SCHEME AND SYLLABUS OF

UNDERGRADUATE DEGREE COURSES IN

ENVIRONMENTAL ENGINEERING

(Session 2021-22)

J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD

Curriculum for First Year

Undergraduate Degree Courses in Engineering & Technology

Chapter -1

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

A. 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)/week	1 credit

Total First Year Credit= 38 + 3*

***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 **03** through MOOC for I Year B.Tech. students admitted in 2019 and onwards.

B. 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

C. Category of Courses:

BASIC SCIENCE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits
			L	T	P	
1		Physics	3	1	3	5.5
2		Chemistry-I	3	1	3	5.5
3		Mathematics –I	3	1	0	4
4		Mathematics –2	3	1	0	4

ENGINEERING SCIENCE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits
			L	T	P	
1		Basic Electrical Engineering	3	1	2	5
2		Engineering Graphics & Design	0	0	4	2
3		Programming for Problem Solving	3	0	4	5
4		Workshop I	0	0	4	2
5		Workshop II	0	0	4	2

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT

Sl. No.	Course Code	Course Title	Hours per week			Credits
			L	T	P	
1		English	2	0	2	3

Chapter -2

Detailed first year curriculum contents

I. Mandatory Induction program

[Induction program for students to be offered right at the start of the first year.]

	3
Physical activity Creative Arts Universal Human Values Literary Proficiency Modules Lectures by Eminent People Visits to local Areas Familiarization to Dept./Branch & Innovations	

J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA FARIDABAD

SCHEME OF INSTRUCTION

B.TECH 1st YEAR (SEMESTER -I) (Environmental Engg.) COURSE STRUCTURE

Course Notation	Course Code	Course Title	L	T	P	Credits	Sessional	External	Category Code
B	BSC101B	Physics (Mechanics)	3	1	-	4	25	75	BSC
C	BSC103B (for Env. Engg.)	Mathematics-I Calculus, Multivariable Calculus & Linear Algebra)	3	1	-	4	25	75	BSC
B	ESC102A/ 21	Engineering Graphics & Design	-	-	4	2	30	70	ESC
B	ESC103	Programming for Problem solving	3	-	-	3	25	75	ESC
C	ESC104A/ 21	Workshop- I	-	-	4	2	30	70	ESC
B	BSC104	Physics lab	-	-	3	1.5	15	35	BSC
B	ESC105	Programming for Problem solving Lab	-	-	4	2	15	35	ESC
		Total Credits				**18.5**			

Note: Exams duration will be as under

a. Theory exams will be of 03 hours duration.
b. Practical exams will be of 02 hours duration
c. Workshop exam will be of 03 hours

duration Important Notes:

Significance of the Course Notations used in this scheme: -
C = These courses are common to both the groups Group-A and Group-B.
A = Other compulsory courses for Group-A.
B = Other compulsory courses for Group-B.

Students will study either

Group A (BSC103, ESC101, BSC102,ESC104A/21,HSMC101,ESC105,BSC105,HSMC102)

OR

Group B (BSC101, BSC103A/B,ESC102A/21,ESC103,ESC104,BSC104,ESC105)

(* Branch specific scheme and syllabus for Maths-I, Math-II and Physics on next page)

J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA FARIDABAD

SCHEME OF INSTRUCTION

B.TECH 1st YEAR (SEMESTER -II) (Environmental Engg.)
COURSE STRUCTURE

Course Notation	Course Code	Course Title	L	T	P	Credits	Sessional	External	Category Code
C	BSC106 B (for Env. Engg.)	Mathematics-II (Differential Equations)	3	1	-	4	25	75	BSC
B	ESC101	Basic Electrical Engineering	3	1	-	4	25	75	AECC
B	BSC 102	Chemistry	3	1	-	4	25	75	BEC
C	ESC106A/ 21	Workshop- II	-	-	4	2	30	70	BEC
B	HSMC101	English	2	-	-	2	25	75	BEC
B	ESC107	Basic Electrical Engineering Lab	-	-	2	1	15	35	BSC
B	BSC 105	Chemistry Lab	-	-	3	1.5	15	35	BEC
B	HSMC102	English Lab	-	-	2	1	15	35	BEC
		Total Credits				**19.5**			

Note: Exams duration will be as under

a. Theory exams will be of 03 hours duration.
b. Practical exams will be of 02 hours duration
c. Workshop exam will be of 03 hours duration

