SCHEME & SYLLABUS
OF

UNDERGRADUATE DEGREECOURSES
IN
ENVIRONMENTAL ENGINEERING

2023-24
(B.Tech. I Yr admitted 2021-22 and B.Tech. LEET Admitted 2023-24)

DEPARTMENT OF CIVIL ENGINEERING

J C BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA
FARIDABAD

J C BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA

VISION

YMCA University of Science and Technology aspires to be a nationally and internationally acclaimed leader in technical and higher education in all spheres which transforms the life of students through integration of teaching, research and character building.

MISSION

- To contribute to the development of science and technology by synthesizingteaching, research and creative activities.
- To provide an enviable research environment and state-of-the-art technologicalexposure to its scholars.
- To develop human potential to its fullest extent and make them emerge as worldclass leaders in their professions and enthuse them towards their social responsibilities.

VISION AND MISSION: CIVIL ENGINEERING DEPARTMENT

VISION

“To be a centre of excellence by producing high calibre, competent and self-reliant CIVIL engineers, who possess scientific temperament and would engage in activities relevant to industries with ethical values and flair to research.”

MISSION

The CIVIL engineering department is committed to

- Provide efficient engineers for global requirements by imparting quality education with an emphasis on practical skills and social relevance.
- Explore, create and develop innovations in various aspects of engineering through industries and institutions.

Program Educational Objectives (PEOs)

PEO-01	A fundamental knowledge of the basic and engineering sciences and develop mathematical andanalytical skills required for civil engineering.
PEO-02	Civil engineering graduates to be equipped with practical skills and experimental practices related to core and applied areas of civil engineering to expand their knowledge horizon beyond books. This will prepare the students to take-up career in industries or to pursue higher studies in civil and interdisciplinary programs.
PEO-03	Civil engineering graduates will have improved team building, team working and leadership skills with high regardfor ethical values and social responsibilities.
PEO-04	Civil engineering graduates will explore and create innovations in various aspects of engineering.

PROGRAMME OUTCOMES (POs) B.TECH. ENVIRONMENTAL ENGINERING

Engineering Graduates will be able to:

PO-01	***Engineering Knowledge:*** Apply knowledge of mathematics, science, engineering fundamentals, and civil engineering to the solution of engineering problems.
PO-02	***Problem Analysis:*** Identify, formulate, review literature and analyze civil engineering problems to design, conduct experiments, analyze data and interpret data.
PO-03	***Design /Development of Solutions:*** Design solution for civil engineering problems and design system components of processes that meet the desired needs with appropriate consideration for public health and safety, and cultural, societal and environmental considerations.
PO-04	***Conduct Investigations of Complex Problems:*** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions in civil engineering.
PO-05	***Modern Tool Usage:*** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to civil engineering activities with an understanding of the limitations.
PO-06	***The Engineer and Society:*** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to civil engineering practice.
PO-07	***Environment and Sustainability:*** Understand the impact of the civil engineering solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development.
PO-08	***Ethics:*** Apply ethical principles and commit to professional ethics and responsibilities and norms of the civil engineering practice.
PO-09	***Individual and Teamwork:*** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings in civil engineering.
PO-10	***Communication:*** Communicate effectively on complex engineering activities with the engineeringcommittee and with society at large, such as being able to comprehend and write effective reports and design documentation, and make effective presentations in civil engineering.
PO-11	***Project Management and Finance:*** Demonstrate knowledge & understanding of the civil engineering principles and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments in civil engineering.
PO-12	***Life-Long Learning:*** Recognize the need for, and the preparation and ability to engage in independent research and lifelong learning in the broadest context of technological changes in civil engineering.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO-01	To apply practical skills, and knowledge of engineering fundamentals and civil engineering, to industries and institutions.
PSO-02	To explore, create and develop innovations in various aspects of engineering. The student will be ready to take-up career or to pursue higher studies with high regard to ethical values and social responsibilities.

CO/PO Mapping Procedure

Illustrative Example

Sub: VAC01: Human Values and Professional Ethics

Course Outcomes: After completion of this course, the successful students will be able to:

CO	Statement
CO1	Apply ethics in society
CO2	Understand the ethical issues related to engineering.
CO3	Analyze the responsibilities as a good citizen.
CO4	Realize the rights in society.

Correlation between COs and the Program Outcomes (POs) and Program Specific Outcomes PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	1	2	1	2	3	2	3	2	3
CO2	3	2	3	3	3	2	2	1	1	2	2	3	2	3
CO3	3	2	3	3	2	1	2	1	2	1	2	3	2	3
CO4	2	3	2	3	3	2	2	1	2	1	2	2	2	2

1 means weak, 2 means average, and 3 means good.

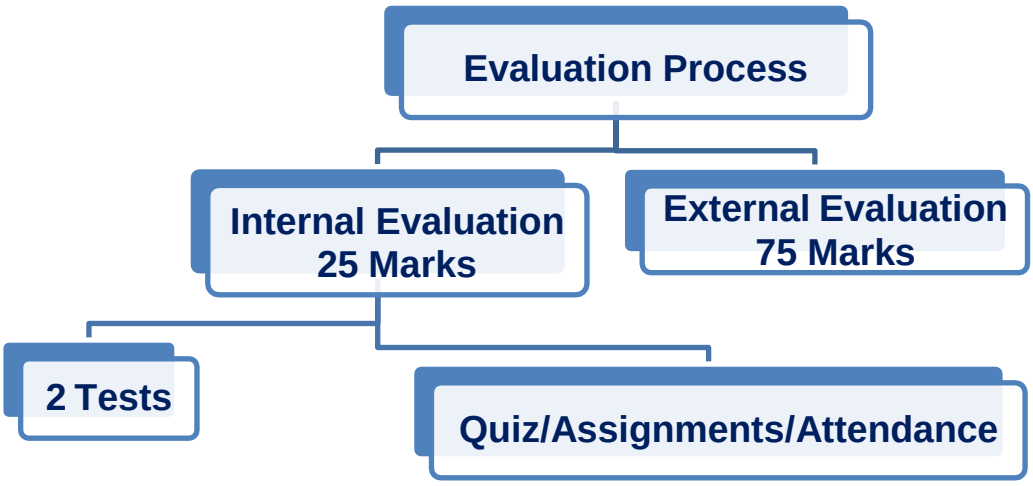
Assessment tools and processes for the evaluation of Course Outcomes

- **Assessment Tools**

There are many direct assessment methods through which the evaluation of course outcomes of the individual subjects has been done. These methods include;

Internal Examination: Internal sessional examination is conducted twice per semester. Each paper is of 15 marks. Apart from the two internal examinations, a third mercy examination is also conducted. If a student fails to get the pass percentage with the average score of the two sessional examinations, only then he is given the chance to appear in this mercy examination. In addition to the average score obtained by the student, attendance is also included in his internal sessional marks. Total of 25 marks are considered for internal examination.

External Examination: External examination is conducted at the end of the semester and is of 75 marks. Student is evaluated on the basis of 100 marks per subject which includes 75 marks of external examination and 25 marks of internal examination.



Assignments/Quizzes: There is also concept of assignments in all courses, which are being given to all students during the semester by concerned faculty member. The assignments are also set by consideringthe subject specific course outcomes. The students submit those assignments in stipulated time and same is evaluated by the faculty member. The scores obtained by students is also considered in internal assessment. Normally 3 to 5 assignments and 1-2 quizzes are given by faculty members.

Processes

Following processes are used to obtain attainment level of course outcome;

1. Student's performance in internal assessments/ end semester examination with respect to the Course Outcomes is tabulated.
2. Assignment score of every student is also recorded with above mentioned performance.
3. External examiner is assigned to conduct practical examination at end of the semester.
4. End semester examination paper is set by different examiners (external/internal examiners) and it is ensured that at least 50% papers are from outside.
5. After evaluation, result is displayed on notice board and answer sheet of each examination is shown to students.
6. Academic audit of all faculty members is carried out at the end of every semester through different parameters (i.e. Syllabus coverage, test conducted, assignments given etc.) which are related to course outcomes directly or indirectly.

Methodology to define course outcome attainment levels Methodology to calculate CO, PO & PSO Attainment:

1. Define CO's for a course and check their quality
2. Do mapping of CO with PO's & PSO's (On a scale of 1,2 & 3)
3. Align CO's with questions of class tests, assignments and end-semester exam
4. Prepare CO alignment sheet and decide Grade scale as follows:

Grade scale	
Marks	**Score**
≤ 40%	**1**
>40% and ≤ 60%	**2**
>60%	**3**

1. Calculate CO's as per table below on the basis of tests, assignments and end-semester exams:
2. Prepare faculty course assessment record (FCAR) of each faculty as Annexure-1
3. Align or distribute result of CO attainment (in %) over PO's as per already done CO-PO mapping.
4. Prepare PO/PSO attainment sheet (in %).
5. Review and compare with target.

S.N	RollNo	Student Name	CO1					CO2	CO..
			Total Marks Obtained	Total marks	≥60%	Score (3,2, 1)	Y/N		
1	Civil 01	Suresh	25	33	75.76	3	Y		
2	Civil02	Mahesh	18	33	54.55	2	N		
3	Civil 03	Arun Kumar	10	33	30.3	1	N		
				Average		2			

GRADING SCHEME

Marks %	Grade	Grade	Category
90-100	O	10	Outstanding
80≤marks<90	A+	9	Excellent
70≤marks< 80	A	8	Very good
60≤marks< 70	B+	7	Good
50≤marks< 60	B	6	Above Average
45≤marks< 50	C	5	
40≤marks< 45	P	4	Pass
<40	F	0	Fail
	Ab	0	Absent

Percentage calculation= CGPA * 9.5

Course code and definition:

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences Including Management Courses
PCC	Professional Core Courses
PEC	Professional Elective Courses
OEC	Open Elective Courses
LC	Laboratory Course
MC	Mandatory Courses
PROJ	Project

Undergraduate Degree Courses in Engineering & Technology
CIVIL ENGINEERING

(As per guidelines of All India Council for Technical Education Model curriculum)

General, Course structure & Theme &Semester-wise credit distribution

Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credits
2 Hours Practical (Lab) per week	1 credit

Credits –178 for a student to be eligible to get Under Graduate degree in Engineering.

Structure of Undergraduate Engineering program:

SEMESTER I – VIII (w. e. f. Session 2022-23)

B. TECH SCHEME CREDITS CALCULATIONS

S. No.	Category of Courses	Contact Hours	Credits
1.	Professional Core Courses (PCC)	73	67
2.	Basic Science Courses (BSC)	28	25
3.	Engineering Science Courses (ESC)	32	23
4.	Humanities and Social Sciences including ManagementCourses (HSMC)	10	6
5.	Professional Elective Courses (PEC)	15	15
6.	Open Elective Courses (OEC)	9	9
7.	Skill Enhancement Course (SEC)	10	20
8.	Mandatory Audit Courses (MAC)	2	0
9.	Massive Open Online Courses (MOOCS)*	-	12*
10.	Value Added Courses (VAC)**	-	-
	Total	**179**	**165+12* =177**

* 03 credit each year through MOOC.

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Refer implementation of Credit Transfer/Mobility Policy of online courses,17th meeting of Academic Council (11.6.2019) for details, regarding MOOC credits. Minimum credit to be earned is 12 (**03 each year)** through MOOC for all B.Tech.students in this scheme.

SEMESTER-WISE SUMMARY OF THE PROGRAMME

S. No.	Semester	Contact Hours	Marks	Credits
1.	I	25	650	19.5
2.	II	26	600	18.5
3.	III	28	800	24
4.	IV	28	850	22
5.	V	29	950	28
6.	VI	23	750	23
7.	VII	20	650	20
8.	VIII	One Semester	500	10
	Total	**179**	**5750**	**165***

Total Credit = 165+12= 177 (* 03 credit each year through MOOC).

Refer implementation of Credit Transfer/Mobility Policy of online courses,17th meeting of Academic Council (11.6.2019) for details, regarding MOOC credits. Minimum credit to be earned is 12 (**03 each year)** through MOOC for all B.Tech.students in this scheme.

Professional Core Courses (PCC)

S.No.	Code	Subject Name	Contact Hours	Total Marks	Credits	Semester
1	PCC-EED201	Environmental Chemistry	3	100	3	III
2	PCC-CED201	Fluid Mechanics	3	100	3	III
3	PCC-CED202	Surveying	3	100	3	III
4	PCC-EED202	Environmental Impact Assessment	3	100	3	IV
5	PCC-EED203	Water Quality and Supply	3	100	3	IV
6	PCC-CED204	Environmental Geology	3	100	3	IV
7	PCC-CED207	Soil Mechanics	3	100	3	IV
8	PCC-EED301	Environmental Microbiology	3	100	3	V
9	PCC-EED302	Solid and Hazardous Waste Management	3	100	3	V
10	PCC-EED303	Air and Noise Pollution Monitoring and Control	3	100	3	V
11	PCC-CED304	Hydraulic Engineering	3	100	3	V
12	PCC-CED305	Geomatics Engineering	3	100	3	V
13	PCC-CED306	Wastewater Engineering	3	100	3	V
14	PCC-EED304	Environmental Management and Sustainable Development	3	100	3	VI
15	PCC-EED305	Environmental Ethics, Law and Regulations	3	100	3	VI
16	PCC-CED309	Engineering Hydrology	3	100	3	VI
17	PCC-EED401	Environmental Health and Safety	3	100	3	VII
18	PCC-EED402	Global and Regional Environmental Issues	3	100	3	VII
19	PCC-EED403	Industrial Waste Management	3	100	3	VII
20	PCC-EED201P	Environmental Chemistry Lab	2	50	1	III
21	PCC-CED201P	Fluid Mechanics Lab	2	50	1	III
22	PCC-CED202P	Environmental Survey Lab	2	50	1	III
23	PCC-EED203P	Water Quality and Supply Lab	2	50	1	IV
24	PCC-CED207P	Soil Mechanics Lab	2	50	1	IV
25	PCC-EED303P	Air and Noise Pollution Monitoring and Control Lab	2	50	1	V
26	PCC-CED304P	Hydraulic Engineering Lab	2	50	1	V
27	PCC-CED306P	Wastewater Engineering Lab	2	50	1	V
28	PEC-EED-SC	Survey Camp*	-	50	2	V

BASIC SCIENCE COURSES (BSC)

S. No.	Code	Name of Course	Contact Hours	Credits	Semester
1.	BSC101	Physics (Mechanics & Mechanics of Solids)	4+3	5.5	I
2.	BSC103	Mathematics –I (Calculus, Multivariable Calculus and Linear Algebra)	4	4	I
3.	BSC 102	Chemistry-I	4+3	5.5	II
4.	BSC 104	Mathematics –II (Differential Equations)	4	4	II
5.	BSC 01	Biology	3	3	IV
6.	BSC-201	Mathematics-III	3	3	IV
		Total	**28**	**25**	

ENGINEERING SCIENCE COURSES (ESC)

S. No.	Code	Name of Course	Contact Hours	Credits	Semester
1.	ESC-101A	Basic Electrical Technology	4	4	I
2.	ESC-107A	Basic Electrical Technology Laboratory	2	1	I
3.	ESC-104	Workshop- I	4	2	I
4.	ESC-103	Programming for Problem Solving	3	3	II
5.	ESC-105	Programming for Problem Solving Lab	4	2	II
6.	ESC-102	Engineering Graphics and Drawing	4	2	II
7.	ESC-106	Workshop- II	4	2	II
8.	ESC-201	Basics of Electronics Engineering	3	3	III
9.	ESC-203R	Engineering Mechanics	4	4	III
		Total	**32**	**23**	

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)

S. No.	Code	Name of Course	Contact Hours	Credits	Semester
1.	HSMC-101	English	2	2	I
2.	HSMC-102	English Lab	2	1	I
3.	HSMC01	Humanities-I (Effective Technical Communication)	3	3	III
4.	VAC01	Human Values and Professional Ethics	-	0 (VAC)	I year
5.	VAC02	Universal Human Values	-	0(VAC)	I year
6.	HSMC(H102)	Universal Human Values 2: Understanding Harmony	3	0	IV
		Total	**10**	**6**	

VAC = Value Added Course

PROFESSIONAL ELECTIVE COURSES (PEC)

S. No.	Name of Course	Contact Hours	Credits	Semester
1.	Professional Elective Course I	3	3	VI
2.	Professional Elective Course II	3	3	VI
3.	Professional Elective Course III	3	3	VI
4.	Professional Elective Course IV	3	3	VI
5.	Professional Elective Course V	3	3	VII
	Total	**15**	**15**	

OPEN ELECTIVE COURSES (OEC)

S. No.	Name of Course	Contact Hours	Credits	Semester
1.	Open Elective Course I	3	3	V
2.	Open Elective Course II	3	3	VI
3.	Open Elective Course III	3	3	VII
	TOTAL	**9**	**9**	

SKILL ENHANCEMENT COURSES (SEC)

S. No.	Code	Name of Course	Contact Hours	Credits	Semester
1.	PREED-1P	Skill Enhancement Project I	2	2	III
2.	PREED-2P	Skill Enhancement Project II	2	2	IV
3.	PREED-3P	Skill Enhancement Project III	2	2	V
4.	PREED-4P	Skill Enhancement Project IV	2	2	VI
5.	PREED-5P	Skill Enhancement Project V	2	2	VII
6.	PREED-6P	Industrial Training	One semester	10	VIII
		Total	**10**	**20**	

MANDATORY AUDIT COURSES (MC)

S. No.	Code	Name of Course	Contact Hours	Credits	Semester
1.	MC-01	Indian Constitution	1	0	III
2.	MC-04	Message of Bhagwat Gita	1	0	IV
		Total	**2**	**0**	

*** course each year to be completed (3*4 = 12 credits)**

Branch / Course: Environmental Engineering Total credits (4-year course):165 + 12 (MOOC) = 177

Semester-wise structure of the curriculum

[L= Lecture, T = Tutorials, P = Practical & C = Credits]

First year credit=38 + 3 (MOOC)
III to VIII Sem credit=127+9 (Including MOOC Credits = 03 per year)

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SCHEME OF STUDIES & EXAMINATIONS
B. TECH 2ND YEAR (SEMESTER – III) ENVIRONMENTAL ENGINEERING (2022-23)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits
		L	T	P	Total		Theory	Practical		
ESC201	Basic Electronics Engineering	3	0	0	3	25	75	0	100	3
HSMC01	Effective Technical Communication	3	0	0	3	25	75	0	100	3
ESC-203R	Engineering Mechanics	3	1	0	4	25	75	0	100	4
PCC-CED201	Fluid Mechanics	3	0	0	3	25	75	0	100	3
PCC-CED202	Surveying	3	0	0	3	25	75	0	100	3
PCC-EED201	Environmental Chemistry	3	0	0	3	25	75	0	100	3
PCC-CED201P	Fluid Mechanics Lab	0	0	2	2	15	0	35	50	1
PCC-CED202P	Survey Lab	0	0	2	2	15	0	35	50	1
PCC-EED201P	Environmental Chemistry Lab	0	0	2	2	15	0	35	50	1
PREED-1P	Skilled Based Project-I	0	0	2	2	15	0	35	50	2
MC-01	Audit Course-1 Indian Constitution	1	0	0	1	25	75	0	0	0
	Total	19	1	8	28				800	24

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B. TECH 2ND YEAR (SEMESTER – IV) ENVIRONMENTAL ENGINEERING (2022-23)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits
		L	T	P	Total		Theory	Practical		
PCC-EED202	Environmental Impact Assessment	3	0	0	3	25	75	0	100	3
PCC-CED204	Environmental Geology	3	0	0	3	25	75	0	100	3
PCC-CED207	Soil Mechanics	3	0	0	3	25	75	0	100	3
PCC-EED203	Water Quality and Supply	3	0	0	3	25	75	0	100	3
BSC-201	Mathematics-III	3	0	0	3	25	75	0	100	3
BSC-01	Biology	3	0	0	3	25	75	0	100	3
PCC-CED207P	Soil Mechanics Lab	0	0	2	2	15	0	35	50	1
PCC-EED203P	Water Quality and Supply Lab	0	0	2	2	15	0	35	50	1
HSMC(H102)	Universal Human Values 2: Understanding Harmony	2	1	0	3	50	50	0	100	0
MC-04	Audit Course-2: Bhagwat Gita	1	0	0	1	25	75	0	0	0
PREED-2P	Skilled Based Project-II	0	0	2	2	15	0	35	50	2
	Total	21	1	6	28				850	22

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B. TECH 3RD YEAR (SEMESTER – V) ENVIRONMENTAL ENGINEERING (2022-23)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits
		L	T	P	Total		Theory	Practical		
PCC-EED301	Environmental Microbiology	3	0	0	3	25	75	0	100	3
PCC-EED302	Solid and Hazardous Waste Management	3	0	0	3	25	75	0	100	3
PCC-EED303	Air and Noise Pollution Monitoring and Control	3	0	0	3	25	75	0	100	3
PCC-CED304	Hydraulic Engineering	3	0	0	3	25	75	0	100	3
PCC-CED305	Geomatics Engineering	3	0	0	3	25	75	0	100	3
PCC-CED306	Wastewater Engineering	3	0	0	3	25	75	0	100	3
PCC-CED304P	Hydraulic Engineering Lab	0	0	2	2	15	0	35	50	1
PCC-CED306P	Wastewater Engineering Lab	0	0	2	2	15	0	35	50	1
PCC-EED303P	Air and Noise Pollution Monitoring and Control Lab	0	0	2	2	15	0	35	50	1
OEC-EED301	Open Elective - I	3	0	0	3	25	75	0	100	3
PREED-3P	Skilled Based Project-III	0	0	2	2	15	0	35	50	2
PEC-EED-SC	Survey Camp	-	-	-	-	50	0	0	50	2
	Total	21	0	8	29				900	28

Surveying Camp to be organized at the end of the semester.

