWLEDGE	T / L/ ETP/IE	L	T/S.Lr	P/ R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0

UNIT I **10 Hrs**

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

UNIT II **10 Hrs**

Order Introduction of roots Technical information about Sanskrit Literature

UNIT III **10 Hrs**

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Total No. of Hours: 30

TEXT BOOKS/ REFERENCE

- Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
- "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
- "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Code EMCC22I04	Course Name VALUE EDUCATION	T / L/ ETP/IE	L	T/S.Lr	P/ R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0

L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab

Objectives .Understand value of education and self- development,
Imbibe good values in students.
Let them should know about the importance of character

COURSE OUTCOMES (COs) : At the end of this course the students would be able to

CO1	Knowledge of self-development
CO2	Learn the importance of Human values
CO3	Developing the overall personality

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9			
CO1	1	1	1	1	1	3	1	1	1			
CO2	1	1	1	1	1	3	1	1	1			
CO3	1	1	1	1	1	3	1	1	1			

COs / PSOs	PSO1	PSO2	PSO3					
CO1	1	1	1					
CO2	1	1	1					
CO3	1	1	1					

1/2/3 **indicates Strength of Correlation 3- High, 2- Medium, 1-Low**

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Audit course		
										✓		

Course Code EMCC22I04	Course Name VALUE EDUCATION	T / L/ ETP/IE	L	T/S.Lr	P/ R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0

UNIT I **6 Hrs**

Values and self-development –Social values and individualattitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgments

UNIT II **8 Hrs**

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT III **8 Hrs**

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV **8 Hrs**

Character and Competence –Holy books vs Blind faith. Self-management and Good health.Science of reincarnation. Equality,Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

Total No. of Hours: 30

SUGGESTED READING

❖ Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford UniversityPress, New Delhi

Course Code	Course Name	T / L/ ETP/IE	L	T/S.Lr	P/ R	C
EMCC22I05	CONSTITUTION OF INDIA					
	Prerequisite: Nil	IE	2	0/0	0/0	0

L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab

Objectives Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism
To address therole of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

COURSE OUTCOMES (COs) : At the end of this course the students would be able to know

CO1	Understand and explain the significance of Indian Constitution as the fundamental law of the land
CO2	Exercise his fundamental rights in proper sense at the same time identifies his responsibilities in national building.
CO3	Analyze the Indian political system, the powers and functions of the Union, State and Local Governments in detail
CO4	Understand Electoral Process, Emergency provisions and Amendment procedure.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9			
CO1	1	1	1	1	1	3	1	1	1			
CO2	1	1	1	1	1	3	1	1	1			
CO3	1	1	1	1	1	3	1	1	1			
CO4	1	1	1	1	1	3	1	1	1			
COs / PSOs	PSO1		PSO2		PSO3							
CO1	1		1		1							
CO2	1		1		1							
CO3	1		1		1							
CO4	1		1		1							

1/2/3 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Audit course		
										✓		

Course Code	Course Name	T / L/ ETP/IE	L	T/S.Lr	P/ R	C
EMCC22I05	CONSTITUTION OF INDIA					
	Prerequisite: Nil	IE	2	0/0	0/0	0

UNIT I: HISTORY OF MAKING OF THE INDIAN CONSTITUTION: **3 Hrs**

History Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble Salient Features

UNIT II PHILOSOPHY **3 Hrs**

Philosophy of the Indian Constitution: Preamble Salient Features

UNIT III: CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES: **6 Hrs**

Fundamental Rights, Right to Equality , Right to Freedom , Right against Exploitation, Right to Freedom of Religion , Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy and Fundamental Duties.

UNIT IV: ORGANS OF GOVERNANCE **6 Hrs**

Parliament Composition, Qualifications and Disqualifications, Powers and Functions Executive President, Governor Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions.