Total First Year Credit= 38 + 3*

***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 **03** through MOOC for I Year B.Tech. students admitted in 2019 and onwards

S.No.	Course code	Course Title	Branch
1.	**BSC101 A** **BSC104A**	**Physics** (Introduction to Electromagnetic Theory) **Physics** (Introduction to Electromagnetic Theory) Lab	**Mechanical Engineering, Automation Engineering, Automobile Engineering**
2	**BSC101B** **BSC104B**	**Physics** (Mechanics) **Physics** (Mechanics) Lab	**Civil Engineering, Environmental Engineering, Fashion Technology**
3	**BSC101C** **BSC104C**	**Physics** (Waves and Optics) **Physics** (Waves and Optics) Lab	**Electrical Engineering, Electronics & Communication Engineering, Electronics Instrumentation and Control Engineering, Electrical and Electronics Engineering**
4	**BSC101D** **BSC104D**	**Physics** (Semiconductor Physics) **Physics** (Semiconductor Physics)	**Computer Engineering, Computer Science & Engineering, Information Technology**
5	**BSC103A**	**Mathematics-I (**Calculus and Linear Algebra)	**Mechanical Engineering, Automation Engineering, Automobile Engineering**
6	**BSC103 B**	**Mathematics-I (**Calculus, Multivariable Calculus & Linear Algebra)	**Civil Engineering, Environmental Engineering**
7	**BSC103 C**	**Mathematics-I (**Calculus and Differential Equations)	**Electrical Engineering**
8	**BSC103 D**	**Mathematics-I (**Calculus and Linear Algebra)	**Electronics & Communication Engineering, Electronics Instrumentation and Control Engineering, Electrical and Electronics Engineering, Fashion Technology**
9	**BSC103 E**	**Mathematics-I (**Calculus and Linear Algebra)	**Computer Engineering, Computer Science & Engineering, Information Technology**
10	**BSC106 A**	**Mathematics-II (**Calculus, ODE & Complex Variables)	**Mechanical Engineering, Automation Engineering, Automobile Engineering**
11	**BSC106 B**	**Mathematics-II (**Differential Equations)	**Civil Engineering, Environmental Engineering,**
12	**BSC106 C**	**Mathematics-II (**Linear Algebra, Transform Calculus and Numerical methods)	**Electrical Engineering,**
13	**BSC106 D**	**Mathematics-II (**Calculus, Ordinary Differential Equations and Complex Variable)	**Electronics & Communication Engineering, Electronics Instrumentation and Control Engineering, Electrical and Electronics Engineering, Fashion Technology**
14	**BSC106 E**	**Mathematics-II (**Probability & Statistics)	**Computer Engineering, Computer Science & Engineering, Information Technology**

SEMESTER-WISE SUMMERY OF THE PROGRAMME

S. No.	Semester	Contact Hours	Marks	Credits
1.	I	26	600	18.5
2.	II	27	650	19.5
3	III	33	750	26
4.	IV	32	750	26
5.	V	30	750	23
6.	VI	30	750	24
7.	VII	29	850	25
8.	VIII	30	500	10
Total		**237**	**5600**	**172**

* 03 credit each year through MOOC in 1st and 2nd year
* 03 credit each year of open elective through MOOC in 3rd and 4th year

** Refer implementation of Credit Transfer/Mobility Policy of Online courses, 17th meeting of Academic Council (June 11, 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.*

PROGRAMME CORE COURSES (PCC)