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B. TECH 3RD YEAR (SEMESTER – VI) ENVIRONMENTAL ENGINEERING (2022-23)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits*
		L	T	P	Total		Theory	Practical		
PCC-EED304	Environmental Management and Sustainable Development	3	0	0	3	25	75	0	100	3
PCC-CED309	Engineering Hydrology	3	0	0	3	25	75	0	100	3
PCC-EED305	Environmental Ethics, Law and Regulations	3	0	0	3	25	75	0	100	3
PEC-EED301	Elective I	3	0	0	3	25	75	0	100	3
PEC-EED302	Elective-II	3	0	0	3	25	75	0	100	3
PEC-EED303	Elective-III	3	0	0	3	25	75	0	100	3
PREED-4P	Skilled Based Project-IV	0	0	2	2	15	0	35	50	2
OEC-EED302	Open Elective - II	3	0	0	3	25	75	0	100	3
	Total	21	0	2	23				750	23

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B. TECH 4TH YEAR (SEMESTER – VII) ENVIRONMENTAL ENGINEERING (2022-23)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits
		L	T	P	Total		Theory	Practical		
PCC-EED401	Environmental Health and Safety	3	0	0	3	25	75	0	100	3
PCC-EED402	Global and Regional Environmental Issues	3	0	0	3	25	75	0	100	3
PCC-EED403	Industrial Waste Management	3	0	0	3	25	75	0	100	3
PEC-EED401	Elective-IV	3	0	0	3	25	75	0	100	3
PEC-EED402	Elective-V	3	0	0	3	25	75	0	100	3
OEC-EED403	Open Elective - III	3	0	0	3	25	75	0	100	3
PREED-5P	Skilled Based Project-V	0	0	2	2	15	0	35	50	2
	Total	18	0	2	20				650	20

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B. TECH 4TH YEAR (SEMESTER – VIII) ENVIRONMENTAL ENGINEERING (2022-23)

Sl. No.	Course Title	Code	Hours per week			Sessional	End Semester	Total	Credits
			L	T	P				
1	Industrial Training with projects	PREED-6P	0	0	30	150	350	500	10 (including 02 credit or 20% weightage for project)

Procedure for Annual Exam and Continuous Assessment of Industrial Training:

(A) Annual Exams Marks

1. Training Evaluation	100 Marks
2. Training Seminar	100 Marks
3. Training Viva	150 Marks

(B) Continuous Assessment Marks

1. Assessment by University / Institute Faculty	50 Marks
2. Assessment by Industrial Guide	50 Marks
3. Conduct Marks	50 Marks

Total: 500 Marks

PROFESSIONAL ELECTIVE COURSES CIVIL ENGINEERING

S. No	Code No.	**Subject**	**Semester**	**Credits /Lectures**
1.	PEC-EED301	Elective-I	VI	3
2.	PEC-EED302	Elective-II	VI	3
3.	PEC-EED303	Elective-III	VI	3
4.	PEC-EED401	Elective-IV	VII	3
5.	PEC- EED402	Elective V	VII	3

PROFESSIONAL ELECTIVE COURSE TRACKS- CIVIL ENGINEERING [PEC-EED]

The following five Mandatory Professional Specialized Tracks offer electives in the respective Tracks:

Track	**Professional Elective Courses (PEC)**
I	Elective-I
II	Elective-II
III	Elective-III
IV	Elective-IV
V	Elective V

The students will have options of selecting the electives from the different tracks depending on the specialization one wishes to acquire.

PROFESSIONAL ELECTIVE COURSES (PEC)

Elective-I, PEC-EED301

Note: PEC-EED301-1 subject 1 Renewable Energy and Alternative Fuels coding: indicates that the Program elective scheme subject code is **PEC-EED301** and S. No. 1 is chosen for this semester.

1. Renewable Energy and Alternative Fuels
2. Climate Change and Adoption
3. Ecological Engineering and Restoration
4. Environmental Modelling and Simulation

Elective-II, PEC-EED302

Note: PEC EED 302-1 subject 1 Sub-Soil water Pollution and Its Control coding: indicates that the Program elective scheme subject code is PEC EED-302 and S. No. 1 is chosen for this semester.

1. Sub-Soil Water Pollution and Its Control
2. Environmental Soil Chemistry
3. Ground Water and Soil Remediation
4. Environmental Foundation Engineering

Elective-III, PEC-EED303

Note: PEC EED 303-1 subject 1 Biomedical Waste Management coding: indicates that Program elective scheme subject code is PEC EED-303 and S. No. 1 is chosen for this semester.

1. Total Quality Management
2. Biomedical Waste Management
3. Agricultural Waste Management
4. Construction Waste Management

Elective-IV, PEC-EED401

Note: PEC EED 401-1 subject 1 Environmental Process Engineering coding: indicates that Program elective scheme subject code is PEC EED-401 and S. No. 1 is chosen for this semester.

1. Environmental Process Engineering
2. Industrial Ecology and Resources Efficiency
3. Atmospheric Chemistry and Climate Change
4. Environmental Auditing and Life Cycle Assessment

Elective-V, PEC-EED402

Note: PEC EED 402-1 subject 1 Constructed Wetland Techniques and Sewage farming coding: indicates that Program elective scheme subject code is PEC EED-402 and S. No. 1 is chosen for this semester.

1. Constructed Wetland Techniques and Sewage farming
2. Urban Environmental Management
3. Sustainable Aspects of Heritage Buildings
4. Green Infrastructures and Urban Ecology

OPEN ELECTIVE COURSE CIVIL ENGINEERING

(3 Credit/3Lecture each)

There may be at least three different electives from the open elective course choices (OEC).

Open Elective I, OEC-CED301

Note: OEC-CED301-2 indicates that the open elective scheme subject code is OEC-CED301 and S. No. 2 is chosen for **Solid Waste Management** Subject.

1. Non-Conventional Energy Resources and Utilisation
2. Solid Waste Management
3. Energy Studies
4. Environmental Science

Open Elective II, OEC-CED302

Note: OEC-CED302-3 indicates that the open elective scheme subject code is OEC-CED302 and S. No. 3 is chosen for **Human Resource Management** Subject.

1. Research and IPR
2. Soft Skills for Engineers
3. Human Resource Management
4. Engineering Economics

Open Elective III, OEC-CED403

Note: OEC-CED403-4 indicates that the open elective scheme subject code is OEC-CED403 and S. No. 4 is chosen for **Environmental Safety Engineering** Subject.

1. Environmental Engineering – Societal & Global Impact
2. Global Warming and its Prevention
3. Energy and Environment
4. Environmental Safety Engineering

SEMESTER - III

ESC- 201 BASIC ELECTRONICS ENGINEERING

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Pre-Requisite: Physics

Successive: Mechatronics, Automation in Manufacturing

Course Objective: To provide an overview of electronic device components to Mechanical engineering students.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Understand the principles of semiconductor devices and their applications.
CO2	Design an application using an Operational amplifier.
CO3	Understand the workings of timing circuits and oscillators.
CO4	Understand logic gates and flip flops as a building block of digital systems.
CO5	Learn the basics of Electronic communication systems.
CO6	Understand Mobile communication systems.

UNIT-I

Semiconductor Devices and Applications: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single-stage CE amplifier, frequency response and bandwidth.

UNIT-II

Operational amplifier and its applications: Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in an open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, Inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator, and differentiator.

UNIT-III

Timing Circuits and Oscillators: RC-timing circuits, IC 555 and its applications as stable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.

UNIT-IV

Digital Electronics Fundamentals: Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K-map, Logic ICs, half and full adder/subtractor, multiplexers, de-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

UNIT-V

Electronic Communication Systems: The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

Reference Books:

1. Floyd ," Electronic Devices" Pearson Education 9th edition, 2012.
2. R.P. Jain , "Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition, 2007.
3. Frenzel, "Communication Electronics: Principles and Applications", Tata Mc Graw Hill, 3rd Edition, 2001

CO-PO and CO-PSO Mapping:

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	1	1	1	2	3	2	1	2	-	1	3	2	2
CO2	3	3	3	3	2	3	2	-	-	1	-	3	3	2
CO3	3	2	1	1	2	3	2	-	3	-	-	3	3	3
CO4	3	2	1	2	2	3	2	-	1	-	-	3	3	3
CO5	3	3	3	2	1	3	1	-	1	1	-	3	3	3
CO6	3	3	3	2	1	3	1	-	1	1	-	3	3	3

HSMC01 EFFECTIVE TECHNICAL COMMUNICATION

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Pre-Requisite: English
Successive: Self-development, communication, technical writing and ethics.
Course Objective: To provide an overview of English communication of engineering students.

Unit: I

Information Design and Development- Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.

Unit: II

Technical Writing, Grammar and Editing- Technical writing process, forms of discourse, writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing, Localization.

Unit: III

Self-Development and Assessment- Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, taking notes; Complex problem solving; Creativity.

Unit: IV

Communication and Technical Writing- Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report

Unit: V

Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, engineering ethics, managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, taking notes, Complex problem solving, Creativity.

Text/Reference Books:

1. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York,2004
2. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003.

(ISBN0312406843)

3. Shiv Khera, You Can Win, Macmillan Books, NewYork,2003.
4. Raman Sharma, Technical Communications, Oxford Publication, London, 2004.
5. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4)
6. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH NewDelhi2002.
7. Xebec, Presentation Book, TMH New Delhi, 2000. (ISBN0402213)

CO-PO and CO-PSO Mapping:

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	1	1	1	2	3	2	1	2	-	1	3	2	2
CO2	3	3	3	3	2	3	2	-	-	1	-	3	3	2
CO3	3	2	1	1	2	3	2	-	3	-	-	3	3	3
CO4	3	2	1	2	2	3	2	-	1	-	-	3	3	3
CO5	3	3	3	2	1	3	1	-	1	1	-	3	3	3
CO6	3	3	3	2	1	3	1	-	1	1	-	3	3	3

ESC-203R ENGINEERING MECHANICS

L	T	P	Total
3	0	1	4

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

To understand the various important mechanical properties of material for designing of structural components such as beams, columns, pressure vessels, springs etc.

Course Outcomes (CO): Upon successful completion of this course, the students will be able to

CO1	Understand the fundamental principles of forces, FBD and equilibrium
CO2	Study the concept of friction, work, energy and degree of freedom
CO3	Determine the centroid, first moment and second moment of various areas.
CO4	Analyse the various motions and rotation of rigid bodies.
CO5	Study the equation of motions and momentum
CO6	Understand system of motion, impact, conservation of energy and momentum

Course Content:

Unit I:

Introduction to Mechanics, Fundamental Principles, Coplanar forces, Equilibrium of particles, Free body diagram, Equilibrium of particle in space, Single equivalent force, Equilibrium of rigid bodies in two dimensions, Analysis of plane trusses, Method of joints, Method of sections, Zero-force member

Unit II:

Characteristics of dry friction, Problems involving dry friction, Ladder, Wedges, Square threaded screws, Definition of virtual work, Principle of virtual work, System of connected rigid bodies, Degrees of freedom, Conservative forces, Potential energy, Potential energy criteria for equilibrium.

Unit III:

Centroid, First moment of area, Theorems of Pappus and Guldinus, Second moment of area, Moment and Product of inertia of plane areas, Transfer Theorems, Polar moment of inertia, Principal axes, Mass moment of inertia

Unit IV:

Position, Velocity and Acceleration, Rectilinear motion, Curvilinear motion of a particle, Tangential and Normal components, Radial and Transverse components, Rotation of rigid bodies about a fixed axis.

Unit V:

General plane motion, Absolute and relative motion method, Instantaneous centre of rotation in plane motion, Linear momentum, Equation of motion, Angular momentum of a particle and rigid body in plane motion, D'Alembert's principle, principle of work and energy for a particle and a rigid body in plane motion,

Unit VI:

Conservation of energy, Principle of impulse and momentum for a particle and a rigid body in plane motion, Conservation of momentum, System of rigid bodies, Impact, direct and central impact, coefficient of restitution

Reference Books:

1. Mechanics of Materials by Hibbeler, Pearson.
2. Mechanics of Materials by.Beer, Jhonston, DEwolf and Mazurek, TMH
3. A. K. Tayal (2009), Engineering Mechanics – Statics and Dynamics, Umesh Publications, ISBN- 978-8 188-11401-6.
4. Introduction to Solid Mechanics by Shames, PHI
5. P. Ferdinand, E. Beer and J. Russell (2010), Vector Mechanics for Engineers, 9th Edition, McGraw-Hill International Edition. ISBN: 978-0-079-12637-5
6. P. Ferdinand, E. Beer and J. Russell (2010), Vector Mechanics for Engineers, 9th Edition, McGraw-Hill International Edition. ISBN: 978-0-079-12637-5

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PCC-CED201 FLUID MECHANICS

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

1. To apply hydrostatic law, principle of mass and momentum in fluid flows, concepts in Euler's and Bernoulli equations.
2. To provide fundamental knowledge of fluids, its properties and behaviour under various conditions of internal and external flows.
3. To determine the losses in a flow system, flow through pipes, boundary layer concepts.

Course Outcomes (CO): Upon successful completion of this course, the students will be able to

CO1	Analyse various hydraulic systems by applying the fundamental laws of fluid statics.
CO2	Solve the fluid flow governing equations by taking suitable constraints and assumptions
CO3	Evaluate major and minor losses in pipes
CO4	Analyse the practical significance of open channel flows
CO5	Perform dimensional analysis on any real-life problems
CO6	Interpret the boundary layer aspects of laminar and turbulent flows

Course Content:

Unit I: Introduction

Fluid properties, mass density, specific weight, specific volume and specific volume and specific gravity, surface tension, capillarity, pressure inside a droplet and bubble due to surface tension, compressibility viscosity, Newtonian and Non-Newtonian fluids, real and ideal fluids.

Unit II: Kinematics of Fluid Flow

Steady & unsteady, uniform and non-uniform, laminar & turbulent flows, one, two & three dimensional. flows, stream lines, streak lines and path lines, continuity equation in differential form, rotation and circulation, elementary explanation of stream function and velocity potential, rotational and irrotational flows, graphical and experimental methods of drawing flownets.

Unit III: Fluid Statics

Pressure-density-height relationship, gauge and absolute pressure, simple differential and sensitive manometers, two liquid manometers, pressure on plane and curved surfaces, center of pressure, Buoyancy, stability of immersed and floating bodies, determination of metacentric height, fluid masses subjected to uniform acceleration, free and forced vortex.

Unit IV: Dynamic of Fluid Flow

Euler's equation of motion along a streamline and its integration, limitation of Bernoulli's equation, Pitot tubes, venturimeter, Orficemeter, flow through orifices & mouth pieces, sharp crested weirs and notches, aeration of nappe.

Unit V: Laminar Flow

Navier-Stoke's equation, Laminar flow between parallel plates, Couette flow, laminar flow through pipes-Hagen Poiseuille law, laminar flow around a sphere-Stokes'law.

Flow through pipes

Types of flows-Reynold's experiment, shear stress on turbulent flow, boundary layer in pipes-Establishment of flow, velocity distribution for turbulent flow in smooth and rough pipes, resistance to flow of fluid in smooth and rough pipes, Stanton and Moody's diagram. Darcy's weisbach equation, other energy losses in pipes, loss due to sudden expansion, hydraulic gradient and total energy lines, pipes in series and in parallel, equivalent pipe, branched pipe, pipe networks, Hardy Cross method, water hammer.

Unit VI: Drag and Lift

Types of drag, drag on a sphere, flat plate, cylinder and airfoil, development of lift on immersed bodies like circular cylinder and airfoil.

Dimensional Analysis and Hydraulic Similitude

Dimensional analysis, Buckinghum pi theorem, important dimensionless numbers and their significance, geometric, kinematic and dynamic similarity, model studies, physical modeling, similar and distorted models.

Reference Books:

1. Theory and application of fluid Mechanics including Hydraulic Mechanics by K Subramanya
2. Introduction to Fluid Mechanics by Robert N. Fox & Alan T. Macnold
3. Hydraulic and Fluid Mechanic by P. N. Modi & S. M. Seth
4. Introduction to Fluid Mechanics by Robert W. Fox & Alan T. McDonald
5. Fluid Mechanics Through Problems by R. I. Garde
6. Engineering Fluid Mechanics by R. I. Garde & A.G. Mirajgaoker

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PCC-CED202 SURVEYING

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

In this subject, the students will acquire basic knowledge on building materials such as stones, bricks, cement, aggregates, mortar and concrete. Study various aspects of paints, varnishes and timber. Develop knowledge of material science and behaviour of various building materials used in construction. Identify the construction materials required for the assigned work.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Possess a sound knowledge of fundamental principles Geodetics.
CO2	Measurement of vertical and horizontal plane, linear and angular dimensions to arrive at solutions to basic surveying problems.
CO3	Capture geodetic data to process and perform analysis for survey problems.
CO4	Analyse the obtained spatial data and compute areas and volumes. Represent 3D data on plane figures as contours.
CO5	Determine the horizontal and vertical angles
CO6	Study the plane table surveying

Course Contents:

UNIT I:

Importance of surveying to engineers, plane and geodetic surveying, principles of surveying, classification of surveys, Accuracy and Errors, Linear Measurements, Measurement of directions: Reference meridians, bearing and azimuths, Compass.

UNIT II:

Methods of determining elevations, Direct levelling- basic terms and definitions, principle, booking and reduction of field notes, curvature and refraction correction, Automatic level, Digital Level, Vertical Control.

UNIT III:

Contouring: methods and uses, Tacheometric surveying, Stadia Tachometry, Different Types of Tachometric Measurements, Analytic lens, Tangential method, Temporary and permanent adjustments Theodolite surveying, Vernier theodolite, Electronic Theodolites and Total Station.

UNIT IV:

Measurement of horizontal and vertical angles, Methods of repetition and reiteration, errors in theodolite surveying, elimination of errors, Area and volume computation, area from latitude and departure, Simpson’s rule and Trapezoidal rule.

UNIT V:

Principles of traversing by compass and theodolite, computations of traverse coordinates, Principles and classification of triangulation systems, strength of figures, satellite stations, triangulation fieldwork. Plane table surveying, equipment, methods, resection by three-point problem

UNIT VI:

Elements of simple circular curves, theory and methods of setting out simple circular curves, transition curves- types and their characteristics, ideal transition curve, equations of various transition curves, Introduction to vertical curves

Reference Books:

1. B.C. Punmia, "Surveying Vol.1", Laxmi Publications pvt Ltd., New Delhi – 2009.
2. Kanetkar T P and S V Kulkarni, Surveying and Leveling Part I, Pune Vidyarthi Griha Prakashan, 1988.
3. S.K. Duggal, "Surveying Vol.1", Tata McGraw Hill Publishing Co. Ltd. New Delhi. – 2009.
4. K.R. Arora, "Surveying Vol. 1" Standard Book House, New Delhi. – 2010
5. R Subramanian, Surveying and Leveling, Second edition, Oxford University Press, New Delhi
6. A. Bannister, S. Raymond, R. Baker, "Surveying", Pearson, 7th ed., New Delhi

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	3	2	1	2	2	1	2	2	-	2	2	2
CO2	3	2	3	2	1	2	2	2	2	2	-	2	3	3
CO3	3	2	3	2	3	2	2	1	2	2	1	2	3	2
CO4	3	2	3	2	3	2	2	2	2	2	1	2	3	3
CO5	3	2	3	2	3	2	2	1	2	2	1	2	3	2
CO6	3	2	3	2	3	2	2	2	2	2	1	2	1	2

PCC-EED201 ENVIRONMENTAL CHEMISTRY

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

In this subject, the students will acquire basic knowledge on building materials such as stones, bricks, cement, aggregates, mortar and concrete. Study various aspects of paints, varnishes and timber. Develop knowledge of material science and behaviour of various building materials used in construction. Identify the construction materials required for the assigned work.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Understand the basic principles and concepts of environmental chemistry.
CO2	Knowledge of the chemical properties of water and the parameters that influence water quality.
CO3	Understand the chemical properties of soil and their impact on plant growth and soil health.
CO4	Knowledge of the chemical composition of the atmosphere and its impact on the environment.
CO5	Students will gain practical skills in environmental analytical chemistry.
CO6	Understand the importance of sustainable chemistry and its role in environmental engineering.

Course Contents:

UNIT 1

Fundamentals of Environmental Chemistry, Covalent and ionic bonding. Chemical equations, concentration, and activity, Structure and chemistry of organic molecules, Radioactivity of elements. Chemical equilibria, Thermodynamics and kinetics of chemical reactions.

UNIT 2

Principles of Water Chemistry, Water quality parameters and their measurement, Acid-base equilibria and buffer solution, Carbonate system, Solubility of gases in water, Complexation, precipitation, and redox reactions, Inorganic and organic contaminants in water and their speciation.

UNIT 3

Soil Chemistry: Organic matter, nitrogen, phosphorus, potassium, Cation exchange capacity, base saturation, and sodium absorption ratio.

UNIT 4

Atmospheric Chemistry: Composition of the atmosphere, Reactivity of trace substances in the atmosphere, Urban atmosphere—smog and particulate pollution, Chemistry of ozone formation, Chemistry of stratosphere.

UNIT 5

Environmental Analytical Chemistry, Sampling and sample preparation, Chromatographic and spectroscopic methods, Electrochemical methods and mass spectrometry, Quality assurance and quality control in environmental analysis, Basic environmental analyses in the laboratory.

UNIT 6

Sustainable Chemistry and Environmental Engineering, Principles of green chemistry and their importance, Life cycle assessment and environmental impact assessment, Principles of chemicals management and regulation, Sustainable materials and processes in environmental engineering, Ethical and social responsibilities in environmental engineering.

Text Books:

1. Environmental Chemistry by A.K. De, S. De, and S. Mukherjee
2. Environmental Chemistry: Fundamentals by J. Mukherjee and S.K. Bhattacharya
3. Textbook of Environmental Chemistry by S.S. Dara
4. Environmental Chemistry and Pollution Control by P.N. Ramachandran and R. Viraraghavan
5. Principles of Environmental Chemistry by B.K. Sharma and M. Kaur

Reference Books:

1. Environmental Chemistry by Stanley E. Manahan
2. Environmental Chemistry by Colin Baird and Michael Cann
3. Principles of Environmental Chemistry by James E. Girard
4. Environmental Chemistry by Julian Andrews, Peter Brimblecombe, and Tim Jickells
5. Environmental Chemistry: A Global Perspective by Gary W. vanLoon and Stephen J. Duffy

PCC-CED201P FLUID MECHANICS LABORATORY

L	T	P	Total
0	0	2	2

Sessional: 15 marks
Theory: 35 marks
Total: 50 marks
Duration of exam: 3 hours

Course Objective:

1. To understand the flow measurement in a pipe flow
2. To determine the energy loss in pipe flow
3. To measure the discharge in a open channel flow

List of Experiments:

1. To determine metacentric height of the ship model.
2. To verify the Bernoulli's theorem.
3. To determine coefficient of discharge for an Orificemeter/venturimeter.
4. To determine coefficient of discharge for an Orifice under variable head.
5. To calibrate a given notch.
6. To determine the coefficient of drag by Stoke's law for spherical bodies.
7. To study the phenomenon of cavitation in pipe flow.
8. To determine the critical Reynold's number for flow through commercial pipes.
9. To study the momentum characteristics of a given jet.
10. To determine head loss due to various pipe fittings.

Note: Students are required to complete at least eight experiments from the above list.