UNIT V: LOCAL ADMINISTRATION: **6 Hrs**

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayat raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT VI: ELECTION COMMISSION **6 Hrs**

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Total Number of Hours: 30

TEXT / REFERENCE BOOKS:

- The Constitution of India, 1950 (Bare Act), Government Publication.
- Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
- M. P. Jain, Indian Constitution Law, 7th Edn. Lexis Nexis, 2014. 4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Code EMCC22I06	Course Name PEDAGOGY STUDIES	T / L/ ETP/IE	L	T/S.Lr	P/ R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0

L :Lecture T :Tutorial P:ProjectR:ResearchC:CreditsT/L:Theory/Lab

ObjectivesStudentswillbeableto:4.Reviewexistingevidenceonthereviewtopictoinformprogramme design and Policy making undertaken by the DfID, other agencies and researchers.5.Identify critical evidence gaps to guide the development.

COURSEOUTCOMES(COs):Attheendofthiscoursethestudentswouldbeabletoknow

CO1	What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
CO2	What is the evidence on the effectiveness of the seped agogical practices, in what conditions, And with what population of learners?
CO3	Howcanteachereducation(curriculumandpracticum)andtheschoolcurriculumand Guidance materials best support effective pedagogy?

Mapping of Course Outcomes with Program Outcomes(POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9			
CO1	1	1	1	1	1	3	1	1	1			
CO2	1	1	1	1	1	3	1	1	1			
CO3	1	1	1	1	1	3	1	1	1			
COs / PSOs	PSO1	PSO2	PSO3									
CO1	1	1	1									
CO2	1	1	1									
CO3	1	1	1									

H/M/L indicates Strength of Correlation 3- High,2-Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social	Program Core	Program Electives	Open Electives	Practical/Project	Internships /Technical	Soft Skills	Audit course		
										✓		

Course Code EMCC22I06	Course Name PEDAGOGY STUDIES	T / L/ ETP/IE	L	T/S.Lr	P/ R	C
	Prerequisite: Nil	IE	2	0/0	0/0	0

UNIT I: INTRODUCTION AND METHODOLOGY **6 Hrs**

Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum,
Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.

UNIT II: THEMATIC OVERVIEW **6 Hrs**

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT III: EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES **6 Hrs**

Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV: PROFESSIONAL DEVELOPMENT **6 Hrs**

Alignment with classroom practices and follow up support Peer support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT V: RESEARCH GAPS AND FUTURE DIRECTIONS **6 Hrs**

Research design Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Total Number of Hours: 30

TEXT / REFERENCE BOOKS:

- Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261. 2.
- Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379. 3.
- Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
- Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282. 5.
- Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
- Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
- www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Code EMCC22I07	Course Name STRESS MANAGEMENT BY YOGA	T / L/ ETP/IE	L	T/S.Lr	P/ R	C
	Prerequisite : None	IE	2	0/0	0/0	0

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :
To introduce health psychology and arrive at the introduction to the philosophy and practice of yoga.

COURSE OUTCOMES (Cos) : (3 – 5)
Students completing the course were able to

CO1	Compile the models of health and the psychological component of health
CO2	Classify healthy behavior and health compromising behavior
CO3	Deduce the impact of stress on health and apply effective stress management strategies
CO4	Extrapolate the role of yoga in health care

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO 9**			
CO1	3	3	1	1	1	1	1	3	3			
CO2	3	3	2	1	1	1	1	3	3			
CO3	3	3	2	1	1	1	1	3	3			
CO4	3	3	2	1	1	1	1	3	3			
COs/PSOs	PSO1	PSO2	PSO 3									
CO1	1	1	1									
CO2	1	1	1									
CO3	1	1	1									
CO4	1	1										

Category	Basic Sciences	Engineering Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills	Audit course
										√

Course Code EMCC22I07	Course Name STRESS MANAGEMENT BY YOGA	T / L/ ETP/IE	L	T/S.Lr	P/ R	C
	Prerequisite : None	IE	2	0/0	0/0	0

UNIT I UNDERSTANDING STRESS 6 Hrs

Stress and lifestyle disorders: Meaning and definition, development of stress; nature of stressors: Frustration, pressure; Factors predisposing stress: life events and daily hassles; Burnout. Coping with stress: Problem oriented and emotion oriented. Stress management: Meaning and definition; Changing thoughts, behavior and physiological responses.