Sr. No.	Code	Name of the Course	Contact Hours	Credit	Semester
1.	PCC-ENV-301	Environmental Chemistry	3	3	III
2.	PCC-ENV-302	Instrumentation Techniques for Environmental Monitoring	4	4	III
3.	PCC-ENV-303	Statistical Analysis and Environmental Modelling	3	3	III
4.	PCC-ENV-304	Lab: Computer-Aided Design (CAD) Lab	4	2	III
5.	PCC-ENV-305	Lab: Environmental Chemistry and Instrumentation	4	2	III
6.	PCC-ENV-401	Fluid Mechanics and Hydraulic Machines	3	3	IV
7.	PCC-ENV-402	Industrial Processes and Pollution Control	3	3	IV
8.	PCC-ENV-403	Air and Noise Pollution: Monitoring and Control	4	4	IV
9.	PCC-ENV-404	Lab: Air Quality Monitoring	4	2	IV
10.	PCC-ENV-405	Lab: Fluid Mechanics and Hydraulic Machines	4	2	IV
11.	PCC-ENV-501	Engineering and Environmental Surveying	3	3	V
12.	PCC-ENV-502	Engineering Hydrology	3	3	V
13.	PCC-ENV-503	Water Engineering: Design and Application	3	3	V
14.	PCC-ENV-504	Environmental Microbiology	3	3	V
15.	PCC-ENV-505	Engineering Economics	3	3	V
16.	PCC-ENV-506	Lab: Engineering and Environmental Surveying	2	1	V
17.	PCC-ENV-507	Lab: Water Engineering: Design and Application	4	2	V
18.	PCC-ENV-601	Solid and Hazardous Waste Management	3	3	VI
19.	PCC-ENV-602	Wastewater Engineering: Design and Application	3	3	VI
20.	PCC-ENV-603	Soil Pollution and Remediation	3	3	VI
21.	PCC-ENV-604	Environmental Pollution, Waste Management and Sanitation	3	3	VI
22.	PCC-ENV-605	Lab: Solid Waste Management	4	2	VI
23.	PCC-ENV-606	Lab: Wastewater Engineering: Design and Application	4	2	VI
24.	PCC-ENV-701	Environmental Impact Assessment and Audit	3	3	VII
25.	PCC-ENV-702	Geotechnical Engineering	3	3	VII
26.	PCC-ENV-703	Industrial Waste Management	3	3	VII
27.	PCC-ENV-704	Environmental Health and Safety	3	3	VII
28.	PCC-ENV-705	Lab: Geotechnical Engineering	2	1	VII
29.	PCC-ENV-706	Lab: Environmental Impact Assessment and Audit	2	1	VII
Total			**93**	**76**	

BASIC SCIENCE COURSES (BSC)

Sr. No.	Code	Name of the Course	Contact Hours	Credit	Semester
1.	BSC-101B	Physics (Mechanics)	4	4	I
2.	BSC-103B	Mathematics-I Calculus, Multivariable Calculus & Linear Algebra)	4	4	I
3.	BSC-104	Physics Lab	3	1.5	I
4.	BSC-102	Chemistry	4	4	II
5.	BSC-105	Chemistry Lab	3	1.5	II
6.	BSC-106B	Mathematics-II (Differential Equations)	4	4	II
7.	BSC-01	Biology	3	3	IV
Total			**25**	**22**	

ENGINEERING SCIENCE COURSES (ESC)

Sr. No.	Code	Name of the Course	Contact Hours	Credit	Semester
1.	ESC-102A/21	Engineering Graphics & Design	4	2	I
2.	ESC-103	Programming for Problem Solving	3	3	I
3.	ESC-104A/21	Workshop-I	4	2	I
4.	ESC-105	Programming for Problem Solving Lab	4	2	I
5.	ESC-101	Basic Electrical Engineering	4	4	II
6.	ESC-106A/21	Workshop-II	4	2	II
7.	ESC-107	Basic Electrical Engineering Lab	2	1	II
8.	ESC-201	Basics of Electronics Engineering	3	3	III
9.	ESC-203A/21	Engineering Mechanics	4	4	III
Total			**32**	**23**	

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMS)

Sr. No.	Code	Name of the Course	Contact Hours	Credit	Semester
1.	HSMC-101	English	2	2	I
2.	HSMC-102	English Lab	2	1	I
3.	HSMC-01	Humanities-I (Effective Technical Communication)	3	3	III
4.	HSMC (H-102)	Universal Human Values 2: Understanding Harmony	3	3* (VAC)	IV
5.	VAC-01	Human Values and Professional Ethics	-	0 (VAC)	1 Year
6.	VAC-02	Universal Human Values	-	0 (VAC)	1 Year
Total			**10**	**6**	

PROGRAMME ELECTIVE COURSES (PEC)

PROGRAMME ELECTIVE COURSES-I (PEC-I) Semester-V

Sr. No.	Code	Name of the Course	Contact Hours	Credit
1.	PEC-ENV-501	Green Technology	3	3
2.	PEC-ENV-502	Surface and Ground Water Pollution	3	3
3.	PEC-ENV-503	Engineering Analysis and Design	3	3

PROGRAMME ELECTIVE COURSES-II & III (PEC-II & III) Semester-VI

Sr. No.	Code	Name of the Course	Contact Hours	Credit
1.	PEC-ENV-601	Climate Change and CDM	3	3
2.	PEC-ENV-602	Environmental Policies and Laws	3	3
3.	PEC-ENV-603	Non-Conventional Energy Systems	3	3
4.	PEC-ENV-604	Disaster Management	3	3
5.	PEC-ENV-605	Environmental and Sustainable Development	3	3
6.	PEC-ENV-606	Environmental Toxicology and Risk Assessment	3	3