Reference Books:

1. Theory and application of fluid Mechanics including Hydraulic Mechanics by K Subramanya
2. Introduction to Fluid Mechanics by Robert N. Fox & Alan T. Macnold
3. Hydraulic and Fluid Mechanic by P. N. Modi & S. M. Seth
4. Introduction to Fluid Mechanics by Robert W. Fox & Alan T. McDonald
5. Fluid Mechanics Through Problems by R. I. Garde
6. Engineering Fluid Mechanics by R. I. Garde & A.G. Mirajgaoker

PCC-CED202P SURVEYING LABORATORY

L	T	P	Total
0	0	2	2

Sessional: 15 marks
Theory: 35 marks
Total: 50 marks
Duration of exam: 3 hours

Course Objective:

1. Introduction to Chain Surveying and Compass Surveying.
2. Plane Table Surveying – Radiation, intersection, Traverse, Resection Leveling.
3. Tacheometry and Theodolite survey
4. Trigonometric levelling to determine heights/elevations.

List of Experiments:

1. To prepare conventional symbol chart based on the study of different types of topographical maps.
2. To measure bearings of a closed traverse by prismatic compass and to adjust the traverse by graphical method.
3. To find out reduced levels of given points using Auto/dumpy level.
4. To perform fly leveling with Auto/tilting level.
5. To study parts of a Vernier theodolite and measurement of horizontal and vertical angle.
6. To measure horizontal angle between two objects by repetition/reiteration method.
7. To determine the height of a vertical structure (e.g. chimney/ water tank etc.) using trigonometrical levelling by taking observations in single vertical plane.
8. To study various parts of Electronic Theodolite, Total Station and practice for measurement of distance, horizontal and vertical angles.
9. To set out a simple circular curve by Rankine's method
10. Plane Table Surveying.

Note: Students are required to complete at least eight experiments from the above list.

Reference Books:

1. B.C. Punmia, "Surveying Vol.1", Laxmi Publications pvt Ltd., New Delhi – 2009.
2. Kanetkar T P and S V Kulkarni, Surveying and Leveling Part I, Pune Vidyarthi Griha Prakashan, 1988.
3. S.K. Duggal, "Surveying Vol.1", Tata McGraw Hill Publishing Co. Ltd. New Delhi. – 2009.
4. K.R. Arora, "Surveying Vol. 1" Standard Book House, New Delhi. – 2010
5. R Subramanian, Surveying and Leveling, Second edition, Oxford University Press, New Delhi
6. A. Bannister, S. Raymond, R. Baker, "Surveying", Pearson, 7th ed., New Delhi

PCC-EED201P ENVIRONMENTAL CHEMISTRY LAB

L	T	P	Total
0	0	2	2

Sessional: 15 marks
Theory: 35 marks
Total: 50 marks
Duration of exam: 3 hours

List of Experiments:

1. Determination of pH, alkalinity, hardness, and turbidity.
2. Determination of dissolved oxygen, total suspended solids, and biochemical oxygen demand.
3. Estimation of acidity and alkalinity of a given water sample. (Acid-base titration)
4. Determination of Total, hardness, calcium and magnesium content in water sample
5. (Complexometric titration)
6. Determination of Chloride of a given water sample. (Precipitation titration)
7. Determination of Residual free chlorine in water sample.
8. Analysis of physical and chemical parameters of water samples
9. Determination of cations (Na, K, Ca and Mg) in a given water/soil sample by using a Flame photometer
10. Determination of soil texture, pH, and organic matter content
11. Determination of turbidity of given water sample using Nephelometer.
12. Determination of Uranium content in water sample using Fluorimetry.
13. Analysis of solid and hazardous waste samples
14. Testing for chemical and physical properties of waste

Note: Students are required to complete at least eight experiments from the above list.

MC-01 CONSTITUTION OF INDIA

L	T	P	Total
1	0	0	1

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

CONSTITUTION OF INDIA– BASIC FEATURES AND FUNDAMENTAL PRINCIPLES

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the ―basic structure‖ of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of ―Constitutionalism‖ – a modern and progressive concept historically developed by the thinkers of ―liberalism‖ – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of ―constitutionalism‖ in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America. The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India‘s legacy of ―diversity‖. It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be ―static‖ and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it ―as one of the strongest court in the world‖.

COURSE CONTENT

1. Meaning of the constitution law and constitutionalism.
2. Historical perspective of the Constitution of India.
3. Salient features and characteristics of the Constitution of India.
4. Scheme of the fundamental rights.
5. The scheme of the Fundamental Duties and its legal status.
6. The Directive Principles of State Policy – Its importance and implementation.
7. Federal structure and distribution of legislative and financial powers between the Union and the States.
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

REFERENCES:

1. The Constitutional Law Of India 9th Edition, by Pandey. J. N.
2. The Constitution of India by P.M.Bakshi
3. Constitution Law of India by Narender Kumar
4. Bare Act by P. M. Bakshi

SEMESTER – IV

PCC-EED202 ENVIRONMETNAL IMPACT ASSESSMENT

L	T	P	Total
3	0	0	0

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective: The course objective for Environmental Impact Assessment (EIA) is to provide students with a comprehensive understanding of the EIA process, its importance in sustainable development, and the legal and institutional framework for EIA in India. The course aims to equip students with the skills to conduct EIA studies, including screening and scoping, baseline studies, impact prediction and evaluation, and report preparation and review.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Remembering: Recall and recognize the EIA process, its objectives, and types of environmental impacts.
CO2	Understanding: Interpret and explain the legal and institutional framework of EIA in India, including the EIA process and its phases.
CO3	Applying: Demonstrate the ability to conduct screening and scoping activities for EIA studies and prepare ToR.
CO4	Analyzing: Break down environmental baseline studies into their constituent parts and identify environmental receptors and their sensitivities.
CO5	Evaluating: Judge the effectiveness of mitigation measures and alternatives, and determine the significance of impacts.
CO6	Creating: Develop EIA reports, review them, and participate in public consultation and review processes.

UNIT 1

Introduction to Environmental Impact Assessment (EIA), Definition, objectives, and scope of EIA, Historical development of EIA in India and globally, Legal and institutional framework of EIA in India EIA process and phases, Types of environmental impacts.

UNIT 2

Screening and Scoping, Screening criteria and methods, Scoping process and activities Stakeholder identification and consultation, Preparation of terms of reference (ToR) for EIA studies.

UNIT 3

Environmental Baseline Studies, Overview of environmental baseline studies, Data collection and analysis techniques for air, water, soil, and biota, Use of remote sensing and GIS in baseline studies, Identification of environmental receptors and their sensitivities.

UNIT 4

Impact Prediction and Evaluation, Methods for predicting and evaluating environmental impacts, Mitigation measures and alternatives, Cumulative impact assessment, Significance determination and ranking of impacts.

UNIT 5

EIA Report Preparation and Review, Content and structure of EIA reports, Quality control and assurance in EIA reports, public participation and review process, Review of EIA reports by regulatory agencies.

UNIT 6

EIA Implementation, Monitoring, and Auditing, Implementation of EIA recommendations and conditions, Monitoring and compliance monitoring, Environmental auditing and management systems EIA effectiveness evaluation and feedback.

Text Books

Environmental Impact Assessment Methodologies by Y. Anjaneyulu
Environmental Impact Assessment: Theory and Practice by N. K. Uberoi
Environmental Impact Assessment in India: An Appraisal by P. S. Ramakrishnan and others
Foreign author:

Reference Books

1. Environmental Impact Assessment by Larry Canter and Sadhan Kumar Ghosh
2. Environmental Impact Assessment: A Guide to Best Professional Practices by Charles H. Eccleston and Charles A. Sadler
3. Environmental Impact Assessment: Practical Solutions to Recurrent Problems by Lawrence B. Cahill

PCC-CED204 ENGINEERING GEOLOGY

L	T	P	Total
3	0	0	0

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective: To teach the process of rock formation, engineering properties of rocks, structural features of rocks, occurrence of landslides and earthquake, and site selection for dam, reservoir, tunnel, bridge and highway

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Understand the formation, structure and texture of different rock types and their suitability in Civil construction
CO2	Know the rock weathering process, structural geology terms like dip, strike, outcrop and engineering properties of building stones
CO3	Appreciate the usefulness and utilization of natural materials in civil engineering works
CO4	Distinguish the structural features of rock such as folds, faults, joints and unconformities
CO5	Learn about earthquake, different seismic zones in India
CO6	Analyze and interpret geological reports and information and the latest geological exploration methods for suitable site selection

Course Contents:

UNIT I:

Introduction and importance of Geological knowledge, Rocks: their origin, structure and texture, Classification of igneous, sedimentary and metamorphic rocks and their suitability as engineering materials.

UNIT II:

Weathering and erosion of rocks, Stratification, Lamination bedding, Outcrop-its relation to topography, Dip and Strike of bed, Overlap, outlier and Inlier, Building stones and their engineering properties.

UNIT III:

Physical properties of minerals, Detailed study of certain rock forming minerals, Alkali aggregate reaction. Grouting, Pozzolonic materials.

UNIT IV:

Folds, Faults, Joints and unconformities, their classification, causes and relation to engineering behavior of rock masses, Landslides, its causes and preventive measures.

UNIT V:
Earthquake, its causes, classification, seismic zones of India and its geological consideration.

UNIT VI:
Geophysical exploration methods for sub-surface structure, Underground water and its origin, Aquifer & Aquiclude, Artesian wells, Underground provinces and its role as geological hazard, Site selection for dam, reservoir, tunnel, bridge and highway.

***References Books*:**

1. Reddy, D. V., Engineering Geology, Vikas Publication, 2nd edition, (2016)
2. Waltham, T., Foundations of Engineering Geology, Spon Press, 2nd edition, (2005)
3. Gokhale, K. V. G. K., Text book of Engineering Geology, B S Publication, (2008)
4. Singh, P., Enginering and General Geology, Katson Publishing House, 8th edition, (2008)
5. Bell, F. G., Fundamental of Engineering Geology, B S Publication, (2009)

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	2	2	1	1	-	2	-	-	-	-	-	2	2	2
CO3	2	2	1	1	-	2	-	-	-	-	-	2	2	3
CO4	2	2	1	1	-	2	-	-	-	-	-	2	2	3
CO5	2	2	1	2	-	2	-	-	-	-	-	2	2	2
CO6	2	1	-	-	-	2	-	-	-	-	-	2	1	2

PCC-CED207 SOIL MECHANICS

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective: To teach the overview of soil properties and fundamental of soil mechanics in relation to soil hydraulics, compaction, consolidation, stress distribution and shear strength.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Understand basic terminology of soil mechanics, soil classification and laboratory tests to determine properties of different types of soils
CO2	Examine the interaction between soil and water systems to understand capillary flow, permeability and seepage
CO3	Apply the weight-volume relationships for compaction and consolidation of soils
CO4	Analyse the stresses in the soil system due to applied loads
CO5	Learn the shear strength and earth pressure theories for slope stability analysis
CO6	Assessment of bearing capacity of shallow and deep foundations

Course Contents:

UNIT I:
Origin and classification of soils, preview of geotechnical field problems in Civil Engineering, soil composition, basic definitions, weight volume relationships, clay minerals, soil structure, index properties, sensitivity and thixotropy, particle size analysis, determination of moisture content, specific gravity and unit weight. Unified and Indian standard soil classification system.

UNIT II:
Stress conditions in soil-total, effective and neutral stresses and relationships, fluctuations of effective stress, permeability - Darcy's Law, hydraulic conductivity, determination of coefficient of permeability: laboratory method and field method, equivalent hydraulic conductivity in stratified soil, seepage, flow nets, seepage calculation from a flow net, flow nets in anisotropic soils, seepage through earth dam, capillarity, critical hydraulic gradient and quick sand condition, uplift pressure, piping.

UNIT III:
Soil compaction, water content - dry unit weight relationships, factors controlling compaction, field compaction equipment, field compaction control, Proctor needle method.
Consolidation, primary and secondary consolidation, Terzaghi’s one dimensional theory of consolidation, consolidation test, normal and over-consolidated soils, over-consolidation ratio, determination of coefficient of consolidation.

UNIT IV:
Stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area, influence factors, isobars, Boussinesq's equation, Newmark's influence chart, contact pressure under rigid and flexible area, computation of displacements from elastic theory.

UNIT V:
Shear strength, Mohr-Coulomb failure criterion, shear strength parameters and determination; direct and tri-axial shear test, unconfined compression test, pore pressure, Skempton's pore pressure coefficients.
Earth pressure, classical theories, Coulomb and Rankine's approaches for frictional and c-φ soils, inclined backfill, graphical methods of earth pressure determination, stability of slopes, Culman method and Method of slices, stability number and chart.

UNIT VI:
Sub surface structure, bearing capacity of shallow foundations, SPT, plate load test, effect of water table, deep foundations, types of piles, static and dynamic formulae, pile group, settlement of pile group, negative skin friction.

***Text and References Books*:**

1. Das, B. M., Advanced Soil Mechanics. Taylor and Francis Group, London, Second edition, (2013)
2. Arora, K. R., Soil Mechanics and Foundation Engineering, 5th edition, Standard publishers (2000)
3. Gopal, R. and ASR Rao, Basic and applied soil mechanics, 2nd edition, New age International publishers (2004)
4. Lambe, T.W. and Whitman, R. V., Soil Mechanics, John Wiley New York (2004)
5. Powrie, W., Soil Mechanics concepts and applications, Spon Press, Taylor and Francis Group, London, Second edition, (2009)

E links:
https://onlinecourses.nptel.ac.in

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PCC-EED203 WATER QUALITY AND SUPPLY

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Evaluate water sources, water quality and transportation of water.
CO2	Understand the various water quality parameters
CO3	Learn the basic design principles of water treatment
CO4	Analyse the fundamentals of water softening
CO5	Design the water supply systems
CO6	Understand the selection criteria of pumps and water fixtures in buildings

Course Contents:

UNIT I:

Water Sources: Definition and Scope of Environmental Engineering, Surface and ground water sources; Selection and development of sources;

Water Supply Systems: Municipal water demands and demand variations, Population forecasting and water demand estimations; Intakes and transmission systems, pipes for transporting water and their design

UNIT II:

Water Quality: Physical, chemical and biological water quality parameters; Water quality index; Water quality standards;

UNIT III:

Water treatment - I: Water treatment schemes; Basic principles of water treatment; Design of plain sedimentation, coagulation and flocculation, filtration – slow, rapid and pressure filter; Disinfection units.

UNIT IV:

Water treatment - II: Fundamentals of water softening, fluoridation and defluorination, and water desalinization and demineralization. Advanced treatments like adsorption, ion exchange, membrane processes.

UNIT V:

Design of Water Supply Systems: Water supply network design and design of balancing and service reservoirs; operation and maintenance of water supply systems. Data and background information for the design of water supply system;

UNIT VI:

Pumps and pumping stations: Types of pumps and their characteristics and efficiencies; Pump operating curves and selection of pumps; pumping stations. Small scale and household level water purification system and water fixtures, Various valves used in W/S systems, Introduction to various types of home plumbing systems for water supply.

References Books

1. Manual on Water Supply and Treatment by Ministry of Urban Development, New Delhi.
2. Water Supply and Sewerage, McGhee, McGraw Hill.
3. Environmental Engineering, Vol. I, S.K. Garg, Khanna Publishers, New-Delhi.
4. Environmental Engineering Peavy, Rowe and Tchobanglous, McGraw Hill.
5. Water and Waste Water Engineering (Vol. 1&2), Fair, Geyer &Okun, John Wiley, New York.
6. Water Supply Engineering P.N. Modi, Standard Book House New-Delhi.
7. Standard Methods for the Examination of Water and Waste Water, American Public Health Association.

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

BSC-201 MATHEMATICS III

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Solve field problems in engineering involving PDEs.
CO2	Formulate and solve problems involving random variables
CO3	Apply statistical methods for analysing experimental data.
CO4	Understand the concept of probability.

Course Contents:

UNIT I:

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables.

UNIT II:

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

UNIT III:

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

References Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications.
3. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall.
4. S. Ross, A First Course in Probability, Pearson Education India.

BSC-01 BIOLOGY

L	T	P	Total
0	0	2	2

Sessional: 15 marks
Theory: 35 marks
Total: 50 marks
Duration of Exam: 3 hours

MODULE 1: INTRODUCTION

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.

Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

MODULE 2: CLASSIFICATION

Purpose: To convey that classification per seis not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted.

Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilisation -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitataacquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. Musculus.

MODULE 3: GENETICS

Purpose: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

MODULE 4: BIOMOLECULES

Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine, Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

MODULE 5: ENZYMES

Purpose: To convey that without catalysis life would not have existed on earth.

Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

MODULE 6: INFORMATION TRANSFER

Purpose: The molecular basis of coding and decoding genetic information is universal

Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure-from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

MODULE 7: MACROMOLECULAR ANALYSIS

Purpose: How to analyse biological processes at the reductionist level

Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

MODULE 8: METABOLISM

Purpose: The fundamental principles of energy transactions are the same in physical and biological world.

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy Charge.

MODULE 9: MICROBIOLOGY

Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

PCC-CED207P SOIL MECHANICS ENGINEERING LAB

L	T	P	Total
0	0	2	2

Sessional: 15 marks
Theory: 35 marks
Total: 50 marks
Duration of Exam: 3 hours

Course Objective:

List of Experiments:

1. Determination of water content of a given moist soil sample by (i) oven drying method, (ii) pycnometer method.
2. Determination of specific gravity of a given soil sample by (i) density bottle, (ii) pycnometer method.
3. Determination of in situ dry density of soil mass by (i) core-cutter method, (ii) sand replacement method.
4. Determination of relative density of a given soil sample.
5. Determination of complete grain size distribution of a given soil sample by sieve analysis and sedimentation (hydrometer) analysis.
6. Determination of consistency limits (liquid, plastic and shrinkage limits) of the soil sample.
7. Classify the soil as per the IS 1498- 1970 based on the results obtained from experiments at serial nos. 5 & 6 (grain size distribution and consistency limits).
8. Determination of compaction characteristics (OMC & MDD) of a given soil sample.
9. Determination of permeability of a remolded soil sample by constant head &/or falling head method.
10. Determination of consolidation characteristics of a remolded soil sample by an oedometer test.
11. Determination of shear strength characteristics of a given soil sample by U/U test from Tri-axial Compression Machine.
12. Retrieving soil samples and conducting SPT tests by advancing boreholes through hand-held auger.

Note: Any 8 experiments are to be performed from the list of experiments.

References:

1. Bowles, Joseph E., “Engineering Properties of Soil and Their Measurement” Fourth Edition, Indian Edition, McGraw Hill Education (India) Pvt. Ltd, New Delhi-110032.

PCC-EED203P WATER QUALITY AND SUPPLY LAB

L	T	P	Total
0	0	2	2

Sessional: 15 marks
Theory: 35 marks
Total: 50 marks
Duration of Exam: 3 hours

Course Objective:

List of Experiments:

1. Determination of turbidity and conductivity.
2. Determination of pH, alkalinity and acidity.
3. Determination of hardness and chlorides.
4. Determination of residual chlorine.
5. Determination of MPN (most probable number) of coliforms.
6. Measurement of SPM and PM10 with high volume sampler.
7. Measurement of sound level with sound level meter.
8. Determination of total, suspended and dissolved solids.
9. Determination of BOD.
10. Determination of COD.
11. Determination of fluoride.
12. Determination of optimum dose of coagulants by Jar Test Apparatus.

Note: Any 8 Experiments out of the list of experiments are to be performed.

References:

1. A.P.H.A. “Standard Methods for the Examination of Water and Wastewater”, American Public Health Association.
2. Sawyer, C.N., McCarty, P.L. & Parkin, G.F. “Chemistry for Environmental Engineering”, Mc-Graw Hill.
3. Mathur, R.P. “Water & Wastewater Testing”, Lab Manual, Roorkee.

MC-04 MESSAGE OF BHAGWAT GITA

L	T	P	Total
1	0	0	1

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of Exam: 3 hours

Course Objectives:

To enable the students to create an awareness on message of Bhagwat Gita.

To instill moral, social values and to appreciate the Karma Yoga.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Realize the relevance of Bhagavad Gita today.
CO2	Relate Yoga to Devotion
CO3	Realize the duties and Responsibilities in the Society.

Course Contents:

UNIT I:

Introduction: Relevance of Bhagavad Gita Today- Background of Mahabharata. Arjuna Vishada Yoga: Arjuna's Anguish and Confusion- Symbolism of Arjuna's Chariot. Sankhya Yoga: Importance of Self- knowledge- Deathlessness: Indestructibility of Counciousness Being Established in Wisdom- Qualities of Sthita- Prajna.

UNIT II:

Karma Yoga: Yoga of Action- Living in the Present- Dedicated Action without Anxiety over Results- Concept of Swadharma.

Dhyana Yoga: Tuning the Mind- Quantity, Quality and Direction of Thoughts- Reaching Inner Silence.

UNIT III:

Bhakti Yoga: Yoga of Devotion- Form and Formless Aspects of the Divine- Inner Qualities of a True Devotee **Gunatraya Vibhaga Yoga:** Dynamics of the Three Gunas: Tamas, Rajas, Sattava- Going Beyond the Three Gunas- Description of the Gunatheetha.

References Books

1. Swami Chinmayananda, "The Holy Geeta", Central Chinmaya Mission Trust.
2. Swami Chinmayananda, "A Manual of Self Unfoldment", Central Chinmaya Mission Trust

HSMC(H102) Universal Human Values 2: Understanding Harmony

L	T	P	Total	
3	0	0	3	

Sessional: 50 marks
Theory: 50 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

1. 1.Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

UNIT-I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education, Purpose and motivation for the course, Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and experiential Validation- as the process for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority 4. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

UNIT-II

Understanding Harmony in the Human Being - Harmony in Myself!, Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health. Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

UNIT-III

Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship, Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student

relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

UNIT-IV

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence, Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in allpervasive space, Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT-VI

Implications of the above Holistic Understanding of Harmony on Professional Ethics, Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations, Sum up. Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Reference Books:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
3. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
4. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
5. The Story of Stuff (Book).
6. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
7. Small is Beautiful - E. F Schumacher.
8. Slow is Beautiful - Cecile Andrews
9. Economy of Permanence - J C Kumarappa
10. Bharat Mein Angreji Raj - PanditSunderlal
11. Rediscovering India - by Dharampal
12. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
13. India Wins Freedom - Maulana Abdul Kalam Azad
14. Vivekananda - Romain Rolland (English)
15. Gandhi - Romain Rolland (English)

SEMESTER – V

PCC-EED301 ENVIRONMENTAL MICROBIOLOGY

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of Exam: 3 hours

Course Objective: The objective of this course is to provide students with a fundamental understanding of microorganisms and their role in environmental engineering. By the end of this course, students should be able to understand the structure and function of microorganisms, their metabolic pathways, growth kinetics, and their applications in environmental engineering for wastewater treatment, bioremediation, and biogeochemical cycling.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Identify and classify microorganisms based on their characteristics and diversity
CO2	Analyze and evaluate microbial growth kinetics and control methods
CO3	Demonstrate an understanding of microbial metabolism and energy production
CO4	Apply knowledge of microbial processes to environmental engineering problems
CO5	Evaluate the role of microorganisms in bioremediation and biogeochemical cycling
CO6	Create and design experiments to quantify microbial populations in environmental samples

UNIT I

Introduction to Microorganisms and Microbial Diversity, Introduction to prokaryotic and eukaryotic microorganisms, Characteristics of diverse groups of microorganisms; Classification of micro-organisms; Microbial diversity; Plant-microbe and soil-microbe interactions; Role of microorganisms in wastewater treatment, bioremediation and biogeochemical cycling.