UNIT II YOGA PHILOSOPHY 10 Hrs

Introduction to Yoga and Yogic Practices – Definition, History, Aim and Objectives, Four Paths of Yoga and Principles of Yoga, Hatha Yoga – Distinction between Yoga and Non Yogic Practices, Concept of Yogic diet, Purpose and Utility of Asanas in Hatha Yoga , Introduction to Patanjali,

UNIT III YOGA IN HEALTH CARE 14 Hrs

Yoga for specific lifestyle disorders: Asthma, Sleeplessness, Diabetes, Blood pressure and Heart Diseases. Research evidence on the impact of yoga intervention on lifestyle disorders. Halasana and Matsyasana for Thyroid, Dhanurasana and Bhujangasana for Polycystic Ovarian Syndrome Disease, Shishuasana and AdhoMukhaSvanasana for Arthritis, SuptaMatsyendrasana and Vrikshasana for Lower back pain, ArdhaMatsyendrasana and Chakrasana for Diabetes, Apanasana and Paschimottanasana for Indigestion and Stomach Disorder, Padmasana and Sirsasana for Migraine, BaddhaKonasana and Sukhasana for Depression, Balasana and Shavasana for Sleeplessness. Evaluation of the applications of psychological knowledge in the area of health and identification of gaps.

Total no. of periods: 30

REFERENCES

- Taylor, S.E (2006). Health Psychology. New Delhi: Tata McGraw Hill
- Serafini, E.P & Smith T.W. (2012). Health Psychology: Bio psychosocial Interventions. New Delhi: Wiley
- Hatha Yoga Pradipika by Swami Svatmarama.
- BKS Iyengar (2013). YOGA - The Path to Holistic Health

Course Code	Course Name	T / L/ ETP/IE	L	T/S.Lr	P/ R	C
EMCC22I08	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS					
	Prerequisite: Nil	IE	2	0/0	0/0	0

L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab

Objectives To learn to achieve the highest goal happily,
To become a person with stable mind, pleasing personality and determination.
To awaken wisdom in student

COURSE OUTCOMES (COs) : At the end of this course the students would be able to know

CO1	Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
CO2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity
CO3	Study of Neetishatakam will help in developing versatile personality of students.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9			
CO1	1	1	1	1	1	3	1	1	1			
CO2	1	1	1	1	1	3	1	1	1			
CO3	1	1	1	1	1	3	1	1	1			
COs / PSOs	**PSO1**		**PSO2**		**PSO3**							
CO1	1		1		1							
CO2	1		1		1							
CO3	1		1		1							

1/2/3 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Audit course		
										✓		

Course Code	Course Name	T / L/ ETP/IE	L	T/S.Lr	P/ R	C
EMCC22I08	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS					
	Prerequisite: Nil	IE	2	0/0	0/0	0
L : Lecture T : Tutorial P : Project R : Research C: Credits T/L: Theory/Lab						

UNIT I: NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY 10 Hrs

Verses- 19,20,21,22 (wisdom) Verses- 29, 31, 32 (pride & heroism) Verses- 26,28,63,65 (virtue) Verses- 52, 53, 59 (dont's)Verses-71, 73, 75, 78 (do's)

UNIT II APPROACH TO DAY TO DAY WORK AND DUTIES 10 hrs

Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47, 48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5, 13, 17, 23, 35, Chapter 18-Verses 45, 46, 48.

UNIT III STATEMENTS OF BASIC KNOWLEDGE 10hrs

Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16, 17, 18 Personality of Role model.Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36, 37, 42, Chapter 4-Verses 18, 38, 39 Chapter18 –Verses 37, 38, 63

Total Number of Hours: 30

TEXT / REFERENCE BOOKS

- "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
- .Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
- Rashtriya Sanskrit Sansthanam, New Delhi

Course Code EMCC22I09	Course Name RESEARCH AND PUBLICATION ETHICS	T / L/ ETP/IE	L	T / S.Lr	P/ R	C
	Prerequisite: core subjects	IE	2	0/0	0/0	0

T/L/ : Theory/Lab L : Lecture T:Tutorial P : Practical/Project R : Research C: Credits T/LTheory/Lab

OBJECTIVE:

- To understand the philosophy of science and ethics, research integrity and publication ethics.
- To identify research misconduct and predatory publications.
- To understand indexing and citation databases, open access publications, research metrics (citations, h-index, impact Factor, etc.).