PROGRAMME ELECTIVE COURSES-IV & V (PEC-IV & V) Semester-VII

Sr. No.	Code	Name of the Course	Contact Hours	Credit
1.	PEC-ENV-701	Water Resource Systems	3	3
2.	PEC-ENV-702	Engineering Geology, GIS and Remote Sensing	3	3
3.	PEC-ENV-703	Water and Soil Conservation	3	3
4.	PEC-ENV-704	Irrigation and Drainage Engineering	3	3
5.	PEC-ENV-705	Advance Surveying	3	3
6.	PEC-ENV-706	Environmental Nanotechnology	3	3

OPEN ELECTIVE COURSES (OEC)

Sr. No.	Name of the Course	Contact Hours	Credit	Semester
1.	Open Elective Course-I (MOOC)	3	3	V
2.	Open Elective Course-II (MOOC)	3	3	VI
3.	Open Elective Course-III	3	3	VII
Total		**9**	**9**	

OPEN ELECTIVE COURSE -III (OEC)

Sr. No.	Code	Name of the Course	Contact Hours	Credit
1.	OEC-CED403-1	Civil Engineering – Societal & Global Impact	3	3
2.	OEC-CED403-2	Estimation and Costing	3	3
3.	OEC-CED403-3	Metro System and Engineering	3	3
4.	OEC-CED403-4	Safety Engineering		

SKILL ENHANCEMENT COURSES (SEC)

Sr. No.	Code	Name of the Course	Contact Hours	Credit	Semester
1.	SEC-ENV-1P	Skill Enhancement Project-I	4	2	III
2.	SEC-ENV-2P	Skill Enhancement Project-II	4	2	IV
3.	SEC-ENV-3P	Skill Enhancement Project-III	4	2	V
4.	SEC-ENV-4P	Skill Enhancement Project-IV	4	2	VI
5.	SEC-ENV-5P	Skill Enhancement Project-V	4	2	VII
6.	SEC-ENV-6P	Industrial Training	Full Semester	10	VIII
Total			**20**	**20**	

MANDATORY COURSES (MC)

Sr. No.	Code	Name of the Course	Contact Hours	Credit	Semester
1.	MCEVS-01	Environment ad Ecology	3	3	II
2.	MC-02	Constitution of India	2	0	III
3.	MCEVS-02	Natural Resources and Biodiversity	3	3	IV
4.	MC-04	Message of Bhagwat Gita	2	0	V
5.	MCEVS-03	Environmental Pollution, Waste Management and Sanitation	3	3	VI
Total			**13**	**9**	

Undergraduate Degree Courses in Engineering and Technology
ENVIRONMENTAL ENGINEERING
(As per guidelines of All India Council for Technical Education Model Curriculum)

General, Course Structure, Theme and 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 Credit
2 Hr. Practical (P) per week	1 Credit

Credits: 17 for a student to be eligible to get Under Graduate degree in Engineering

Structure of Undergraduate Engineering Program

Semester: I – VIII (w.e.f. 2021-22)

B.TECH. SCHEME CREDIT CALCULATIONS

Sr. No.	Category of Courses	Contact Hours	Credits
1.	Professional Core Courses (PCC)	93	76
2.	Basic Science Courses (BSC)	25	22
3.	Engineering Science Courses (ESC)	32	23
4.	Humanities and Social Sciences including Management Courses (HSMC)	10	6
5.	Professional Elective Courses (PEC)	15	15
6.	Open Elective Courses (OEC)	9	9
7.	Skill Enhancement Courses (SEC)	20	20
8.	Mandatory Audit Courses (MAC)	13	09
9.	Massive Open Online Courses (MOOC)*	-	6
10.	Value Added Course (VAC)**	3	3
	Total	**220**	**189**

* 03 credit each year through MOOC in 1st and 2nd year
* 03 credit each year of open elective through MOOC in 3rd and 4th year

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J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA FARIDABAD