UNIT II

Cell Chemistry and Cell Biology, Structure of proteins, nucleic acid (DNA & RNA), lipids and polysaccharides; Bonds in biomolecules; Stereoisomerism in biomolecules; Structure of cell; Structure and function of cytoplasmic membrane, cell wall, outer membrane, glycocalyx, chromosomes, endospores, storage products, mitochondria and chloroplasts.

UNIT III

Microbial Metabolism, Overview of microbial metabolism (anabolism and catabolism), Phosphorylation and ATP production, Major metabolic pathways (glycolysis, TCA cycle, electron transport chain), Fermentation and anaerobic respiration, Enzymes and enzyme kinetics.

UNIT IV

Microbial Growth and Control, Bacterial nutrition and growth requirements, Specific growth rate and doubling time, Monod's model for microbial growth, Types of culture media and culture techniques (batch and continuous culture), Effects of environmental factors on microbial growth, Control of microbes using physical and chemical methods

UNIT V

Microbiology and the Environment, Role of microorganisms in wastewater treatment, Bioremediation of pollutants, Biogeochemical cycling and microbial transformations of nutrients

UNIT VI

Microbiology and Health, Pathogens and modes of transmission, Indicator organisms and their use in water quality monitoring, Quantification of coliforms using MPN and membrane filtration techniques

Reference Books:

1. Environmental Microbiology by Ian L. Pepper, Charles P. Gerba, and Terry J. Gentry (Foreign Author)
2. Environmental Microbiology: A Laboratory Manual by Ian L. Pepper and Charles P. Gerba (Foreign Author)
3. Microbiology for Environmental and Public Health Engineers by Qingyan Chen (Indian Author)
4. Environmental Microbiology and Biotechnology by R. N. Singh and R. K. Gautam (Indian Author)

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PCC-EED302 SOILD AND HAZARDOUS WASTE MANAGEMENT

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective: The objective of this course is to provide students with an in-depth understanding of the management of solid and hazardous waste. The course will focus on the principles, techniques, and tools required to manage different types of waste in an environmentally responsible manner.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Describe the principles and practices of solid and hazardous waste management.
CO2	Analyze the sources and characteristics of different types of waste.
CO3	Evaluate waste processing and disposal options, including reuse, biological methods, energy recovery, and landfilling.
CO4	Understand the rules and regulations for solid waste management in India.
CO5	Develop an understanding of soil contamination and leaching of contaminants into groundwater.
CO6	Apply the principles of integrated waste management and waste minimization.

Course Contents:

Unit – I

Introduction to Solid and Hazardous Waste Management, Definition and classification of waste, Waste hierarchy, Rules and regulations for solid waste management in India

Unit – II

Municipal Solid Waste Management, Sources, generation, and characteristics of municipal solid waste, Collection and transportation of municipal solid waste, Waste processing and disposal options, including reuse, biological methods, energy recovery, and landfilling

Unit – III

Hazardous Waste Management, Characteristics and classification of hazardous waste, Generation and fate of hazardous waste in the environment, Treatment and disposal of hazardous waste.

Unit – IV

Soil Contamination and Groundwater Leaching, Sources of soil contamination, Environmental impacts of soil contamination, Leaching of contaminants into groundwater

Unit – V

Biomedical Waste, Plastic Waste, and E-waste Management, Sources, generation, and characteristics of biomedical waste, plastic waste, and E-waste, Waste management practices, including storage, collection, and transfer.

Unit – VI

Integrated Waste Management, Integration of solid and hazardous waste management, Waste minimization and recycling, Life cycle assessment.

***References Books*:**

1. Solid Waste Management: Principles and Practice by Ramesha Chandrappa and Diganta B. Das
2. Handbook of Environmental Engineering: A System of Decision-Making by Suresh K. Bhargava and P. Aarne Vesilind
3. Environmental Pollution Control Engineering by C.S. Rao and A.K. Datta
4. Solid Waste Engineering: A Global Perspective by William A. Worrell, P. Aarne Vesilind, and Christian Ludwig
5. Hazardous Waste Management by Michael D. LaGrega, Phillip L. Buckingham, and Jeffrey C. Evans
6. Integrated Solid Waste Management: Engineering Principles and Management Issues by George Tchobanoglous, Hilary Theisen, and Samuel Vigil

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PCC-EED303 AIR AND NOISE POLLUTION MONITORING AND CONTROL

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of Exam: 3 hours

Course Objective: The objective of this course is to provide students with an understanding of air pollution control, including the sources and characteristics of air pollutants, measurement and control methods for particulate matter and gaseous pollutants, automotive emissions control, air quality management strategies, and noise pollution control.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Explain the sources and effects of air pollution on health and environment
CO2	Evaluate the effectiveness of different particulate and gaseous pollutant control methods
CO3	Design automotive emission control systems using appropriate technology
CO4	Analyze air quality data and develop air quality management strategies
CO5	Compare and contrast the various methods for measuring and controlling noise pollution
CO6	Evaluate the impact of air pollution control regulations and policies (Evaluation and Synthesis

Course Contents:

UNIT-1

Structure of the atmosphere; Natural and anthropogenic sources of pollution; Atmospheric sources, sinks, transport; Indoor air pollution; Effects on health and environment; Air pollution: gases and particulate matter; Air quality standards; Primary and secondary pollutants; Criteria pollutants, ambient and source standards, air quality indices, visibility.

UNIT-2

Particulate Pollutants: measurement and control methods; Control of particulate air pollutants using gravitational settling chambers, cyclone separators, wet collectors, fabric filters (Bag-house filter), electrostatic precipitators (ESP).

UNIT-3

Gaseous Pollutants: Measurement and control methods; Control of gaseous contaminants: absorption, adsorption, condensation and combustion; Control of sulphur oxides, nitrogen oxides, carbon monoxide, and hydrocarbons; Vapour-liquid and vapour-solid equilibria; Diffusion, Fick's law and interfacial mass transfer.

UNIT-4

Air Pollution NOx & SOx Control Equipment, Automotive emission controls, fuel quality, diesel particulate filters, catalytic convertors.

UNIT-5

Air Quality Management: Point, line and area sources; Inventory; Influence of meteorology – wind rose diagrams, stability, mixing height, topography, dispersion modelling, monitoring.

UNIT-6

Noise pollution: Sources; Health effects; Standards; Measurement and control methods.

***Text and Reference Books*:**

1. Air Pollution: Its Origin and Control by K. V. Rao
2. Environmental Pollution Control Engineering by C.S. Rao
3. Air Pollution and Control by S. M. Mukhtar
4. Air Pollution Control: A Design Approach by C. David Cooper and F. C. Alley
5. Atmospheric Pollution: History, Science, and Regulation by Mark Z. Jacobson
6. Air Pollution Control Engineering by Noel de Nevers (McGraw-Hill Education)
7. Fundamentals of Air Pollution by Daniel Vallero (Academic Press)
8. Air Pollution: Measurement, Modelling and Mitigation by S. K. Goyal and S. K. Gupta (New Age International Publishers)
9. Air Quality, Fourth Edition by Thad Godish and Wayne T. Davis (CRC Press)
10. Principles and Practice of Air Pollution Control by C. David Cooper and F. C. Alley (Waveland Press)

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PCC-CED304 HYDRAULIC ENGINEERING

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

4. To apply hydrostatic law, principle of mass and momentum in fluid flows, concepts in
5. Euler's and Bernoulli equations.
6. To provide fundamental knowledge of fluids, its properties and behaviour under various conditions of internal and external flows.
7. To determine the losses in a flow system, flow through pipes, boundary layer concepts.

Course Outcomes (CO): Upon successful completion of this course, the students will be able to

CO1	Acquire specific knowledge regarding fluid flow phenomena observed in Civil Engineering systems such as flow in open channel flow
CO2	Develop understanding of the basic principles of fluid flow patterns and provide skills in analyzing fluid flows in open channel hydraulics
CO3	Understand gradually varied flow profile in detail
CO4	Understand rapidly varied flow profile in detail
CO5	Analyse the practical significance of open channel flows
CO6	Knowledge is useful for the design of open channels for rectangular and non-rectangular channels for hydraulic jump phenomena.

Course Content:

Unit-I: Definition, importance of study of open channel flow, Types of channels, Classification of Flows, Velocity distribution, One-Dimensional method of flow analysis, Pressure Distribution, Equation of Continuity, Energy Equation, Momentum equation.

Unit-II: Chezy Equation, Darcy-Weisbach Friction Factor, Manning's roughness Formula, Resistance Formulate for Practical Use, Normal Depth and its computation.

Unit-III: Specific Energy, specific fore, Critical Flow, critical depth, Calculation of Critical Depth for some shapes of channels. Weirs, Sharp-crested Weir, Broad-crested Weir, Critical-Depth Flumes, Sluice-gate Flow, free and submerged flow and its analysis of sluice gate.

Unit-IV: Gradually varied flow: Theory and analysis, gradually-varied flow computations in prismatic channels, gradually varied flow in non-prismatic channels. Characteristics of flow profiles –Draw down and back water curves – Profile determination – Graphical integration, direct step and standard step method – Flow through transitions,

Unit- V: Occurrence and importance, Momentum Equation for hydraulic Jump, computation of sequent depth, Classification of Jumps, Characteristics of Jump in a Rectangular Channel, location of jump, Hydraulic jump application, Use of the Jump as an Energy Dissipates.

Unit-VI: Reciprocating pumps, their types, work done by single and double acting pumps. Centrifugal pumps, components and parts and working, types, heads of a pump-statics and manometric heads, Force executed by fluid jet on stationary and moving flat vanes., Turbines, classifications of turbines based on head and specific speed, component and working of Pelton wheel and Francis turbines, cavitation and setting of turbines.

Reference Books:

1. Chow Ven Te, "Open Channel Hydraulics". McGaw Hill International Edition.
2. Ranga Raju, K.G. "Flow Through Open Channel". Tata McGraw-Hill
3. Choudhary, Hanif "Open Channel Hydraulics" Prentice Hall of India
4. Subramanya K. "Flow in Open Channels". Tata McGraw-Hill
5. Srivastava, R. "Flow Through Open Channels". Oxford University Press.

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PCC-CED305 GEOMATICS ENGINEERING

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objectives (CO):

1. To understand use of aerial camera, aerial photographs and procedure of aerial survey
2. To provide background knowledge and understanding of principle of remote sensing and remote sensing system
3. To gain knowledge about the data interpretation techniques.
4. To provide knowledge about the basic of GPS
5. To gain knowledge about working principle of GIS

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Gain a clear understanding of photogrammetry surveying.
CO2	Understand the working principle of remote sensing system.
CO3	Understanding of various image processing techniques
CO4	Gain understanding of Global Positioning System
CO5	Gain understanding of GIS
CO6	Analysis of geospatial data.

Course Contents:

UNIT – I

Photogrammetry: Principles& types of aerial photograph, geometry of vertical aerial photograph, Scale & Height measurement on single vertical aerial photograph, Height measurement based on relief displacement, Fundamentals of stereoscopy.

UNIT – II

Remote Sensing: Introduction, Definition and Overview of Remote Sensing and Remote Sensing Systems, Electromagnetic Radiation, Terms and Definitions, electromagnetic Spectrum, Sources of electromagnetic radiation, Principles of energy interaction in atmosphere and earth surface features, Remote sensing advantages & Limitations.

UNIT-III

Image Processing and Interpretation: Image interpretation techniques, visual interpretation, Digital image processing, Principles of Thermal Remote Sensing & its applications, Principles of Microwave Remote Sensing & its applications

UNIT – IV

GPS Basics: System overview, working principle of GPS, Satellite ranging, calculating position, Ranging errors and its correction, Static and Rapid GPS surveying, DGPS and Kinematic methods, Real time and post processing DGPS, visibility diagram, GAGAN.

UNIT – V

Geographical Information System: Definition of GIS, Key Components of GIS, Functions of GIS,

UNIT- VI

Geospatial Analysis: Spatial data, spatial information system Geospatial analysis, Integration of Remote sensing and GIS, and Applications in Civil Engineering

Text Books

1.Basics of Remote sensing & GIS by S. Kumar, Laxmi Publications.
2.Concepts & Techniques of GIS by C. P. Lo Albert, K.W. Yonng, Prentice Hall India) Publications.
3.Principals of Geo physical Information Systems – Peter ABurragh and Rachael A. Mc Donnell, Oxford Publishers 2004.
4.Surveying Vol. II and III by Dr. B.C. Punamia, Laxmi Publishers. New Delhi
5. Remote Sensing and GIS Lillesand and Kiefer, John Willey 2008.
6. Remote Sensing and GIS B. Bhatta by Oxford Publishers 2015
7. Introduction to Geographic Information System – Kang-Tsung Chang, McGraw-Hill 2015

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
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CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PCC-CED306 WASTE WATER ENGINEERING

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Define the concept of wastewater flow engineering.
CO2	Evaluate reuse of treated effluent in the most efficient manner.
CO3	Analyse the sewage treatment units**.**
CO4	Determine the various characteristics of sewage
CO5	Estimate the most appropriate disposal option for waste water.
CO6	Understand the waste water schemes.

Course Contents:

UNIT – I

Introduction: Wastewater flow and its characteristics, Wastewater collection systems. Problems of industrial wastewaters. Wastewater treatment processes. Theory and design of screens, grit chambers, sedimentation, coagulation, flocculation.

UNIT – II

Physio-chemical and biological treatment strategies and their evaluation.

UNIT-III

Activated sludge process (ASP), extended aeration systems, trickling filters (TF), aerated lagoons, stabilization ponds, oxidation ditches, sequential batch reactor, rotating biological contactor, etc.

UNIT – IV

Anaerobic treatment process, Effects of pH, temperature and other parameters on anaerobic treatment, Concept of anaerobic contact process, anaerobic filter, anaerobic fixed film reactor, fluidized bed and expanded bed reactors and upflow anaerobic sludge blanket (UASB) reactor**.**

UNIT – V

Indian standards for disposal of treated wastewaters on land and in natural streams, Treated wastewater reclamation and reuse. Recent technologies of treatment.

UNIT- VI

Study on wastewater generation points, wastewater characteristics, process flow sheets, treatment scheme for tannery, sugar, textile, steel, distillery, paper/ pulp and oil refinery industry wastewater.

Text Books

1. Metcalf & Eddy “Wastewater Engineering: Treatment & Reuse”, Tata Mc Graw Hill.
2. Peavy, Rowe & Tchobanoglous “Environmental Engineering”, Mc. Graw Hill, New Delhi.

3. Davis, M. “Water and Wastewater Engineering’’, Mc-Graw Hill.
4. Fair, G.M. & Geyer, J.C. “Water supply and Wastewater Disposal”, John Wiley & Sons.
6. Qasim, S.R., Motley, E.M., and Zhu, G. “Water Works Engineering”, Prentice Hall Publication.
7. CPHEEO “Manual on Sewerage & Sewage Treatment”, Ministry of urban development, Government of India, New Delhi.
8. Parker, H. “Wastewater System Engineering”, Prentice Hall.
9. Garg, S.K. “Environmental Engineering Vol. II (Sewage Disposal and Air Pollution Engineering)”, Khanna Publishers.
10. Rao, M.N. & Dutta, A.K. “Wastewater Treatment”, Oxford & IBH Publishing.

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
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CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PCC-CED304P HYDRAULIC ENGINEERING LAB

L	T	P	Total
0	0	2	2

Sessional: 15 marks
Theory: 35 marks
Total: 50 marks
Duration of exam: 3 hours

Course Objective:

1. Application of principles of fluid mechanics to the solution of problems encountered in both natural and constructed water systems.
2. Use of model studies in solving problems in river engineering.

List of Experiments

1. Flow Visualization of uniform Flow in hydraulic flumes.
2. Velocity Distribution in open channel flow
3. Venturiflume
4. Standing wave flume
5. Gradually varied flow in hydraulic flumes
6. To study the characteristics of a hydraulic jump in hydraulic flumes
7. To determine the coefficient of discharge for flow over a sluice gate
8. To determine the coefficient of discharge for flow over a broad crested weir.
9. Flow through V - Notch
10. Studies in wind tunnel and Boundary Layer
11. Flow around an airfoil/circular cylinder

Note: Ten experiments are to be performed in the Semester taking at least seven experiments from the above list. Remaining three experiments should be performed as designed & set by the concerned Institution as per the scope of the syllabus.

Reference Books:

1. Chow Ven Te, “Open Channel Hydraulics”. McGaw Hill International Edition.
2. Ranga Raju, K.G. “Flow Through Open Channel”. Tata McGraw-Hill
3. Choudhary, Hanif “Open Channel Hydraulics” Prentice Hall of India
4. Subramanya K. “Flow in Open Channels”. Tata McGraw-Hill
5. Srivastava, R. “Flow Through Open Channels”. Oxford University Press.

PCC-EED303P AIR AND NOISE POLLUTION MONITORING AND CONTROL LAB

L	T	P	Total
0	0	2	2

Sessional: 15 marks
Theory: 35 marks
Total: 50 marks
Duration of exam: 3 hours

Course Objective:
Application of principles of Air and Noise pollution control for assessment of air and noise quality parameters.

List of Experiments

1. Measurement of particulate matter using a high-volume air sampler
2. Determination of air quality index using a portable air quality monitor
3. Measurement of noise levels using a sound level meter
4. Characterization of gaseous pollutants using a gas chromatograph
5. Testing of various air pollution control devices like cyclone separators, fabric filters, electrostatic precipitators, etc.
6. Design and testing of noise barriers for reducing noise pollution
7. Analysis of indoor air pollutants like VOCs, CO2, and radon
8. Determination of meteorological factors like wind speed and direction, temperature, and humidity and their impact on air pollution dispersion
9. Study of emission standards and their implementation in different industries
10. Evaluation of the effectiveness of automotive emission control devices like catalytic converters and diesel particulate filters.
11. Development of Air Quality Index (AQI) Calculation Program

Reference Books:

1. Environmental Engineering Laboratory Manual for Air and Noise Pollution Control" by S. C. Santra and S. K. Gupta
2. Air and Noise Pollution Control Laboratory Manual" by A. K. Jain and R. K. Trivedi
3. Experiments in Environmental Engineering: Air and Noise Pollution Control Laboratory" by P. N. Modi and S. M. Modi
4. Air and Noise Pollution Control Laboratory Manual" by P. Venkateswara Rao and S. Suresh Kumar
5. Practical Manual of Air and Noise Pollution Control" by P. S. Rao

PCC-CED306P WASTEWATER ENGINEERING LAB

L	T	P	Total
0	0	2	2

Sessional: 15 marks
Theory: 35 marks
Total: 50 marks
Duration of exam: 3 hours

Course Objective:
Application of principles of waste water engineering for assessment of waste water quality parameters.

List of Experiments

1. To determine the acidity of a wastewater sample
2. To determine the alkalinity of a wastewater sample
3. To determine total, suspended, dissolved and settable solids in a wastewater sample
4. To determine volatile and fixed solids in a wastewater sample
5. To determine oil and grease in a wastewater sample
6. To determine the chloride concentration in a wastewater sample.
7. To determine the sulphate concentration in a wastewater sample.
8. To determine the B.O.D. of a given wastewater sample.
9. To determine the C.O.D. of a given wastewater sample.
10. To determine the T.O.C. of a given wastewater sample.
11. To determine the fecal count of a given wastewater sample.
12. Microscopic studies of a wastewater

References:

1. A.P.H.A. “Standard Methods for the Examination of Water and Wastewater”, American Public Health Association.
2. Sawyer, C.N., McCarty, P.L. & Parkin, G.F. “Chemistry for Environmental Engineering”, Mc-Graw Hill.
3. Mathur, R.P. “Water & Wastewater Testing”, Lab Manual, Roorkee.

SEMESTER – VI

PCC-EED304 ENVIRONMENTAL MANAGEMENT AND SUSTAINABLE DEVELOPMENT

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective: The objective of this course is to provide students with an understanding of the principles, frameworks, and techniques of environmental management and sustainable development. The course aims to equip students with the knowledge and skills necessary for identifying, assessing, and managing environmental problems and developing sustainable solutions.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Understand the concepts, principles, and frameworks of environmental management and sustainable development.
CO2	Interpret and analyze environmental policies, regulations, and practices.
CO3	Apply environmental assessment and management techniques to solve environmental problems.
CO4	Analyze the causes and effects of environmental problems and assess the effectiveness of management strategies.
CO5	Develop sustainable solutions to environmental problems and evaluate their feasibility and effectiveness.
CO6	Evaluate the economic, social, and ethical dimensions of environmental management and sustainable development.

Course Contents:

UNIT-I

Introduction to Environmental Management and Sustainable Development**,** Definition and scope of environmental management and sustainable development, Principles and frameworks of environmental management, Sustainable development and its dimensions, Environmental policies and regulations.

Environmental Management Systems; ISO14000 series; Environmental auditing: Environmental Impact Assessment; Life cycle assessment; Human health risk assessment.

UNIT-II

Environmental Impact Assessment, Definition and principles of EIA, Steps involved in EIA process, EIA methods and techniques, Environmental management plan.

UNIT-III

Environmental Planning and Management, Land use planning and management, Water resources planning and management, Forest resources planning and management, Coastal zone management, Disaster management and risk assessment.

UNIT-IV

Environmental Pollution Control and Management, Air pollution control and management, Water pollution control and management, Soil pollution control and management, Solid waste management, Hazardous waste management.

UNIT-V

Sustainability and Corporate Social Responsibility, Sustainability reporting and indicators, Sustainable business practices and corporate social responsibility, Eco-labeling and environmental certification, Life cycle assessment and analysis.

UNIT-VI

Environmental Economics and Ethics, Economic instruments for environmental management, Cost-benefit analysis and environmental decision-making, Environmental ethics and values, Environmental justice and equity.