COURSE OUTCOMES (COs) : By doing this course students will

CO1	Understand the ethical issues related to Research and Publication
CO2	Get to know about different types of plagiarism and ways for avoiding plagiarism
CO3	Know about best practices and guidelines in publication ethics and also learns to avoid Publication misconduct
CO4	Get to know about Violation of publication ethics, authorship and contributor ship and get to identify about Predatory publishers and journals.
CO5	Get to know about various open sources database and research metrics like indexing, citation etc.,

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	
CO1	2	3	3	3	3	2	3	3	2	
CO2	2	3	3	3	3	2	3	3	2	
CO3	2	3	3	3	3	2	3	3	2	
CO4	2	3	3	3	3	3	3	3	3	
CO5	2	3	3	3	3	2	3	3	2	

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	3
CO2	2	3	3
CO3	2	3	2
CO4	2	3	3
CO5	2	3	3

1/2/3 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Audit Course
										✓

Course Code EMCC22I09	Course Name RESEARCH AND PUBLICATION ETHICS	T / L/ ETP/IE	L	T / S.Lr	P/ R	C
	Prerequisite: core subjects	IE	2	0/0	0/0	0
T/L/ : Theory/Lab L : Lecture T:Tutorial P : Practical/Project R : Research C: Credits T/LTheory/Lab						

UNIT I INTRODUCTION **6 Hrs**

Introduction to philosophy: Definition, nature and scope, concept, branches - Ethics: Definition, moralphilosophy, nature of moral judgments and reactions – Ethics with respect to Science and ResearchIntellectualhonestyandresearchintegrity.

UNIT II SCIENTIFIC CONDUCT **6 Hrs**

Scientificmisconducts:Falsification,Fabrication,andPlagiarism(FFP) Redundant Publications: Duplicate and over lapping publications, salami slicing – Selective reportingandmisrepresentationofdata.

UNIT III PUBLICATION ETHICS-I **6 Hrs**

Publication ethics: Definition, introduction and importance – Best practices/standards setting initiativesand guidelines: COPE, WAME etc. Publication misconduct: definition, Concept, problems that lead tounethical behaviorandvice-versa,types.

UNIT IV PUBLICATION ETHICS–II **6 Hrs**

Violation of publication ethics, authorship and contributor ship – Identification of publicationmisconduct, complaints and appeals – Predatory publishers and journals – Subject specific ethicalissues,Complaints andappeals:examplesandfraudfromIndiaandAbroad.

UNIT V DATABASES AND RESEARCH METRICS **6 HRS**

OpenAccesspublicationandInitiatives–Indexingdatabases–Citationdatabases,Web of Science,Scopus, etc. – Impact factor of journals as per Journal Citation report .SNIP, SJR, IPP, Cite Score -Metrics: h index, gindex,i10index,altmetrics–Conflictof interest.

Total Number of Hours: 30

REFERENCES

- BirdA2006,Philosophy of Science,Routledge
- MacIntyre&Alasdair,1967,AShortHistoryofEthics,London.
- Chaddah,P20 18,EthicsinCompetitiveResearch:Donotgetscooped; do notgetplagiarized,ISBN:9789387480865.
- OnBeingaScientist:AGuidetoResponsibleConductinResearch,2009,NationalAcademyofSciences,NationalAcademyofEngineeringandInstituteofMedicine.3rd edition,NationalAcademiesPress.
- Resnik,D.B2011,whatisethicsinresearch&whyisitimportant.NationalInstituteofEnvironmentalHealthSciences,pp.1—10.https://www.niehs.nih.gov/research/reso_uuces/bioethics/whatis/index.cfm
- Bcall,J2012,Predatorypublishersarecorruptingopenaccess,Nature,Vol.489,no.7415,pp. 79—179.https://d0i.org/lO.1038/48917%,Ethics in Science Education, 2019Indian National Science Academy (INSA), Research and Governance