SCHEME OF STUDIES & EXAMINATIONS
B. TECH 2nd YEAR (SEMESTER – III)
ENVIRONMENTAL ENGINEERING (2021-22)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits
		L	T	P	Total		Theory	Practical		
PCC-ENV-301	Environmental Chemistry	3	0	0	3	25	75	-	100	3
PCC-ENV-302	Instrumentation Techniques for Environmental Monitoring	4	0	0	4	25	75	-	100	4
PCC-ENV-303	Statistical Analysis and Environmental Modelling	3	0	0	3	25	75	-	100	3
ESC-201	Basic of Electronics Engineering	3	0	0	3	25	75	-	100	3
ESC-203A/21	Engineering Mechanics	3	1	0	4	25	75	-	100	4
HSMC-01	Humanities-I (Effective Technical Communication)	3	0	0	3	25	75	-	100	3
MC-02	Constitution of India	2	0	0	2	25	75	-	100	0
PCC-ENV-304	Lab: Computer-Aided Design (CAD) Lab	0	0	4	4	15	-	35	50	2
PCC-ENV-305	Lab: Environmental Chemistry and Instrumentation	0	0	4	4	15	-	35	50	2
SEC-ENV-1P	Project-I	0	0	4	4	15	-	35	50	2
					33				**750**	**26**

J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA FARIDABAD

SCHEME OF STUDIES & EXAMINATIONS
B. TECH 2nd YEAR (SEMESTER – IV)
ENVIRONMENTAL ENGINEERING (2021-22)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits
		L	T	P	Total		Theory	Practical		
PCC-ENV-401	Fluid Mechanics and Hydraulic Machines	3	0	0	3	25	75	-	100	3
PCC-ENV-402	Industrial Processes and Pollution Control	3	0	0	3	25	75	-	100	3
PCC-ENV-403	Air and Noise Pollution: Monitoring and Control	4	0	0	4	25	75	-	100	4
MCEVS-02	Natural Resources and Biodiversity	3	0	0	3	25	75	-	100	3
BSC-01	Biology	3	0	0	3	25	75	-	100	3
HSMC (H-102)	Universal Human Values 2: Understanding Harmony	3	0	0	3	25	75	-	100	3
PCC-ENV-404	Lab: Air Quality Monitoring	0	0	4	4	15	-	35	50	2
PCC-ENV-405	Lab: Fluid Mechanics and Hydraulic Machines	0	0	4	4	15	-	35	50	2
SEC-ENV-2P	Project-II	0	0	4	4	15	-	35	50	2
					32				**750**	**25**

J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA FARIDABAD

SCHEME OF STUDIES & EXAMINATIONS
B. TECH 2nd YEAR (SEMESTER – V)
ENVIRONMENTAL ENGINEERING (2021-22)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits
		L	T	P	Total		Theory	Practical		
PCC-ENV-501	Engineering and Environmental Surveying	3	0	0	3	25	75	-	100	3
PCC-ENV-502	Engineering Hydrology	3	0	0	3	25	75	-	100	3
PCC-ENV-503	Water Engineering: Design and Application	3	0	0	3	25	75	-	100	3
PCC-ENV-504	Environmental Microbiology	3	0	0	3	25	75	-	100	3
PCC-ENV-505	Engineering Economics	3	0	0	3	25	75	-	100	3
	Programme Elective Course-I (PEC-I)	3	0	0	3	25	75	-	100	3
MC-04	Message of Bhagwat Gita	2	0	0	2	25	75	-	100	0
PCC-ENV-506	Lab: Engineering and Environmental Surveying	0	0	2	2	15	-	35	50	1
PCC-ENV-507	Lab: Water Engineering: Design and Application	0	0	4	4	15	-	35	50	2
SEC-ENV-3P	Project-III	0	0	4	4	15	-	35	50	2
					30				**750**	**23**

J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA FARIDABAD

SCHEME OF STUDIES & EXAMINATIONS
B. TECH 2nd YEAR (SEMESTER – VI)
ENVIRONMENTAL ENGINEERING (2021-22)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits
		L	T	P	Total		Theory	Practical		
PCC-ENV-601	Solid and Hazardous Waste Management	3	0	0	3	25	75	-	100	3
PCC-ENV-602	Wastewater Engineering: Design and Application	3	0	0	3	25	75	-	100	3
PCC-ENV-603	Soil Pollution and Remediation	3	0	0	3	25	75	-	100	3
PCC-ENV-604	Environmental Pollution, Waste Management and Sanitation	3	0	0	3	25	75	-	100	3
	Programme Elective Course-II (PEC-II)	3	0	0	3	25	75	-	100	3
	Programme Elective Course-III (PEC-III)	3	0	0	3	25	75	-	100	3
PCC-ENV-605	Lab: Solid Waste Management	0	0	4	4	15	-	35	50	2
PCC-ENV-606	Lab: Wastewater Engineering: Design and Application	0	0	4	4	15	-	35	50	2
SEC-ENV-4P	Project-IV	0	0	4	4	15	-	35	50	2
					30				**750**	**24**