***References Books*:**

1. Environmental Management by Anil Kumar De and Arnab Kumar De
2. Environmental Management: Text and Cases by Ramesha Chandrappa and N. Kumar
3. Sustainable Development and Environmental Management: Experiences and Case Studies by R. B. Singh and D. K. Swain
4. Environmental Management: Principles and Practice by D. S. Bhakuni and S. C. Bhatia
5. Sustainable Development and Environmental Management by Suresh Kumar and S. R. Banerjee
6. Principles of Environmental Management: The Greening of Business by R. M. Harrison (Foreign Author)
7. Environmental Management in Indian Corporations: Approaches and Responses by Jyoti Parikh and Kirit S. Parikh (Indian Author)
8. Environmental Management: A Comprehensive Guide for Students and Practitioners by Ian Williams, John S. Owens, and Richard J. Allan (Foreign Author)

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PCC-CED309 ENGINEERING HYDROLOGY

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

1. To understand the physical processes that determines the exchange of water at the Earth's surface.
2. To become familiar with the physical properties that govern the movement of water through the unsaturated zone and how these can be observed in the field and modelled mathematically.
3. To understand the physical factors that control evaporation and their representation using energy fluxes and diffusive transfer.
4. To be familiar with the various physical and empirical models used to calculate evaporation & evapotranspiration and the data need to support their use.
5. To be able to understand the processes which influence runoff from catchments and the methods for estimating the runoff
6. To use measured/estimated data like precipitation, runoff, infiltration, for hydrologic design

Course Outcomes (CO): Upon successful completion of this course, the students will be able to

CO1	Understand the process and mathematical representation of hydrologic cycle
CO2	Differentiate the measure and apply precipitation for hydrologic design
CO3	Understand the importance of catchment characteristics for runoff estimation
CO4	Evaluate the hydrologic abstractions and also learn about the factors affecting various hydrologic abstractions
CO5	Apply statistical tools to hydrologic data and implementing the knowledge of precipitation and runoff measurement in hydrologic design
CO6	Implementing the knowledge of precipitation and runoff measurement in hydrologic design

Course Content:

Unit-I: Introduction

Hydrologic cycle, hydrologic system model, Water budget: analysis and synthesis, atmospheric circulation.

Precipitation

Formation of precipitation – types of precipitation – Precipitable water – Precipitation in a cloud system - Rainfall measurement and characteristics – Estimating missing rainfall data – Rain gauge consistency – Average annual rainfall – Development of a design storm – probable maximum precipitation

Unit-II: Watershed Characteristics

Watershed definition and delineation - Watershed geomorphology – channel geomorphology – travel time estimation

Unit-III: Hydrologic Abstractions

Infiltration: Definition and factors affecting infiltration – Infiltration Estimation: Horton's model, Green-Ampt Model, Infiltrometer, SCS Method. Evaporation and Transpiration: Definition, factors affecting evaporation, methods for estimation of evaporation – EPT: Definition, estimation of EPT

Unit-IV: Unit Hydrograph

Sources of streamflow, streamflow hydrograph and hydrograph characteristics, excess rainfall and direct runoff, Abstractions: Using infiltration indices and SCS method – Peak discharge. Unit hydrograph: Definition, Assumptions and Limitations, UH derivation and Application, S-Hydrograph, Synthetic UH, UH for different rainfall durations

Unit-V: Frequency Analysis

Return period, extreme value distributions, Frequency analysis using frequency factors, Probability plotting – Risk Assessment

Unit-VI: Hydrologic Design

Design Storms: Design precipitation depth, IDF curves, Design precipitation hyetographs from IDF curves, Calculation of probable maximum precipitation. Design Flows: Simulating design flows, flood plain analysis, flood forecasting.

Reference Books:

1. Ven Te Chow, David R Maidment, Larry W. Mays, Applied Hydrology. McGraw Hill International Editions, (2010)
2. Subramanya, Engineering Hydrology, Tata McGraw Hill Co., Graw Hill Co., (2010).
3. Hydrology and Water Resources Engineering, S.K. Garg, JBA publishers, (2015)

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PCC-EED305 ENVIRONMENTAL ETHICS, LAW AND REGULATIONS

L T P Total	Sessional: 25 marks
3 0 0 3	Theory: 75 marks
	Total: 100 marks
	Duration of exam: 3 hours

Course Objective: This course aims to provide students with an understanding of the legal and policy frameworks governing environmental protection and sustainable development. The course covers the sources, principles, and instruments of environmental law and policy, and examines the regulatory framework and governance mechanisms for implementing them.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Understand the principles and objectives of environmental law and policy
CO2	Identify the sources of environmental law and policy, and evaluate their strengths and weaknesses
CO3	Analyze the regulatory framework for environmental governance and the functions of regulatory agencies
CO4	Interpret and apply the provisions of the Water and Air Acts and the Environment (Protection) Act, 1986
CO5	Evaluate the role and functions of the National Green Tribunal in environmental governance
CO6	Assess the principles and instruments of international environmental law and policy

Course Contents:

UNIT-I

Introduction to Environmental Law and Policy, Definition of environmental law and policy, Objectives and principles of environmental law and policy, Types of environmental law and policy instruments, Relationship between environmental law and policy.

UNIT-II

Sources of Environmental Law and Policy, Indian Constitution and its provisions related to the environment, Judicial pronouncements and case law, International conventions and treaties on environmental protection, Domestic legislation related to environment and natural resources.

UNIT-III

Environmental Governance and Regulatory Framework, Roles and responsibilities of different government bodies in environmental governance, Overview of regulatory agencies and their functions, National and state-level environmental policies and programmes, The Polluter Pays Principle and the Precautionary Principle.

UNIT-IV

Water and Air Acts and the Environment (Protection) Act, 1986: The Water (Prevention and Control of Pollution) Act, 1974 and its amendments. The Air (Prevention and Control of Pollution) Act, 1981 and its amendments, The Environment (Protection) Act, 1986 and its amendments, Relevant rules and notifications under these acts.

UNIT-V

National Green Tribunal Act, 2010 and its Functions, Introduction to National Green Tribunal (NGT), Establishment and composition of NGT, Powers and functions of NGT, Cases and judgments delivered by NGT.

UNIT-VI

International Environmental Law and Policy, Principles of International Law related to environment, Overview of major international environmental conventions and treaties, India's role in international environmental negotiations and agreements, Global environmental governance and sustainable development.

***References Books*:**

1. Environmental Law and Policy in India by Sreenivasulu N. S.
2. Environmental Law and Policy in India: Cases, Materials and Statutes by Shyam Divan and Armin Rosencranz
3. Environmental Law, Policy and Management in India by Maria Lee and Philippe Sands
4. Environmental Law and Policy in India: A Handbook for Lawyers, Judges, and Policymakers by Dr. M.K. Ramesh

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

SEMESTER – VII

PCC-EED401 ENVIRONMENTAL HEALTH AND SAFETY

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

- To provide a comprehensive understanding of environmental health and safety
- To develop skills for identifying, evaluating, and managing environmental health risks
- To understand the principles of occupational health and safety
- To develop skills for environmental epidemiology and disease control
- To understand the importance of environmental health and safety planning and implementation
- To develop skills for environmental health and safety auditing, inspection, and emergency planning

Course Outcomes (CO): Upon successful completion of this course, the students will be able to

CO1	Understand the fundamental concepts and principles of environmental health and safety
CO2	Analyze and evaluate environmental health risks and hazards
CO3	Apply occupational health and safety regulations and standards
CO4	Design and implement control measures for environmental health and safety hazards
CO5	Develop a sustainable approach to environmental health and safety
CO6	Evaluate and audit environmental health and safety systems

Course Content:

UNIT I

Introduction to Environmental Health and Safety, Definition and scope of environmental health and safety, Environmental health risks and their sources, Environmental health regulations and standards Environmental health and safety management systems.

UNIT II

Risk Assessment and Management, Principles of risk assessment and management, Hazard identification and evaluation, Exposure assessment and control, Risk communication and community engagement.

UNIT III

Environmental Health and Safety Hazards, Chemical hazards and toxicology, Physical hazards and their effects, biological hazards and their control, Radiation hazards and protection.

UNIT IV

Occupational Health and Safety, Occupational health and safety regulations and standards, Workplace hazards and their evaluation, Occupational health and safety management systems, Control measures for workplace hazards

UNIT V

Environmental Epidemiology and Disease Control, Epidemiology and its applications in environmental health, Communicable and non-communicable diseases and their environmental determinants, Control measures for environmental diseases

UNIT VI

Environmental Health and Safety Planning and Implementation, Environmental health and safety auditing and inspection, Emergency planning and response, Sustainability in environmental health and safety, Case studies and best practices in environmental health and safety

Reference Books:

1. Environmental Health and Safety for Hazardous Waste Sites by Michael D. LaGrega, Phillip L. Buckingham, and Jeffrey C. Evans
2. Industrial Hygiene and Safety Management by K. Narayanan and R. K. Tyagi
3. Environmental Health and Safety Management: A Guide to Compliance by Nicholas P. Cheremisinoff and Anton Davletshin
4. Occupational Health and Safety Management: A Practical Approach by S. Sriram
5. Environmental Health and Safety Auditing Handbook by Lawrence B. Cahill
6. Fundamentals of Industrial Hygiene by Barbara A. Plog and Patricia J. Quinlan
7. Environmental Health and Safety in Health Institutions by K. Subramanya

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PCC-EED402 GLOBAL AND REGIONAL ENVIRONMENTAL ISSUES

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

This course aims to provide an understanding of the various global and regional environmental issues and their impacts on the environment and human health. It also focuses on the measures to mitigate the effects of these issues and the role of sustainable development in promoting environmental well-being.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Understand the global and regional environmental issues and their impacts on the environment and human health
CO2	Analyze the causes and effects of air pollution, climate change, and biodiversity loss
CO3	Identify the strategies to mitigate the impacts of environmental issues
CO4	Evaluate the role of sustainable development in promoting environmental well-being
CO5	Develop the skills to assess the environmental impact of human activities and suggest appropriate solutions
CO6	Communicate the environmental issues and their impacts effectively

Course Contents:

UNIT I

Introduction to global and regional environmental issues, Definition of global and regional environmental issues, Impacts on the environment and human health.

UNIT II

Air pollution and climate change, Greenhouse gases and their effects, Global warming and climate change, Urban heat islands, Acid rain, Ozone hole.

UNIT III

Biodiversity and ecosystems, Definition of biodiversity and its importance, Various ecosystems and their characteristics, Factors influencing biodiversity loss.

UNIT IV

Population growth and energy consumption, Factors influencing population growth and its impact on the environment, Energy consumption and environmental degradation.

UNIT V

Mitigation strategies for global and regional environmental issues, Sustainable development and its role in promoting environmental well-being, Renewable energy sources, Pollution control measures.

UNIT VI

Environmental impact assessment and communication, Environmental impact assessment methods and tools, Effective communication of environmental issues and their impacts.

Text Books & References:

1. Environmental Studies: From Crisis to Cure by R.Rajagopalan and J.P. Modi
2. Environmental Studies by Anindita Basak
3. Environmental Science and Engineering by P. Venugopala Rao
4. Environmental Studies: Multiple Choice Questions by S. Sivanagaraju and S. Sivaramakrishnan
5. Environmental Science and Engineering by J. Glynn Henry and Gary W. Heinke
6. Environmental Studies: From Crisis to Cure by R. Rajagopalan
7. Environmental Science: Earth as a Living Planet by Daniel B. Botkin and Edward A. Keller
8. Global Environmental Issues by Frances Harris and Stuart Harris
9. Environmental Management: Science and Engineering for Industry by Kim Young and Hyun-Chul Kim
10. Environmental Pollution Control Engineering by C.S. Rao and G. Venkata Ramana

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PCC-EED403 GROUND WATER ENGINEERING

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

- To provide an understanding of the fundamentals of groundwater engineering
- To teach the principles of groundwater flow and its properties
- To develop the ability to analyze and design groundwater systems
- To prepare students to apply groundwater engineering concepts to environmental issues

Course Outcomes (CO): Upon successful completion of this course, the students will be able to

CO1	Remembering: Recall and define key concepts and terminology related to groundwater engineering
CO2	Understanding: Explain the principles of groundwater flow and its properties
CO3	Applying: Analyze and design groundwater systems to solve environmental problems
CO4	Analyzing: Evaluate and compare different groundwater engineering solutions and their effectiveness
CO5	Creating: Develop innovative and sustainable groundwater management strategies
CO6	Evaluating: Critique and justify groundwater management decisions based on ethical and scientific principles

Course Content:

UNIT I

Introduction to Groundwater, Definition of groundwater; Hydrologic cycle; Aquifers; Importance of groundwater; Groundwater management; Groundwater in India.

UNIT II

Geologic Formations as Aquifers, Types of geologic formations as aquifers; Porosity, permeability, transmissivity, storage coefficient, and their significance in groundwater flow; Hydrogeologic properties of different rock types.

UNIT III

Unsaturated and Saturated Zones, Definition and characteristics of Unsaturated and saturated zones; Unsaturated and saturated hydraulic conductivity; Water table; Capillary fringe; Unsaturated zone monitoring; Soil moisture.

UNIT IV

Confined and Unconfined Aquifers, Definition and characteristics of confined and unconfined aquifers; Water table and potentiometric surface; Aquifer boundaries; Flow nets; Dupuit assumptions; Hydraulic head.

UNIT V

Darcy's Law and Applications, Darcy's law and its applications in groundwater flow; Steady-state flow equation; Unsteady-state flow equation; Groundwater velocity and discharge; Dupuit assumptions; Confined and unconfined flow.

UNIT VI

Steady State Well Hydraulics, Groundwater wells and pumping; Well efficiency and losses; Steady-state well hydraulics; Pumping test analysis; Specific capacity; Well interference; Cone of depression; Groundwater mounding.

Reference Books:

1. Groundwater Engineering" by K. R. Arora (Indian author)
2. Applied Groundwater Modeling" by M. E. Anderson and W. W. Woessner (Foreign author)
3. Groundwater Hydrology" by D. K. Todd (Foreign author)
4. Principles of Groundwater Engineering" by R. J. Schotting and C. F. N. Cowan (Foreign author)
5. Introduction to Groundwater Modeling: Finite Difference and Finite Element Methods" by H. A. Abbaspour and J. H. Knight (Foreign author)
6. Groundwater Science" by C. Fitts (Foreign author)

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PROFESSIONAL ELECTIVE COURSE (PEC)

Professional Elective I

1. Renewable Energy and Alternative Fuels
2. Climate Change and Adoption
3. Ecological Engineering and Restoration
4. Environmental Modelling and Simulation

PEC-EED301-1 RENEWABLE ENERGY AND ALTERNATIVE FUELS

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective: The course aims to provide an understanding of renewable energy sources and alternative fuels to reduce the dependence on non-renewable resources and to promote sustainable development. The students will learn about various types of renewable energy sources, their conversion technologies, and the challenges associated with their integration into the grid. The course will also cover the use of alternative fuels for transportation and their environmental impacts.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Remembering: Recall the types of renewable energy sources and alternative fuels
CO2	Understanding: Explain the conversion technologies for different renewable energy sources
CO3	Applying: Apply the concepts of energy storage systems for grid integration
CO4	Analyzing: Analyze the environmental impacts of different types of renewable energy sources and alternative fuels
CO5	Evaluating: Evaluate the sustainability of different renewable energy sources and alternative fuels
CO6	Creating: Propose a renewable energy system for a given location and justify its suitability

UNIT I:
Introduction to Renewable Energy Sources, Definition and classification of renewable energy sources, Solar energy and conversion technologies, Wind energy and conversion technologies, Hydro energy and conversion technologies.

UNIT II:
Biomass Energy, Introduction to biomass energy and conversion technologies, Biofuels: Bioethanol, Biodiesel, Biogas, Environmental impacts and sustainability of biofuels

UNIT III:
Geothermal Energy, Introduction to geothermal energy and conversion technologies, Types of geothermal power plants, Environmental impacts and sustainability of geothermal energy.

UNIT IV:

Ocean Energy, Introduction to ocean energy and conversion technologies, Types of ocean energy: Wave, Tidal, and Ocean Thermal Energy Conversion (OTEC), Environmental impacts and sustainability of ocean energy.

UNIT V:

Alternative Fuels for Transportation, Introduction to alternative fuels for transportation, Types of alternative fuels: Compressed Natural Gas (CNG), Liquefied Petroleum Gas (LPG), Hydrogen fuel cells, Electric vehicles, Environmental impacts and sustainability of alternative fuels for transportation.

UNIT VI:

Energy Storage and Integration, Introduction to energy storage systems, Types of energy storage: Batteries, Pumped Hydro Storage, Flywheels, Thermal Energy Storage, Integration of renewable energy sources into the grid, Challenges and future prospects.

Reference books:

1. Renewable Energy: Power for a Sustainable Future by Godfrey Boyle
2. Renewable Energy Sources and Emerging Technologies by Khalid S. Al-Abdul-Wahab and Wasim A. Asghar
3. Alternative Transportation Fuels: Utilisation in Combustion Engines by M. A. Kalam and Masjuki Haji Hassan

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PEC-EED301-2 CLIMATE CHANGE AND ADOPTION

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective: This course aims to provide students with a comprehensive understanding of the science, impacts, and management of climate change, as well as the principles and practices of climate change adaptation. Through a combination of lectures, case studies, and interactive discussions, students will develop their critical thinking, problem-solving, and communication skills in the context of environmental engineering.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Understand the basic science of climate change and its impacts on natural and human systems
CO2	Evaluate the evidence and projections of climate change and assess the uncertainties involved
CO3	Analyze the drivers and sources of greenhouse gas emissions and the options for mitigation and carbon management
CO4	Identify and evaluate the strategies and practices for climate change adaptation and resilience building
CO5	Assess the impacts of climate change on human health and analyze the options for adaptation and risk reduction
CO6	Synthesize and communicate the key concepts and challenges of climate change and its management, and analyze the implications for environmental engineering

UNIT I:
Introduction to Climate Change and its Impacts, Climate change: causes and evidence, Impacts of climate change on natural and human systems, Climate change projections and scenarios, Vulnerability, resilience, and adaptation.

UNIT II:
Climate Science and Modelling, Physical basis of climate science, Climate modelling and scenarios, Assessing climate risks and uncertainties, Downscaling and regional climate projections.

UNIT III:
Mitigation and Carbon Management, Greenhouse gas emissions: sources and trends, Energy systems and decarbonization pathways, Carbon capture and storage, Carbon markets and policy instruments.

UNIT IV:
Adaptation Strategies and Practices, Adaptation measures and approaches, Adaptive capacity and resilience building, Ecosystem-based adaptation, Mainstreaming adaptation into planning and decision-making.

UNIT V:

Climate Change and Human Health, Health impacts of climate change, Heat waves, air pollution, and infectious diseases, Adaptation measures for protecting public health, Climate change and health policy.

UNIT VI:

Case Studies and Future Directions, Case studies of climate change adaptation and mitigation projects, Challenges and opportunities for sustainable development in a changing climate, Future directions in climate change research, policy, and action.

Reference Books

1. Climate Change: IPCC Assessment Reports
2. Climate Change Science: A Modern Synthesis
3. Climate Change Adaptation Manual: Lessons Learned from European and Other Industrialised Countries
4. Climate Change and Sustainable Development: New Challenges for Poverty Reduction
5. Climate Change Adaptation in Practice: From Strategy Development to Implementation
6. Renewable Energy Sources and Climate Change Mitigation

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PEC-EED301-3 ECOLOGICAL ENGINEERING AND RESTORATION

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective: The objective of this course is to provide students with a comprehensive understanding of ecological engineering principles and techniques for ecosystem management and restoration. The course will cover the theoretical foundations of ecological engineering and its practical applications in various settings. Students will also learn about emerging issues in ecological engineering and the policy and regulatory frameworks that guide its implementation.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Describe the principles of ecological engineering and their relevance to sustainable development
CO2	Analyze ecosystem processes and functions and their relationship to ecological engineering practices
CO3	Evaluate the effectiveness of different ecosystem management and restoration strategies
CO4	Apply green infrastructure design principles to address environmental challenges
CO5	Critique the sustainability of current agricultural and forestry practices and propose alternative solutions
CO6	Synthesize the knowledge gained throughout the course to propose solutions to emerging issues in ecological engineering

UNIT I:
Introduction to Ecological Engineering, Definition and principles of ecological engineering, Historical perspective and evolution of ecological engineering, Interdisciplinary nature of ecological engineering Sustainability and ecological engineering.

UNIT II:
Ecosystem Processes and Functions, Ecosystem structure and function, Biogeochemical cycles and nutrient cycling, Succession and disturbance in ecosystems, Ecological indicators and monitoring.

UNIT III:
Ecosystem Management and Restoration, Ecosystem management principles, Ecosystem restoration techniques and strategies, Watershed management and restoration, Wetland restoration and management.

UNIT IV:
Green Infrastructure, Definition and principles of green infrastructure, Types and benefits of green infrastructure, Design and implementation of green infrastructure, Case studies of successful green infrastructure projects.

UNIT V:

Sustainable Agriculture and Forestry, Principles of sustainable agriculture and forestry, Agroecology and sustainable farming practices, Sustainable forestry practices and certification, Role of ecological engineering in sustainable agriculture and forestry.

UNIT VI

Case Studies and Emerging Issues, Case studies of ecological engineering projects, Emerging issues in ecological engineering and restoration, Policy and regulatory frameworks for ecological engineering, Future directions for ecological engineering research and practice.

Reference Books:

1. Ecological Engineering: Principles and Practice by Patrick Kangas
2. Ecological Engineering for Pest Management: Advances in Habitat Manipulation for Arthropods by Geoff M. Gurr and Steve D. Wratten
3. Ecological Restoration: Principles, Values, and Structure of an Emerging Profession by Andre F. Clewell and James Aronson
4. Ecological Engineering Design: Restoring and Conserving Ecosystem Services by Marty D. Matlock and Robert Hagan
5. Ecological Engineering Handbook: An Introduction to Ecosystem Restoration by William J. Mitsch and Sven E. Jorgensen
6. Principles and Practice of Ecological Engineering for Sustainable Agriculture by Shabtai Bittman and Yoram Kapulnik.

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PEC-EED301-4 ENVIRONMENTAL MEODELLING AND SIMULATION

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

- To provide students with an understanding of the principles and methods of environmental modelling and simulation
- To enable students to develop skills in the use of environmental models for predicting and assessing environmental impacts
- To equip students with the knowledge and skills to apply environmental models for decision making and policy development

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Remembering: Recall the basic principles of environmental modelling and simulation
CO2	Understanding: Interpret and explain the different types of environmental models and simulations
CO3	Applying: Apply modelling and simulation techniques to environmental problems
CO4	Analyzing: Analyze the performance of environmental models and simulations
CO5	Evaluating: Evaluate the suitability of different models and simulations for different environmental scenarios
CO6	Creating: Develop new models and simulations for environmental systems

UNIT - I

Introduction to Environmental Modelling and Simulation, Overview of environmental modelling and simulation, Classification of environmental models, Components of environmental models, Advantages and limitations of environmental models, Types of simulations.

UNIT - II

Environmental Data Collection and Pre-processing, Overview of environmental data collection methods, Types of environmental data, Data quality and uncertainty, Data pre-processing techniques.

UNIT - III

Deterministic Environmental Models, Mathematical models, System dynamics models, Water quality models, Air quality models, Models for waste management.

UNIT - IV

Stochastic Environmental Models, Probability theory, Monte Carlo simulation, Random walk models, Time series models.

UNIT V:

Optimization and Decision Making, Environmental decision making, multi-objective optimization Sensitivity analysis, Uncertainty analysis.

UNIT VI:

Applications of Environmental Modelling and Simulation, Case studies on environmental modelling and simulation, Application of models in environmental impact assessment, Application of models in environmental management and policy making, Future directions in environmental modelling and simulation.

Reference books:

1. Environmental Modelling and Simulation with MATLAB by Shyam Diwakar
2. Mathematical Modelling of Environmental Problems: An Introduction by Subir Kumar Ghosh
3. Environmental Modelling: An Indian Perspective by M.C. Joshi and Ashvani Kumar Gosain.
4. Environmental Modelling: An Introduction by Joao Gomes Ferreira and Ana Isabel Miranda
5. Principles of Environmental Modelling and Simulation by John W. Dickey and Richard C. Bathurst
6. Environmental Modelling: Finding Simplicity in Complexity by John Wainwright and Mark Mulligan
7. Applied Environmental Modelling: An Indispensable Tool for the Environmental Professional by John W. Birks
8. Environmental Modelling and Simulation: Theory, Methods, and Applications by Antoine Trad, Karine Zeitouni, and Pierre Zweigenbaum

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

Professional Elective II

1. Sub-Soil water Pollution and Its Control
2. Environmental Soil Chemistry
3. Ground Water and Soil Remediation
4. Environmental Foundation Engineering

PEC-EED302-1 SUB-SOIL WATER POLLUTION AND ITS CONTROL

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective: This course aims to provide students with an understanding of the sources and types of sub-soil water pollution, the associated environmental and health impacts, and the principles and techniques for controlling and remedying such pollution.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Analyze the sources and types of sub-soil water pollution
CO2	Evaluate the environmental and health impacts of sub-soil water pollution
CO3	Identify the principles and techniques for controlling and remedying sub-soil water pollution
CO4	Demonstrate proficiency in conducting laboratory experiments to measure sub-soil water quality parameters
CO5	Design and evaluate sub-soil water remediation systems
CO6	Evaluate and select appropriate management options for sub-soil water pollution control

Course Contents:

UNIT I:

Introduction to sub-soil water pollution, Definition of sub-soil water pollution, Types and sources of sub-soil water pollution, Environmental and health impacts of sub-soil water pollution, Groundwater quality standards.

UNIT II:

Sub-soil water quality parameters and monitoring, Sub-soil water quality parameters, Laboratory analysis of sub-soil water quality parameters, Field measurements of sub-soil water quality parameters, Monitoring networks and data interpretation.

UNIT III:

Controlling and remedying sub-soil water pollution, Groundwater recharge and artificial recharge, Source control measures, Physical, chemical, and biological treatment methods, In-situ and ex-situ remediation techniques.

UNIT IV:

Design of sub-soil water remediation systems, Conceptual design of sub-soil water remediation systems, Design criteria and guidelines for sub-soil water remediation, Modeling and simulation of sub-soil water remediation systems.

UNIT V:

Management of sub-soil water pollution, Regulatory frameworks for sub-soil water pollution control, Institutional arrangements for sub-soil water management, Public participation and stakeholder engagement in sub-soil water pollution control.

UNIT VI:

Case studies and emerging trends: Case studies on sub-soil water pollution control and remediation, Emerging trends in sub-soil water pollution control and remediation.

Text Books

1. Todd, D.K. and Mays, L.W. (2005). Groundwater Hydrology. John Wiley & Sons, Inc.
2. Kresic, N. and Stevanovic, Z. (2015). Groundwater Resources: Sustainability, Management, and Restoration. McGraw Hill Education.
3. Alley, W.M., Healy, R.W., LaBaugh, J.W., and Reilly, T.E. (2002). Ground Water and Surface Water: A Single Resource. United States Geological Survey.
4. National Ground Water Association. (2000). Ground Water and Well. CRC Press.
5. Kumar, M. and Ramanathan, A. (2017). Groundwater Quality: Analysis and Remediation. CRC Press.

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PEC-EED302-2 ENVIRONMENTAL SOIL CHEMISTRY

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

- To understand the fundamental principles of environmental soil chemistry and their application in environmental management.
- To develop a critical understanding of soil reactions and equilibria, and the impact of soil contaminants on environmental quality.
- To gain knowledge about the fate and transport of soil contaminants and soil remediation techniques.
- To learn about soil fertility and nutrient management, and its impact on soil and environmental quality.
- To develop an understanding of advanced topics in environmental soil chemistry, such as soil microbiology, emerging contaminants, and soil carbon sequestration.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Remembering: Recall the fundamental principles of environmental soil chemistry and their application in environmental management.
CO2	Understanding: Explain the impact of soil reactions and equilibria on soil and environmental quality.
CO3	Applying: Apply knowledge about soil contamination and remediation techniques in environmental management.
CO4	Analyzing: Analyze the impact of soil fertility and nutrient management on soil and environmental quality.
CO5	Evaluating: Evaluate the effectiveness of soil remediation techniques and their impact on environmental quality.
CO6	Creating: Develop strategies for environmental soil management based on an understanding of advanced topics in environmental soil chemistry.

Course Contents:

UNIT I:

Soil Chemistry Fundamentals, Introduction to environmental soil chemistry, Soil composition and properties, Soil colloids and their properties, Soil pH and buffering capacity, Soil organic matter.

UNIT II:

Soil Reactions and Equilibria, Acid-base reactions in soils, Ion exchange reactions in soils, Redox reactions in soils, Adsorption and desorption reactions in soils, Surface complexation reactions in soils.

UNIT III:

Soil Contaminants, Sources of soil contaminants, Fate and transport of soil contaminants, Heavy metal contamination and remediation, Organic contaminants in soil and remediation.

UNIT IV:

Soil Nutrient Management, Soil fertility and nutrient management, Nutrient cycling in soil, Nitrogen and phosphorus in soil, Soil amendments and their impact on soil fertility.

UNIT V:

Soil and Environmental Quality, Soil quality parameters and their evaluation, Soil quality and ecosystem health, Soil and water pollution, Soil remediation techniques.

UNIT VI:

Advanced Topics in Environmental Soil Chemistry, Soil microbiology and its role in environmental processes, Emerging contaminants in soil and their impact, Soil bioremediation and phytoremediation, Soil carbon sequestration.

Text Books

1. Sparks, D. L. (2003). Environmental soil chemistry. Academic Press.
2. Huang, P. M., Li, Y., & Sumner, M. E. (Eds.). (2003). Handbook of soil sciences: Properties and processes (Vol. 1). CRC Press.
3. Brady, N. C., & Weil, R. R. (2016). The nature and properties of soils (15th ed.). Pearson.
4. Hendershot, W. H., Lalande, H., & Duquette, M. (Eds.). (2008). Soil sampling and methods of analysis (2nd ed.). CRC Press.

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PEC-EED302-3 GROUND WATER AND SOIL REMEDIATION

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective: This course is designed to provide an understanding of the principles, methods and technologies available for the remediation of contaminated ground water and soil. It covers the fundamental principles of hydrogeology and soil chemistry, and the various physical, chemical, and biological treatment methods that are used for remediation. The course also focuses on the regulatory framework for soil and groundwater remediation, and provides practical experience through case studies and laboratory exercises.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Demonstrate knowledge and understanding of hydrogeological principles and soil chemistry.
CO2	Identify and evaluate the sources, types, and characteristics of soil and groundwater contaminants.
CO3	Analyze and design soil and groundwater remediation systems using physical, chemical, and biological treatment methods.
CO4	Understand the regulatory framework for soil and groundwater remediation and the role of environmental laws and regulations.
CO5	Apply laboratory techniques for soil and groundwater analysis.
CO6	Analyze case studies of soil and groundwater remediation projects.

Course Contents:

UNIT I:

Introduction to soil and groundwater remediation, Overview of soil and groundwater contamination, Regulatory framework for soil and groundwater remediation, Environmental laws and regulations.

UNIT II:

Principles of hydrogeology and soil chemistry, Groundwater flow and contaminant transport, Soil properties and their impact on contaminant transport and remediation, Biogeochemical cycles.

UNIT III:

Physical treatment methods, Pump and treat systems, Air sparging and soil vapor extraction, Soil washing and excavation.

UNIT IV:

Chemical treatment methods, Chemical oxidation, Chemical reduction, Soil stabilization.

UNIT V:

Biological treatment methods, Bioremediation, Phytoremediation, Enhanced natural attenuation

UNIT VI:
Case studies and laboratory exercises, Analysis of case studies of soil and groundwater remediation projects, Laboratory exercises for soil and groundwater analysis

Text Books

1. Remediation Engineering: Design Concepts, Second Edition by Suthan S. Suthersan
2. Groundwater and Soil Remediation: Process Design and Cost Estimating of Proven Technologies by Evan K. Nyer
3. Handbook of Groundwater Remediation using Permeable Reactive Barriers: Applications to Radionuclides, Trace Metals, and Nutrients by John M. Zachara, David W. Blowes, and Thomas B. Boving
4. Environmental Soil Chemistry by Donald L. Sparks
5. Groundwater Remediation and Treatment Technologies by Nicholas P. Cheremisinoff

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PEC-EED302-4 ENVIRONMENTAL FOUNDATION ENGINEERING

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course objective:

- To understand the importance of environmental factors in foundation design
- To familiarize students with the site characterization and soil investigation techniques used in environmental foundation engineering
- To provide students with the knowledge and skills necessary to design and construct foundations for environmental applications
- To introduce students to geosynthetics, ground improvement techniques, and their applications in environmental foundation engineering
- To expose students to case studies and emerging trends in environmental foundation engineering
- To familiarize students with relevant codes and standards for environmental foundation design

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Analyze site-specific environmental factors and their impact on foundation design Conduct site characterization and soil investigations for environmental foundation design
CO2	Design and analyze shallow and deep foundations for environmental applications
CO3	Design geosynthetic-reinforced structures for environmental applications
CO4	Design and construct soil stabilization and reinforcement for environmental applications
CO5	Evaluate case studies and emerging trends in environmental foundation engineering
CO6	Apply relevant codes and standards to environmental foundation design

Course Contents:

UNIT I:

Introduction to Environmental Foundation Engineering, Definition, scope and objectives of Environmental Foundation Engineering, Environmental factors affecting foundation design, Sustainability in Foundation Engineering

UNIT II:

Site Characterization and Soil Investigations, Techniques of site characterization and soil investigations, In-situ tests and laboratory tests for soil properties, Soil mapping and classification for foundation design, Soil-water interaction and its effect on foundation design

UNIT III:

Geotechnical Design Considerations for Environmental Applications, Design of shallow and deep foundations for environmental applications, Bearing capacity, settlement, and stability considerations for environmental applications, Design of foundations for waste containment and landfill closures

UNIT IV:

Geosynthetics in Environmental Foundation Engineering, Types and properties of geosynthetics, Applications of geosynthetics in environmental foundation engineering, Design of geosynthetic-reinforced structures for environmental applications

UNIT V:

Ground Improvement Techniques for Environmental Applications, Types and applications of ground improvement techniques, Design and construction of soil stabilization and reinforcement for environmental applications, Design and construction of ground improvement for waste containment

UNIT VI:

Case Studies and Emerging Trends in Environmental Foundation Engineering, Case studies of environmental foundation engineering projects, Emerging trends in environmental foundation engineering, including green foundations and sustainable design, Overview of relevant national and international codes and standards

Text Books

1. Das, B. M. (2013). Principles of Foundation Engineering. Cengage Learning.
2. Koerner, R. M. (2012). Designing with Geosynthetics. Xlibris Corporation.
3. Liu, C. N. (2012). Introduction to Geotechnical Engineering: Principles and Practices. CRC Press.
4. Terzaghi, R. D., & Peck, R. B. (2017). Soil Mechanics in Engineering Practice. Routledge.
5. United States Environmental Protection Agency. (2016). Technical Manual for the Design and Construction of Road Tunnels—Civil Elements. EPA.

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

Professional Elective III

1. Total Quality Management
2. Biomedical Waste Management
3. Agricultural Waste and Its application
4. Construction waste and its applications

PEC-EED303-1 1. TOTAL QUALITY MANAGEMENT

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

Students will comprehend the fundamental principles and philosophies of Total Quality Management and their relevance in the context of environmental engineering. Also Students will able to develop strategies for risk management and quality improvement, particularly in the context of environmental impact and sustainability.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Explain the principles and philosophies of Total Quality Management and its application in Environmental Engineering.
CO2	Develop quality plans, control charts, and process capability analysis for environmental projects.
CO3	Implement ISO 14001 standards and conduct environmental audits.
CO4	Apply Lean, Six Sigma, and continuous improvement methodologies to environmental processes.
CO5	Assess the ethical and sustainability implications of TQM in Environmental Engineering.
CO6	Apply TQM principles to real-world environmental engineering challenges through case studies and projects.

Course Contents:

UNIT I:

Introduction to Total Quality Management, concept and importance of Total Quality Management. Explain the historical development of TQM, key principles and philosophies of TQM, Role of TQM in Environmental Engineering.

UNIT II:

Quality Planning and Environmental Management, Development of quality plans for environmental projects, Application of tools such as Quality Function Deployment (QFD) in environmental planning, Environmental risks and implement risk management strategies.

UNIT III: Quality Control Techniques in Environmental Engineering, Implementation of statistical process control (SPC) in environmental monitoring. Application of control charts and process capability analysis to environmental data, Root cause analysis for environmental issues.

UNIT IV: Quality Assurance in Environmental Engineering, ISO 14001 and its relevance to environmental quality assurance, Environmental management systems (EMS) for organizations,

Audits to assess compliance with environmental quality standards.

UNIT V: Continuous Improvement and Lean Thinking, Lean principles to improve environmental processes, Kaizen and Six Sigma methodologies in environmental projects, Case studies of successful continuous improvement in environmental engineering.

UNIT VI: Sustainability and Ethical Considerations, Relationship between TQM and environmental sustainability, Ethical dimensions of TQM in environmental decision-making, Strategies for responsible and sustainable environmental engineering practices.

***References Books*:**

1. "Total Quality Management" by Dale H. Besterfield
2. "Total Quality Management for Engineers" by Stamatis, D. H.
3. "Environmental Management: Quality Systems Handbook for Planners and Engineers" by J. Kent Crawford and Jeannette Cabanis-Brewin
4. "Quality Management for Organizational Excellence: Introduction to Total Quality" by David L. Goetsch and Stanley B. Davis
5. "Environmental Management: A Guide for Facility Managers" by Joseph F. Gustin

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PEC-EED303-2 BIOMEDICAL WASTE MANAGEMENT AND ITS APPLICATIONS

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

- To understand the concept of biomedical waste and its importance in environmental management
- To learn about the regulatory requirements for biomedical waste management and its classification
- To study the various methods for biomedical waste treatment and disposal
- To explore the potential applications of biomedical waste in various industries

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Identify the regulatory requirements for biomedical waste management
CO2	Describe the various methods for biomedical waste treatment and disposal
CO3	Apply the principles of biomedical waste management to design an efficient waste management plan
CO4	Analyze the various factors affecting biomedical waste management and disposal
CO5	Evaluate the impact of biomedical waste on human health and the environment
CO6	Design a sustainable biomedical waste management plan for a healthcare facility

Course Contents:

UNIT-1

Introduction to Biomedical Waste Management, Definition and classification of biomedical waste, Sources and types of biomedical waste, Regulatory requirements for biomedical waste management.

UNIT-II

Biomedical Waste Collection and Transportation, Segregation and packaging of biomedical waste, Transportation of biomedical waste, Storage of biomedical waste.

Unit-III

Biomedical Waste Treatment Methods, Incineration, Autoclaving, Chemical disinfection, Microwave treatment, Irradiation.

UNIT-IV

Biomedical Waste Disposal Methods, Landfilling, Deep burial, Plasma pyrolysis, Gasification, Recycling.

UNIT-V

Applications of Biomedical Waste, Medical research and education, Agriculture, Energy production, Manufacturing.

UNIT-VI

Biomedical Waste Management Plan, Designing a biomedical waste management plan, Implementation and monitoring of the plan, Evaluation and improvement of the plan.

***References Books*:**

1. Biomedical Waste Management: Principles, Techniques and Current Issues by Subramanian Senthilkannan Muthu and Jeyabalan Sangeetha
2. Handbook of Biodegradable Polymers: Biomedical and Environmental Applications by Andreas Lendlein and Adam Sisson
3. Biomedical Waste Management and Disposal by M. N. Rao and K. Krishnaiah
4. Biomedical Waste Management and Treatment by R. K. Gautam and Anil Kumar Gupta
5. Biomedical Waste: Production, Stigmas, Management and Treatment Practices by Subramanian Senthilkannan Muthu and Meenakshi Upreti

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PEC-EED303-3 AGRICULTURAL WASTE MANAGEMENT AND ITS APPLICATIONS

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

The objective of this course is to familiarize students with the various types of agricultural waste generated and their potential environmental impacts. Students will learn about the principles and techniques of agricultural waste management and their applications for sustainable agriculture.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Analyze the types of agricultural waste generated and their environmental impacts
CO2	Apply principles and techniques of agricultural waste management to prevent or reduce environmental pollution
CO3	Evaluate the effectiveness of different agricultural waste management practices and technologies for sustainable agriculture
CO4	Develop strategies for the safe disposal and reuse of agricultural waste materials
CO5	Demonstrate knowledge of relevant environmental laws and regulations related to agricultural waste management
CO6	Communicate effectively about agricultural waste management issues and solutions

Course Contents:

UNIT I:

Introduction to Agricultural Waste Management, Definition of agricultural waste and its types, Environmental impacts of agricultural waste, Laws and regulations related to agricultural waste management.

UNIT II:

Principles of Agricultural Waste Management, Waste reduction and prevention, Waste reuse and recycling, Waste treatment and disposal.

UNIT III:

Techniques for Agricultural Waste Management, Composting and vermiculture, Biogas production and utilization, Incineration and pyrolysis.

UNIT IV:

Agricultural Waste Management for Sustainable Agriculture, Benefits of sustainable agriculture, Use of agricultural waste for energy production and soil improvement, Role of agricultural waste management in achieving sustainable agriculture.

UNIT V:

Case Studies of Agricultural Waste Management, Success stories of agricultural waste management in India and abroad, Challenges and opportunities in agricultural waste management.

UNIT VI:

Emerging Trends in Agricultural Waste Management, Innovations in agricultural waste management technologies, Integration of technology and policy for effective agricultural waste management.

***References Books*:**

1. Agricultural Waste Management: Problems, Processes, and Approaches by Richard Dawson and Stephen Hilton
2. Agricultural Waste Management and Sustainable Development by S. K. Goyal and S. K. Gupta
3. Agricultural Waste Management: Solutions and Best Practices edited by Petr Hlavinek, et al.

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PEC-EED303-4 CONSTRUCTION WASTE MANAGEMENT AND ITS APPLICATIONS

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

The objective of this course is to provide students with an understanding of the types and sources of construction waste, the potential impacts of construction waste on the environment and human health, and the techniques for managing and recycling construction waste. Students will also learn about the role of sustainable construction practices in minimizing waste generation and promoting a circular economy.

Course Outcomes (CO): On completion of this course, the students will be able to

CO1	Identify and classify different types of construction waste.
CO2	Analyze the environmental and health impacts of construction waste.
CO3	Evaluate the effectiveness of different waste management techniques.
CO4	Design and implement a waste management plan for a construction project.
CO5	Explain the principles of sustainable construction and their role in minimizing waste generation.
CO6	Develop a framework for promoting a circular economy in the construction sector.

Course Content

UNIT I:

Introduction to Construction Waste Management, Overview of construction waste and its sources, Environmental and health impacts of construction waste, Legal and regulatory framework for construction waste management.

UNIT II:

Construction Waste Characterization and Quantification, Types and properties of construction waste, Techniques for measuring and quantifying construction waste, Estimation of waste generation rates for different types of construction projects.

UNIT III:

Construction Waste Minimization, Principles of sustainable construction and their role in minimizing waste generation, Techniques for reducing waste generation at the source, Reuse and recycling of construction waste.

UNIT IV:

Construction Waste Management Techniques, Landfilling and its environmental impacts, Incineration and its environmental impacts, Biological treatment of construction waste, On-site and off-site recycling of construction waste.

UNIT V:

Waste Management Planning and Implementation, Development of a construction waste management plan, Implementation of the waste management plan, Monitoring and evaluation of waste management practices.

UNIT VI:

Circular Economy and Construction Waste Management, Principles of circular economy and their application in the construction sector, Strategies for promoting a circular economy in construction waste management, Case studies of successful circular economy initiatives in the construction sector.

***Text and Reference Books*:**

1. Construction Waste Management: An Integrated Approach by Ming-Xin Li and Yao-Ting Huang
2. Sustainable Construction: Green Building Design and Delivery by Charles J. Kibert
3. Construction Materials: Their Nature and Behaviour by J.M. Illston and P.K. Rowe
4. Circular Economy in the Construction Industry: Theory and Practice by Yuan Tan, Zhi Chen, and Mervyn K. Lewis
5. Waste Management in Construction Sites by Gabriela Fernandes and João Couto Marques

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

Professional Elective IV

1. Environmental Process Engineering
2. Industrial Ecology and Recourse Efficiency
3. Atmospheric Chemistry and Climate Change
4. Environmental Auditing and Life Cycle Assessment

PEC-EED401-1 ENVIRONMENTAL PROCESS ENGINEERING

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

- To introduce the students to the principles and concepts of Environmental Process Engineering
- To provide an understanding of various treatment processes for water, air, and hazardous waste
- To impart knowledge of design and optimization of environmental treatment systems
- To sensitize the students towards the importance of sustainable technologies in environmental engineering.

Course Outcomes (CO): Upon successful completion of this course, the students will be able to

CO1	Analyze and interpret data to design and optimize environmental treatment processes
CO2	Evaluate and select the appropriate treatment processes for different environmental pollutants
CO3	Design treatment systems for various types of environmental pollutants
CO4	Evaluate the environmental impact of treatment systems
CO5	Develop a critical understanding of emerging and advanced technologies for environmental treatment
CO6	Apply sustainable technologies to solve environmental problems

Course Content:

UNIT I:
Fundamentals of Environmental Process Engineering, Introduction to Environmental Process Engineering, Environmental systems and components, Physical and chemical properties of pollutants, Reaction kinetics and equilibrium.

UNIT II:
Water Treatment Processes, Coagulation and Flocculation, Sedimentation, Filtration, Disinfection.

UNIT III:
Air Pollution Control Processes, Particulate Matter Removal, Gaseous Pollutant Removal, Control of Industrial Emissions.

UNIT IV:
Biological Treatment Processes, Aerobic and Anaerobic Biological Processes, Activated Sludge Process, Biological Nutrient Removal.

UNIT V:
Hazardous Waste Treatment Processes, Incineration, Stabilization and Solidification, Landfilling, Leachate Treatment.

UNIT VI:
Emerging Processes and Advanced Technologies, Membrane Processes, Photocatalytic Oxidation, Nanotechnology in Environmental Processes, Green Technology.

Reference Books:

1. Davis, M.L., and Cornwell, D.A. (2013). Introduction to Environmental Engineering. Tata McGraw-Hill Education.
2. Vesilind, P.A., and Weiner, R.F. (2017). Environmental Engineering: Fundamentals, Sustainability, Design. Wiley.
3. Punmia, B.C., Jain, A.K., and Jain, A. (2010). Environmental Engineering. Laxmi Publications.

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PEC-EED401-2 INDUSTRIAL ECOLOGY AND RESOURCES EFFICIENCY

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

- To understand the principles and concepts of industrial ecology and resource efficiency
- To apply tools and techniques of industrial ecology and resource efficiency to analyze industrial systems
- To identify opportunities for improving resource efficiency in industrial processes
- To evaluate the environmental and economic impacts of industrial systems and technologies
- To develop strategies for promoting sustainable industrial development.

Course Outcomes (CO): Upon successful completion of this course, the students will be able to

CO1	Define the key concepts and principles of industrial ecology and resource efficiency
CO2	Apply tools and techniques of industrial ecology, such as life cycle assessment and material flow analysis, to analyze industrial systems
CO3	Evaluate the environmental and economic impacts of industrial systems and technologies
CO4	Identify opportunities for improving resource efficiency in industrial processes
CO5	Develop strategies for promoting sustainable industrial development
CO6	Communicate effectively about industrial ecology and resource efficiency to technical and non-technical audiences

Course Content:

UNIT I:
Introduction to Industrial Ecology and Resource Efficiency, Definition and scope of industrial ecology, Industrial metabolism and systems thinking, Principles of resource efficiency and circular economy, Case studies of sustainable industrial practices.

UNIT II:
Life Cycle Assessment (LCA), Phases of LCA: goal and scope definition, inventory analysis, impact assessment, and interpretation, Applications of LCA in product and process design, eco-labelling, and environmental policy, Software tools for LCA: SimaPro, Gabi, OpenLCA.

UNIT III:
Industrial Symbiosis and Eco-Industrial Parks, Definition and principles of industrial symbiosis, Case studies of industrial symbiosis in practice, Eco-industrial parks: concepts and benefits, Barriers and enablers of industrial symbiosis and eco-industrial parks.

UNIT IV:
Cleaner Production and Eco-Design, Principles of cleaner production and pollution prevention, Methods for identifying and assessing pollution prevention opportunities, Eco-design and sustainable product development, Case studies of cleaner production and eco-design in practice.

UNIT V:
Resource Recovery and Waste Minimization, Technologies for resource recovery from waste streams, Industrial ecology of waste management, Zero waste and closed-loop systems, Case studies of resource recovery and waste minimization in practice.

UNIT VI:
Sustainable Industrial Development and Policy, National and international policies for promoting sustainable industrial development, Environmental management systems (ISO 14001) and environmental performance indicators, Corporate sustainability reporting and stakeholder engagement, Challenges and opportunities for industrial ecology and resource efficiency in the future.

Reference Books:

1. Graedel, T. E., & Allenby, B. R. (2010). Industrial ecology and sustainable engineering. Prentice Hall.
2. Ayres, R. U., & Ayres, L. W. (2002). A handbook of industrial ecology. Edward Elgar.
3. Troschinetz, A. M., & Mihelcic, J. R. (2009). Sustainable industrial design and waste management: cradle-to-cradle for sustainable development. John Wiley & Sons.
4. Lowe, E. A., & Evans, G. (2015). Environmental management for sustainable development. Routledge.

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PEC-EED401-3 ATMOSPHERIC CHEMISTRY AND CLIMATE CHANGE

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

The objective of this course is to provide students with an understanding of the chemical composition and physical processes of the Earth's atmosphere and how these impact climate change. Students will learn about atmospheric chemistry, air pollution, and climate change mechanisms, including greenhouse gases, aerosols, and atmospheric reactions. The course will also introduce students to the principles and techniques of measuring and modeling atmospheric chemistry and climate change.

Course Outcomes (CO): Upon successful completion of this course, the students will be able to

CO1	Knowledge: Understand the basic principles of atmospheric chemistry and climate change, including the composition and structure of the Earth's atmosphere, greenhouse gases, and climate change mechanisms.
CO2	Comprehension: Explain the chemical and physical processes that occur in the atmosphere, including photochemistry, ozone depletion, and acid rain.
CO3	Application: Apply atmospheric chemistry principles to analyze air pollution and climate change issues and to evaluate potential solutions.
CO4	Analysis: Analyze the impact of human activities on atmospheric chemistry and climate change, including emissions of greenhouse gases and aerosols.
CO5	Synthesis: Synthesize information from atmospheric chemistry and climate change research to propose and evaluate strategies for mitigating and adapting to climate change.
CO6	Evaluation: Evaluate the effectiveness of atmospheric chemistry and climate change policies and technologies in addressing environmental challenges.

Course Content:

UNIT I:

Introduction to atmospheric chemistry and climate change, The Earth's atmosphere, Chemical composition of the atmosphere, Climate change mechanisms and impacts, The role of greenhouse gases and aerosols.

UNIT II:

Atmospheric reactions and photochemistry, The basics of atmospheric reactions, Ozone depletion and the ozone hole, Acid rain and its effects on ecosystems.

UNIT III:

Air pollution and its effects on health, Sources and types of air pollutants, Health impacts of air pollution, Air pollution control technologies.

UNIT IV:
Greenhouse gases and climate change, Carbon dioxide and other greenhouse gases, Anthropogenic and natural sources of greenhouse gases, Climate feedbacks and tipping points.

UNIT V:
Atmospheric measurements and modelling, Techniques for measuring atmospheric composition, Principles of atmospheric modelling, Climate models and projections.

UNIT VI:
Mitigation and adaptation strategies, Policies and technologies for reducing greenhouse gas emissions, Climate change adaptation strategies, Case studies of successful environmental policies and programs.

Reference Books:

1. Atmospheric Chemistry and Physics: From Air Pollution to Climate Change, by John H. Seinfeld and Spyros N. Pandis
2. Introduction to Atmospheric Chemistry, by Daniel Jacob
3. Climate Change Science: A Modern Synthesis, by G. Thomas Farmer and John Cook
4. Air Pollution and Control, by S. M. Khopkar
5. Environmental Chemistry, by B. K. Sharma
6. Climate Change: Mitigation and Adaptation Strategies, by R. Ramanathan and Y. Feng

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PEC-EED401-4 ENVIRONMENTAL AUDITING AND LIFE CYCLE ASSESSMENT

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

- To understand the principles and practices of environmental auditing
- To develop skills in conducting environmental audits and identifying areas for improvement
- To understand the principles and practices of life cycle assessment
- To develop skills in conducting life cycle assessments and analyzing environmental impacts
- To understand the role of environmental auditing and life cycle assessment in sustainable development
- To understand the regulatory and legal frameworks related to environmental auditing and life cycle assessment.

Course Outcomes (CO): Upon successful completion of this course, the students will be able to

CO1	Knowledge: Students will be able to recall and understand the principles and practices of environmental auditing and life cycle assessment.
CO2	Comprehension: Students will be able to interpret and explain the concepts and methodologies of environmental auditing and life cycle assessment.
CO3	Application: Students will be able to apply environmental auditing and life cycle assessment principles and techniques to real-world situations.
CO4	Analysis: Students will be able to analyze and evaluate the environmental impacts of products and processes using life cycle assessment.
CO5	Synthesis: Students will be able to synthesize information from environmental audits and life cycle assessments to identify areas for improvement and make recommendations for sustainable development.
CO6	Evaluation: Students will be able to evaluate the effectiveness of environmental auditing and life cycle assessment programs in achieving environmental goals and objectives.

Course Content:

UNIT I:
Introduction to Environmental Auditing and Life Cycle Assessment, Environmental auditing principles and practices, Types of environmental audits, Life cycle assessment principles and practices, Life cycle assessment methodologies.

UNIT II:
Environmental Auditing, Compliance auditing, Management systems auditing, Sustainability auditing, ISO 14001 and other auditing standards.

UNIT III:
Life Cycle Assessment, Goal and scope definition, Inventory analysis, Impact assessment, Interpretation.

UNIT IV:
Environmental Impact Analysis, Air pollution, Water pollution, Solid waste, Energy use and greenhouse gas emissions.

UNIT V:
Sustainable Development, Triple bottom line: economic, social, and environmental sustainability, Corporate social responsibility, Green design and manufacturing, Sustainable supply chain management.

UNIT VI:
Regulatory and Legal Frameworks, International agreements and treaties, National and regional regulations, Liability and enforcement, Compliance and certification programs.

Reference Books:

1. Environmental Auditing and Compliance: A Guide to Laws, Regulations, and Standards by Craig R. Johnson
2. Life Cycle Assessment Handbook: A Guide for Environmentally Sustainable Products by Mary Ann Curran
3. Environmental Life Cycle Assessment by Guido Sonnemann and Manuele Margni
4. Environmental Auditing: Theory and Applications by James E. Leemann, Michael B. Bittner, and Hans P. Blaschek

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

Professional Elective V

1. Constructed Wet land Techniques and Sewage farming
2. Urban Environmental Management
3. Sustainable Aspects of Heritage Buildings
4. Green Infrastructures and Urban Ecology

PEC-EED402-1 CONSTRUCTED WET LAND TECHNIQUES AND SEWAGE FARMING

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

- To provide an understanding of the principles, design, operation, and maintenance of constructed wetlands and sewage farming systems for wastewater treatment and reuse
- To develop skills in the analysis and design of constructed wetland and sewage farming systems
- To explore the benefits and challenges of using these systems for wastewater treatment and reuse

Course Outcomes (CO): Upon successful completion of this course, the students will be able to

CO1	Analyze the principles and processes of constructed wetlands and sewage farming for wastewater treatment and reuse
CO2	Design and size a constructed wetland or sewage farming system for a specific application
CO3	Evaluate the performance and effectiveness of constructed wetland and sewage farming systems
CO4	Assess the economic, social, and environmental benefits and challenges of using these systems for wastewater treatment and reuse
CO5	Develop operation and maintenance plans for constructed wetland and sewage farming systems
CO6	Communicate technical information about constructed wetland and sewage farming systems effectively

Course Content:

UNIT I:
Introduction to Constructed Wetlands and Sewage Farming, Principles and processes of constructed wetlands and sewage farming, Types of constructed wetlands and sewage farming systems, Benefits and challenges of using these systems for wastewater treatment and reuse

UNIT II:
Design of Constructed Wetlands and Sewage Farming Systems, Site selection and preparation, System components and layout, Sizing and hydraulic loading rates, Vegetation selection and management.

UNIT III:
Performance and Effectiveness of Constructed Wetland and Sewage Farming Systems, Removal

mechanisms and efficiency, Monitoring and evaluation of system performance, Optimization and troubleshooting of system operation.

UNIT IV:
Economic, Social, and Environmental Considerations, Cost-benefit analysis of constructed wetland and sewage farming systems, Stakeholder engagement and community acceptance, Environmental impact assessment and mitigation measures

UNIT V:
Operation and Maintenance of Constructed Wetland and Sewage Farming Systems, Start-up and commissioning procedures, Routine and preventive maintenance activities, Health and safety considerations

UNIT VI:
Communication and Case Studies, Effective communication of technical information about constructed wetland and sewage farming systems, Case studies of successful implementation of these systems for wastewater treatment and reuse

Reference Books:

1. "Constructed Wetlands for Wastewater Treatment: Municipal, Industrial and Agricultural" by Marcos von Sperling
2. "Sewage Treatment: Plant Design, Operation and Maintenance" by Volume 1-2 by BC Punmia
3. "Constructed Wetlands: A Promising Wastewater Treatment System for Small Communities" by R. P. Canales and K. R. Reddy

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PEC-EED402-2 URBAN ENVIRONMENTAL MANAGEMENT

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective: The objective of this course is to provide students with a comprehensive understanding of the issues related to urban environmental management, including the key concepts, principles, and practices for managing urban environments.

Course Outcomes (CO): Upon successful completion of this course, the students will be able to

CO1	Define the concept of urban environmental management and explain its importance in sustainable development.
CO2	Identify the key environmental challenges facing urban areas and describe their impacts on human health and the environment.
CO3	Analyze the different policy and governance frameworks that can be used to address urban environmental challenges.
CO4	Evaluate the role of different stakeholders in urban environmental management, including government agencies, private sector, civil society, and the community.
CO5	Apply the principles of urban environmental management to develop sustainable solutions for environmental challenges in urban areas.
CO6	Communicate effectively on issues related to urban environmental management, including the use of relevant terminology and concepts.

Course Content:

UNIT I
Introduction to Urban Environmental Management, Definition of urban environmental management, Importance of urban environmental management in sustainable development, Key environmental challenges facing urban areas

UNIT II
Policy and Governance Frameworks for Urban Environmental Management, National and local policies for urban environmental management, Governance structures for urban environmental management, Role of different stakeholders in urban environmental management

UNIT III
Urban Environmental Health, Environmental health challenges in urban areas, Impact of environmental health on human health and the environment, Management strategies for urban environmental health

UNIT IV
Waste Management in Urban Areas, Sources and types of waste in urban areas, Management strategies for solid and liquid waste in urban areas, Sustainable waste management practices

UNIT V

Water Management in Urban Areas, Challenges in water management in urban areas, Sustainable water management strategies for urban areas, Water conservation and recycling practices

UNIT VI

Air Pollution in Urban Areas, Sources of air pollution in urban areas, Impact of air pollution on human health and the environment, Management strategies for air pollution in urban areas

Reference Books:

1. Urban Environmental Management in India by T. V. Ramachandra and Uttam Kumar
2. Environmental Management of Urban Lakes in Bangalore by H. S. Sudhira and T. V. Ramachandra
3. Urban Environmental Management and Planning: A Casebook of Best Practice by Arvind Garg and Ashok Khosla
4. Urban Environmental Management: A South Asian Perspective by Shabbir H. Gheewala and Eric Caulton
5. Sustainable Urban Environmental Management: A Strategic Approach by Nick Gray and Lisa Benton-Short
6. Urban Environmental Management and Technology by N. Kumar and M. R. Ramesh
7. Principles and Practice of Urban Environmental Management: An International Perspective by Richard Stren and Rodney White

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PEC-EED402-3 SUSTAINABLE ASPECTS OF HERITAGE BUILDINGS

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:
The objective of this course is to recognize the cultural, historical, and architectural significance of heritage buildings and their sustainable designs aspects.

Course Outcomes (CO): Upon successful completion of this course, the students will be able to

CO1	Describe the cultural and historical significance of heritage buildings and their importance in preservation efforts.
CO2	Apply sustainable design principles to heritage buildings, considering both environmental and cultural aspects.
CO3	Implement energy-efficient solutions and calculate potential energy savings in heritage structures.
CO4	Develop water management strategies and systems tailored to heritage buildings, considering sustainability.
CO5	Plan and design sustainable landscapes and surroundings that enhance the sustainability of heritage sites.
CO6	Navigate regulatory frameworks and assess case studies of heritage buildings showcasing successful sustainable practices.

Course Content:

UNIT I
Introduction to Sustainable Heritage Buildings, Importance of heritage buildings in cultural preservation. Concept of sustainability in the context of heritage conservation, Challenges and opportunities in integrating sustainability into heritage buildings.

UNIT II:
Sustainable Design Principles, Sustainable design principles to heritage buildings, Environmental and cultural benefits of sustainable design. Case studies illustrating successful sustainable design in heritage buildings.

UNIT III:
Energy-efficient solutions in heritage buildings, Environmental impact of energy-saving technologies. Potential energy savings and carbon reduction in heritage structures.

UNIT IV:
Sustainable water uses in heritage buildings, water conservation practices in heritage structures, Ecological benefits of sustainable water management.

UNIT V:
Sustainable landscaping practices in heritage site surroundings, Plan and design sustainable landscapes that complement heritage buildings, Ecological restoration of heritage site surroundings.

UNIT VI:
Regulatory Framework and Case Studies, Navigate regulatory frameworks relevant to sustainable heritage conservation, international and local policies promoting sustainable heritage practices, Case studies of heritage buildings demonstrating exemplary sustainable practices.

Reference Books:

1. "Sustainable Heritage: Merging Environmental Conservation and Historic Preservation" by Robert R. Page
2. “Sustainable Design: Ecology, Architecture, and Planning” by Daniel E. Williams
3. "Energy Efficiency in Historic Buildings" by Michael Forsyth
4. "Sustainable Water Management in Historic Buildings: Rehabilitating, Retrofitting, and Conserving" by Angelica Trinco
5. "Sustainable Landscapes and Gardens: Design, Implementation, and Management" by Robert L. France

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

PEC-EED402-4 GREEN INFRASTRUCTURES AND URBAN ECOLOGY

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Objective:

- Understand the principles and practices of green infrastructures
- Learn about the ecological benefits of green infrastructures in urban environments
- Analyze case studies of successful green infrastructure projects in urban areas
- Understand the challenges and limitations of implementing green infrastructures in urban areas
- Develop skills to design and implement green infrastructure projects in urban areas
- Critically evaluate the role of green infrastructures in promoting sustainable urban development

Course Outcomes (CO): Upon successful completion of this course, the students will be able to

CO1	Define the concept of green infrastructures and their role in promoting urban ecology
CO2	Evaluate the ecological benefits of green infrastructures in urban environments
CO3	Analyze case studies of successful green infrastructure projects in urban areas
CO4	Apply design principles and best practices for green infrastructure projects
CO5	Create a plan for implementing a green infrastructure project in an urban area
CO6	Evaluate the role of green infrastructures in promoting sustainable urban development from a critical perspective

Course Content:

UNIT I

Introduction to Green Infrastructures and Urban Ecology, Definition and principles of green infrastructures, the role of green infrastructures in promoting urban ecology, Ecological functions of green infrastructures in urban environments, Benefits of green infrastructures for sustainable urban development

UNIT II

Types of Green Infrastructures, Natural and engineered green infrastructures, Examples of green infrastructures: green roofs, urban forests, rain gardens, etc., Design principles and best practices for green infrastructure projects

UNIT III

Case Studies of Green Infrastructure Projects in Urban Areas, Successful examples of green infrastructure projects in urban areas, Analysis of ecological and social benefits of green infrastructure projects, Challenges and limitations of implementing green infrastructure projects in urban areas

UNIT IV

Implementation of Green Infrastructure Projects, Planning and design of green infrastructure projects, Construction and maintenance of green infrastructure projects, Monitoring and evaluation of green infrastructure projects

UNIT V

Green Infrastructures and Sustainable Urban Development, Role of green infrastructures in promoting sustainable urban development, Green infrastructure policies and regulations at local and national levels, Integrating green infrastructures with other urban planning and development initiatives

UNIT VI

Critical Perspectives on Green Infrastructures and Urban Ecology, Critiques of the green infrastructure approach, Alternative perspectives on urban ecology and sustainable urban development, Opportunities and challenges for advancing green infrastructures in urban areas

Reference Books:

1. Green Infrastructure for Landscape Planning: Integrating Human and Natural Systems by Gary Austin and Andrew C. Millington (Foreign Author)
2. Urban Ecology: Science of Cities by Richard T. T. Forman (Foreign Author)
3. Green Infrastructure: A Landscape Approach by David C. Rouse and Ignacio F. Bunster-Ossa (Foreign Author)
4. Green Infrastructure: Creating and Restoring Habitats in Our Cities by Mark A. Benedict and Edward T. McMahon (Foreign Author)
5. Urban Ecology: An Indian Perspective by H. Santapau and K. M. Bhat (Indian Author)
6. Ecology and Development in the Third World by Avijit Gupta (Indian Author)

CO-PO and CO-PSO Mapping:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	-	-	-	-	1	-	-	-	-	-	1	2	2
CO2	3	2	1	1	-	2	-	-	-	-	-	2	3	3
CO3	3	2	1	1	-	3	-	-	-	-	-	2	3	2
CO4	3	1	1	1	-	3	-	-	-	-	-	2	3	3
CO5	3	2	1	2	-	3	-	-	-	-	-	2	3	2
CO6	3	1	-	-	-	3	-	-	-	-	-	2	1	2

OPEN ELECTIVE COURSES

OEC-EED301-1

NON-CONVENTIONAL ENERGY RESOURCES AND UTILISATION

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

UNIT 1:
Energy resources and their utilization: Indian and global energy sources, Energy exploited, Energy planning, Energy parameters (energy intensity, energy-GDP elasticity), Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy, Hydrogen energy systems, Fuel cells, Decentralized and dispersed generation. Solar radiations: Extra-terrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, Measurement of solar radiations, Solar radiation geometry, Flux on a plane surface, Latitude, Declination angle, Surface azimuth angle, Hour angle, Zenith angle, Solar altitude angle expression for angle between incident beam and the normal to a plane surface (no derivation), Local apparent time, Apparent motion of sun, Day length, Solar radiation data for India.

UNIT 2:
Solar energy: Solar thermal power and it's conversion, Solar collectors, Flat plate, Performance analysis of flat plate collector, Solar concentrating collectors, Types of concentrating collectors, Thermodynamic limits to concentration, Cylindrical collectors, Thermal analysis of solar collectors, Tracking CPC and solar swing. Solar thermal energy storage, Different systems, solar pond. Applications, Water heating, Space heating & cooling, Solar distillation, solar pumping, Solar Cooking, Green Houses, Solar Power plants, solar photovoltaic system: Photovoltaic effect, Efficiency of solar cells, Semiconductor materials for solar cells, Solar photovoltaic system, Standards of solar photovoltaic system, Applications of PV system, PV hybrid System.

UNIT 3:
Biogas: Photosynthesis, Bio gas production, Aerobic and anaerobic bio-conversion process, Raw materials, Properties of bio gas, Producer gas, Transportation of bio gas, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production, Bio gas applications, Biomass conversion techniques, Biomass gasification, Energy recovery from urban waste, Power generation from liquid waste, Biomass cogeneration, Energy plantation, Fuel properties, Biomass resource development in India. Wind energy: Properties of wind, Availability of wind energy in India, wind velocity, Wind machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis wind mills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Wind energy farms, Economic issues, Recent development.

UNIT 4:
Electrochemical effects and fuel cells: Principle of operation of an acidic fuel cell, Reusable cells, Ideal fuel cells, Other types of fuel cells, Comparison between acidic and alkaline hydrogen-oxygen fuel cells, Efficiency and EMF of fuel cells, Operating characteristics of fuel cells, Advantages of fuel cell power plants, Future potential of fuel cells, Tidal power: Tides and waves as sources of energy, Fundamentals of tidal power, Use of tidal energy, Limitations of tidal energy conversion systems.

Hydrogen Energy: Properties of hydrogen in respect of its use as source of renewable energy, Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel, Development of hydrogen cartridge, Economics of hydrogen fuel and its use.

UNIT 5:

Thermoelectric systems: Kelvin relations, power generation, Properties of thermoelectric materials, Fusion Plasma Generators, Geothermal energy: Structure of earth's interior, Geothermal sites, earthquakes & volcanoes, Geothermal resources, Hot springs, Steam ejection, Principal of working, Types of geothermal station with schematic representation, Site selection for geothermal power plants. Advanced concepts, Problems associated with geothermal conversion. Ocean energy: Principle of ocean thermal energy conversion, Wave energy conversion machines, Power plants based on ocean energy, Problems associated with ocean thermal energy conversion systems, Thermoelectric OTEC, Developments of OTEC, Economics. Impact of renewable energy generation on environment, Kyoto Protocol, Cost of electricity production from different energy sources, Energy options for Indian economy.

REFERENCE/TEXT BOOKS:

1. Bansal Keemann, Meliss, “Renewable energy sources and conversion technology", Tata McGrawHill.
2. Kothari D.P., “Renewable energy resources and emerging technologies", Prentice Hall of IndiaPvt.Ltd.
3. Ashok V. Desai, "Non conventional Energy", New Age International Publishers Ltd.

OEC-EED301-2

SOLID WASTE MANAGEMENT

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

UNIT 1:
Sources And Types of Municipal Solid Wastes: Sources and types of solid wastes - Quantity – factors affecting generation of solid wastes; characteristics – methods of sampling and characterization; Effects of improper disposal of solid wastes – public health effects. Principle of solid waste management – social & economic aspects; Public awareness; Role of NGOs; Legislation.

UNIT 2:
On-Site Storage & Processing: On-site storage methods – materials used for containers – on-site segregation of solid wastes – public health & economic aspects of storage – options under Indian conditions – Critical Evaluation of Options

UNIT 3:
Collection And Transfer: Methods of Collection – types of vehicles – Manpower requirement – collection routes; transfer stations – selection of location, operation & maintenance; options under Indian conditions.

UNIT 4:
Off-Site Processing: Processing techniques and Equipment; Resource recovery from solid wastes – composting, incineration, Pyrolysis - options under Indian conditions.
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UNIT 5:
DISPOSAL: Dumping of solid waste; sanitary landfills – site selection, design and operation of sanitary landfills – Leachate collection & treatment.

Text Books/Reference Books: \
1. George Tchobanoglous et.al., Integrated Solid Waste Management‖, McGraw-Hill Publishers, 1993.
2. B.Bilitewski, G.HardHe, K.Marek, A.Weissbach, and H.Boeddicker, Waste Management‖, Springer, 1994
3. Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000
4. R.E.Landreth and P.A.Rebers, Municipal Solid Wastes – problems and Solutions‖, Lewis Publishers, 1997.
5. Bhide A.D. and Sundaresan, B.B., Solid Waste Management in Developing Countries‖, INSDOC, 1993

OEC-EED301-3

ENERGY STUDIES

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Contents:

UNIT 1:
Introduction to Energy Science: Scientific principles and historical interpretation to place energy use in the context of pressing societal, environmental and climate issues; Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment

UNIT 2:
Energy Sources: Overview of energy systems, sources, transformations, efficiency, and storage. Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration, high efficiency batteries.

UNIT 3:
Energy& Environment: Energy efficiency and conservation; introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumption and sustainability; introduction to the economics of energy; How the economic system determines production and consumption; linkages between economic and environmental outcomes; How future energy use can be influenced by economic, environmental, trade, and research policy.

UNIT 4:
Engineering Projects connected with the Energy Sources: Coal mining technologies, Oil exploration offshore platforms, Underground and under-sea oil pipelines, solar chimney project, wave energy caissons, coastal installations for tidal power, wind mill towers; hydro power stations above-ground and underground along with associated dams; Nuclear reactor containment buildings and associated buildings, Spent Nuclear fuel storage and disposal systems.

UNIT 5:
Engineering for Energy conservation: Concept of Green Building and Green Architecture; Identification of energy related enterprises that represent the breath of the industry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption.

Course outcomes:

The students will be able to:

1. Understand effect of using these sources on the environment and climate
2. Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the impact on the environment.
3. List and describe the primary renewable energy resources and technologies.
4. To quantify energy demands and make comparisons among energy uses, resources, and technologies.
5. Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.

Text/Reference Books:

1. Boyle, Godfrey (2004), Renewable Energy (2nd edition). Oxford University Press
2. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press
3. Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living, Gaiam
4. Jean-Philippe; Zaccour, Georges (Eds.), (2005), Energy and Environment Set: Mathematics of Decision Making, Loulou, Richard; Waaub, XVIII,
5. Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A. (2006) Energy and the Environment, 2nd Edition, JohnWiley
6. UNDP (2000), Energy and the Challenge of Sustainability, World Energy assessment
7. E H Thorndike (1976), Energy & Environment: A Primer for Scientists and Engineers, Addison-Wesley Publishing Company
8. Related papers published in international journals

OEC-EED301-4

ENVIRONMENTAL SCIENCE

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Contents:

UNIT 1:
Plant Physiology covering, Transpiration; Mineral nutrition

UNIT 2:
Ecology covering, Ecosystems- Components, types, flow of matter and energy in an ecosystem; Community ecology- Characteristics, frequency, life forms, and biological spectrum; Ecosystem structure- Biotic and a-biotic factors, food chain, food web, ecological pyramids;

UNIT 3:
Population Dynamics covering, Population ecology- Population characteristics, ecotypes; Population genetics- Concept of gene pool and genetic diversity in populations, polymorphism and heterogeneity.

UNIT 4:
Environmental Management covering, Principles: Perspectives, concerns and management strategies; Policies and legal aspects- Environment Protection Acts and modification, International Treaties; Environmental Impact Assessment- Case studies (International Airport, thermal power plant).

UNIT 5:
Biotechnology covering, Basic concepts: Totipotency and Cell manipulation; Plant & Animal tissue culture- Methods and uses in agriculture, medicine and health.

UNIT 6:
Biostatistics covering, Introduction to Biostatistics: -Terms used, types of data; Measures of Central Tendencies- Mean, Median, Mode, Normal and Skewed distributions; Analysis of Data- Hypothesis testing and ANNOVA (single factor)

Text/Reference Books:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons.
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd editionWm, C. Brown Publishers.

OEC-EED302-1

RESEARCH AND IPR

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Contents:

UNIT 1:
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT 2:
Effective literature studies approaches, analysis Plagiarism, and Research ethics.

UNIT 3:
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT 4:
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

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

1. Understand research problem formulation.
2. Analyze research related information.
3. Follow research ethics.
4. 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.

Text/Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for Science& engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step-by-Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.

OEC-EED302-2

SOFT SKILLS FOR ENGINEERS

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Contents:

UNIT 1:
CORPORATE INTERACTION, LEADERSHIP & COMMUNICATION
Part I. Audio/Video Lessons and Observation/Listening Skills (Practical)Interviews Lectures by Eminent Engineers, scientists and technocrats.
Other inspiring speeches on social issues as well as related to the corporate world and industry.
Part-II. Group Discussions, Corporate Dialogue/Role Play (conflict and resolution);Mock-interviews. Discussions with briefs on CSR and IPR and role of important international bodies like WTO and IMF; Presentations; Technical/Business vocabulary; Body Language.
Part-III: Leadership & Participation: Review of social, political and corporate scene; Leadership skills, Attitudes, Sensitivity training. Learning/'Take-aways' from scenarios/situations. Crisis-handling; Negotiation-Conflict resolution exercises; Communication Skills; Seven Cs of Communication; Barriers of/to Effective Communication

UNIT 2:
CREATIVE COMPOSITION& TECHNICAL WRITING: Exercises in creative writing:USP and image building; Setting Goals; Charting Objectives; Minutes of a Meeting; Reports; Interoffice Memorandum; Resume and Covering Letter.

UNIT 3:
SEMANTICS & SYNTAX: Idioms & Proverbs, Vocabulary building, Crosswords, Neologisms, Portmanteau words, Correct sentences/usage.

UNIT 4:
DISSERTATION & PRACTICAL ASSESSMENT: Short Multimedia Dissertation on any topic of student's interest; Group Discussion and Mock-interview.

Reference Book:

1. Stephen Robbins and Seema Sanghi. Organizational Behaviour. Pearson. Latest edition.
2. Kotler, Philip and Kevin Lane Keller. Marketing Management. 13 th edition.2008 Eastern Economy Edition
3. Wehmeier, Sally. Oxford Advanced Learner's Dictionary. Oxford UP.2005
4. Ghosh, BN. Managing Soft Skills for Personality Development. Tata McGraw-Hill 2012
5. Rizvi, M Ashraf. Effective Technical Communication. Tata Mc Graw-Hill.2005
6. Bretag, Crossman and Bordia. Communication Skills. Tata Mc Graw-Hill.2009
7. Sites: Youtube and Wikipedia in general.

OEC-EED302-3

HUMAN RESOURCE MANAGEMENT

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Contents:

UNIT 1:
Human Resource Management: concept and scope; Roles, responsibilities and competencies of HR manager; Challenges to HR professionals; Human Resource Planning & Forecasting: significance and process.

UNIT 2:
HR Sourcing: Recruitment, Selection and Induction. Job Analysis: job Description and job Specification; Job Design: concept and methods; Job Evaluation-concept &methods; Performance appraisal and counselling.

UNIT 3:
Training: training process and methods; Career planning and Development; Succession planning; Employee Compensation: basic concepts & determinants;

UNIT 4:
Industrial Relations and Grievance Handling; Employee welfare; Dispute Resolution; International Human Resource Management; Contemporary Issues in HRM. HR Audit &Accounting, ethics & corporate social responsibility.

Reference Book:

1. K. Aswathapa Human resource Management: Text and cases, 6th edition, Tata McGraw Hill, New Delhi,2012
2. Uday Kumar Haldar &Juthika Sarkar(2012) Human resource Management New Delhi, Oxford University Press.
3. De Cenvo, Da & Robbins S.P.(2010) Fundamentals of Human Resource Management, 9th edition, New York, John Wiley & Sons.
4. Gary Dessler (2008) Human Resource Management, 11th edition New Delhi: Pearson Prentice Hall.
5. Tanuja Agarwala, Strategic Human resource Management, Oxford University Press 2007.

OEC-EED302-4

ENGINEERING ECONOMICS

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Contents:

UNIT 1:

Basic Principles and Methodology of Economics. Demand/Supply – elasticity – Government Policies and Application. Theory of the Firm and Market Structure. Basic Macro-economic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes

UNIT 2:

Public Sector Economics –Welfare, Externalities, Labour Market. Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve.

UNIT 3:

Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control – Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows). Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method.

UNIT 4:

Indian economy - Brief overview of post-independence period – plans. Post reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized, Unorganized, Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors.

Reference Books:

1. Mankiw Gregory N. (2002), Principles of Economics, Thompson Asia
2. V. Mote, S. Paul, G. Gupta(2004), Managerial Economics, Tata McGraw Hill
3. Misra, S.K. and Puri (2009), Indian Economy, Himalaya
4. Pareek Saroj (2003), Textbook of Business Economics, Sunrise Publishers

OEC-EED403-1

ENVIRONMENTAL ENGINEERING – SOCIETAL & GLOBAL IMPACT

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Contents:

UNIT I

Introduction to Environmental Engineering and Sustainability, Overview of environmental engineering and its role in promoting sustainability, Sustainable development goals and their relevance to environmental engineering, Environmental policy and regulations Environmental impact assessment

UNIT II

Air Pollution and Climate Change, Sources and types of air pollution, Impacts of air pollution on human health and the environment, Greenhouse gases and global warming, Mitigation strategies for climate change

UNIT III

Water Quality and Quantity, Water pollution and its impacts on human health and the environment, Water scarcity and management strategies, Sustainable water use and management practices, Water treatment technologies

UNIT IV

Waste Management, Solid waste management and disposal, Hazardous waste management and disposal, Recycling and composting, Life cycle assessment of waste management systems

UNIT V

Environmental Ethics and Justice, Environmental ethics and values, Environmental justice and equity, the role of social and cultural factors in environmental decision-making Case studies of environmental justice issues

UNIT VI

Global Environmental Issues and Sustainable Development, Global environmental challenges and their impact on society and the economy, Sustainable development and its relevance to environmental engineering, the role of environmental engineering in achieving sustainable development, Case studies of sustainable development projects

Course Outcomes

1. Analyze the impact of environmental engineering on society and the environment (Analysis)
2. Evaluate the effectiveness of environmental policies and regulations (Evaluation)
3. Create sustainable solutions to environmental challenges (Creation)
4. Understand the ethical and social dimensions of environmental issues (Comprehension)
5. Apply principles of sustainable development to environmental engineering (Application)
6. Synthesize information from multiple sources to develop a comprehensive understanding of global environmental issues (Synthesis)

Reference Books:

1. "Environmental Science and Engineering" by J. Glynn Henry and Gary W. Heinke (Indian author)
2. "Environmental Engineering: Fundamentals, Sustainability, Design" by James R. Mihelcic and Julie B. Zimmerman (Foreign author)
3. "Environmental Engineering: Prevention and Response to Water-, Food-, Soil-, and Airborne Disease and Illness" by Nelson Leonard Nemerow (Foreign author)
4. "Sustainability Science and Engineering: Defining Principles" by M. A. Abraham (Indian author)
5. "Environmental Engineering" by P. N. Modi and S. M. Seth (Indian author)
6. "Introduction to Environmental Engineering and Science" by Gilbert M. Masters and Wendell P. Ela (Foreign author)

OEC-EED403-2

GLOBAL WARMING AND ITS PREVENTIONS

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Contents:

UNIT I

Introduction to Global Warming, the science of global warming and the greenhouse effect, Historical and current trends in greenhouse gas emissions, Impacts of global warming on the environment and society.

UNIT II

Causes of Global Warming, Fossil fuels and their role in global warming, Land use changes and deforestation, Agricultural practices and livestock production, Industrial processes and waste management.

UNIT III

Mitigation Strategies for Global Warming, Energy efficiency and conservation, Renewable energy sources (solar, wind, hydropower, geothermal, bioenergy), Carbon capture and storage, Sustainable land use and forestry practices, Waste reduction and recycling.

UNIT IV

Policy Measures to Prevent Global Warming, International agreements and treaties (e.g. Paris Agreement, Kyoto Protocol), National and sub-national policies (e.g. carbon taxes, cap-and-trade systems, renewable portfolio standards), Technological innovation and research and development, Public awareness and education

UNIT V

Adaptation to Global Warming, Impacts of global warming on vulnerable populations (e.g. low-income communities, coastal areas), Adaptation strategies for agriculture, water resources, infrastructure, and public health, Role of ecosystem-based adaptation and green infrastructure

UNIT VI

Case Studies and Project Work, Case studies of successful global warming mitigation and adaptation projects, Project work on developing a plan for reducing greenhouse gas emissions in a specific sector or region.

Course Outcomes:

1. Understand the science of global warming and the greenhouse effect
2. Explain the key concepts related to global warming, such as climate feedback loops, carbon footprint, and carbon capture and storage
3. Apply the principles of energy efficiency and renewable energy to reduce greenhouse gas emissions
4. Analyze the economic, social, and political factors that influence global warming and its prevention
5. Develop a comprehensive plan to reduce greenhouse gas emissions in a specific sector or region
6. Evaluate the strengths and weaknesses of different strategies to mitigate global warming

Reference Books:

1. Global Warming: The Complete Briefing by John Houghton
2. Climate Change: Science, Strategies, and Solutions by Amarjeet S. Bassi and Larsen T. Elsgaard
3. Climate Change: What Everyone Needs to Know by Joseph Romm
4. Climate Change in India: Vulnerability Assessment and Adaptation by P. R. Shukla, S. K. Sharma, N. H. Ravindranath, A. K. Bhattacharya
5. Global Warming: Understanding the Forecast by C. B. S. Dutt
6. Climate Change and India: A 4X4 Assessment - A Sectoral and Regional Analysis for 2030

OEC-EED403-3

ENERGY AND ENVIRONMENT

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Contents:

UNIT I

Introduction to Energy and Environment, Energy sources and their environmental impact, Environmental regulations and policies, Energy efficiency and conservation.

UNIT II

Fossil Fuel Energy, Coal, oil, and natural gas production and consumption, Impacts of fossil fuel energy on environment, Carbon capture and storage technologies.

UNIT III

Nuclear Energy, Nuclear power production and waste management, Environmental impacts of nuclear energy, Safety and security concerns

UNIT IV

Renewable Energy, Solar, wind, hydroelectric, and geothermal energy production, Environmental benefits and challenges of renewable energy, Energy storage technologies

UNIT V

Energy and Transportation, Transportation energy consumption and environmental impact, Alternative fuels and vehicles, Sustainable transportation policies

UNIT VI

Energy and Society, Energy access and equity issues, Energy and economic development, Role of individuals and communities in promoting sustainable energy practices

Course Outcomes:

1. Remembering: Recall the basic concepts and terminology associated with energy and environment.
2. Understanding: Understand the relationship between energy and environment and the impact of energy production and consumption on the environment.
3. Applying: Apply the principles of energy and environment to analyze and solve problems related to energy production and consumption.
4. Analyzing: Analyze the environmental impact of different energy sources and technologies.
5. Evaluating: Evaluate the effectiveness of different policies and technologies for mitigating the environmental impact of energy production and consumption.
6. Creating: Design and propose innovative solutions for sustainable energy production and consumption.

Reference Books:

1. Energy and the Environment by Robert A. Ristinen and Jack P. Kraushaar (Foreign Author)
2. Energy, Environment, and Climate by Richard Wolfson (Foreign Author)
3. Energy and Environment: Science, Technology and Society by David Elliott (Foreign Author)
4. Energy, Environment and Sustainable Development by Suresh Jain and V. K. Vijay (Indian Authors)
5. Energy and Environment by R. Rajagopalan (Indian Author)
6. Energy and Environmental Management in Metallurgical Industries by R. K. Jana (Indian Author)

OEC-EED403-4

ENVIRONMENTAL SAFETY ENGINEERING

L	T	P	Total
3	0	0	3

Sessional: 25 marks
Theory: 75 marks
Total: 100 marks
Duration of exam: 3 hours

Course Contents:

UNIT I
Introduction to Environmental Safety Engineering, Definition and scope of environmental safety engineering, Overview of environmental safety hazards and risks, Regulatory and legal framework for environmental safety engineering

UNIT II
Hazard Identification and Risk Assessment, Hazard identification techniques, Risk assessment methods, Quantitative risk assessment techniques.

UNIT III
Environmental Safety Management, Safety culture and management systems, Environmental safety programs and policies, Emergency response planning and management

UNIT IV
Prevention and Control of Environmental Safety Hazards and Risks, Design principles for environmental safety, Hazard prevention and control techniques, Safety audits and inspections

UNIT V
Environmental Safety Engineering Applications, Case studies of environmental safety engineering in practice, Role of environmental safety engineering in sustainable development, Emerging trends in environmental safety engineering

UNIT VI
Communication and Ethics in Environmental Safety Engineering, Communication strategies for diverse stakeholders, Ethical and social implications of environmental safety hazards and risks, Professional ethics and responsibilities of environmental safety engineers

Course Outcomes:

1. Analyze and evaluate environmental safety hazards and risks associated with industrial, chemical, and biological processes using appropriate tools and techniques (Evaluate).
2. Design and implement environmental safety programs and policies that comply with national and international regulations and standards (Create).
3. Develop effective emergency response plans to mitigate environmental safety hazards and risks (Create).
4. Apply engineering principles to prevent and control environmental safety hazards and risks (Apply).
5. Communicate effectively with diverse stakeholders about environmental safety hazards and risks and their implications (Communicate).

6. Understand the ethical and social implications of environmental safety hazards and risks, and the role of environmental safety engineering in promoting sustainable development (Understand).

Reference Books:

1. Environmental Health and Safety Auditing Handbook by J. P. Steer and Barbara Nash (Foreign Author)
2. Environmental Safety and Health Engineering by Gayle Woodside and Dianna Wong (Foreign Author)
3. Environmental Safety Management: A Guide to Compliance by Nicholas Cheremisinoff and Anton Davletshin (Foreign Author)
4. Environmental Safety: A Guide to the Regulations by David O. Norris (Indian Author)
5. Environmental Management System and Safety Culture: A Guide for Airports by Miguel A. Nunes (Indian Author)
6. Environmental Safety Engineering and Management by S. Rao (Indian Author)

VALUE ADDED COURSES WITH EFFECT FROM 2021-22

VAC01 Human Values and Professional Ethics

The above 02 value added courses is compulsory for students. It may be taught through digital aided learning / class room teaching. Its duration is 31-35 hours. Minimum 75% attendance is compulsory for students and its evaluation will be done by concerned Dept. through Viva-Voce examination. These are recommended in I year.

VAC01: HUMAN VALUES AND PROFESSIONAL ETHICS

Professional Ethics Objectives:

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

UNIT I

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

UNIT II

Ethics: Senses of Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy –Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion.

UNIT III

Professionals as Social Experimentation: Social Experimentation – Professionals as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV

Safety, Responsibilities and Rights: Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) Gender inequality, causes and consequences. Discrimination, Social understandings, Women and Men in the Organization, Consequences of sexual harassment.

UNIT V

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

Course Outcomes:

Upon completion of the course, the student should be able to:

1. Apply ethics in society
2. Discuss the ethical issues related to engineering.
3. Realize the responsibilities as a good citizen.
4. Realize the rights in the society.

Textbooks:

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

Reference's books:

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

Web sources:

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