J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA FARIDABAD

SCHEME OF STUDIES & EXAMINATIONS
B. TECH 2nd YEAR (SEMESTER – VII)
ENVIRONMENTAL ENGINEERING (2021-22)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits
		L	T	P	Total		Theory	Practical		
PCC-ENV-701	Environmental Impact Assessment and Audit	3	0	0	3	25	75	-	100	3
PCC-ENV-702	Geotechnical Engineering	3	0	0	3	25	75	-	100	3
PCC-ENV-703	Industrial Waste Management	3	0	0	3	25	75	-	100	3
PCC-ENV-704	Environmental Health and Safety	3	0	0	3	25	75	-	100	3
	Programme Elective Course-IV (PEC-IV)	3	0	0	3	25	75	-	100	3
	Programme Elective Course-V (PEC-V)	3	0	0	3	25	75	-	100	3
	Open Elective Course-III	3	0	0	3	25	75	-	100	3
PCC-ENV-705	Lab: Geotechnical Engineering	0	0	2	2	15	-	35	50	1
PCC-ENV-706	Lab: Environmental Impact Assessment and Audit	0	0	2	2	15	-	35	50	1
SEC-ENV-5P	Project-V	0	0	4	4	15	-	35	50	2
					29				**850**	**25**

J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA FARIDABAD

SCHEME OF STUDIES & EXAMINATIONS
B. TECH 2nd YEAR (SEMESTER – VIII)
ENVIRONMENTAL ENGINEERING (2021-22)

Sl. No.	Course Title	Code	Hours per week			Sessional	End Semester	Total	Credits
			L	T	P				
1	Industrial Training with projects	SEC-ENV-5P	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

Semester-III

B.TECH. (ENVIRONMENTAL ENGINEERING) - SEMESTER III

PCC-ENV-301

ENVIRONMENTAL CHEMISTRY

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

At the completion of this course, the learner will be able to:

- **CO1** : Understand concepts of basic chemistry associated with the occurrence of environmental pollutants.
- **CO2** : Explore the chemical composition and interactions existed among the different constituents of environment
- **CO3** : To analyze the behavior of toxic chemical in environmental.
- **CO4** : To consider the interactions and chemical composition to control of pollutants in environment

UNIT I

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-II

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

UNIT-III

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.

Soil chemistry: Organic matter, nitrogen, phosphorous, potassium, cation exchange capacity, base saturation, and sodium absorption ratio.

UNIT IV

Green Chemistry: Basic principle and current trends in green chemistry; Atom economy concept and its environmental importance; Green reagents and Green solvents

Green technology and synthesis process: Microwave heating, Ultrasound technique, Industrial Ecology.

REFERENCE BOOKS:

1. Ahluwalia, V.K, (2017). Advance Environmental Chemistry. Teri Press Publisher
2. Baird, C. and Cann, M. (2012). *Environmental Chemistry*, 5th Edition, W.H. Freeman, USA.
3. Clark J. H. and Macquarrie, D. J. (2008). *Handbook of Green Chemistry and Technology*, Wiley-Blackwell, UK.
4. Connell D. W. (2005). *Basic concepts of Environmental Chemistry* 2nd Edition, CRC Press, USA.
5. Girard J. (2013). *Principles of Environmental Chemistry* 2nd Edition, James & Barlett Publishers, USA.

6. Harrison R M (2007). *Principles of Environmental Chemistry*, RSC Publishing, UK.
7. Hillel, D. (2008). *Soil in the Environment: Crucible of Terrestrial Life*, 1st edition, Academic Press, USA.
8. Lancaster M. (2002). *Green Chemistry: An Introductory Text*, RSC Publishing, UK.
9. Manahan, S. E. (2006). *Green chemistry and the ten commandments of sustainability*, 2nd Edition, Chem Char Inc. Publishers, USA.
10. Manahan, S. E. (2017). *Fundamentals of Environmental Chemistry*, 10th Edition, CRC Press, USA.
11. Manahan, S. E. (2017). *Water chemistry: green science and technology of nature's most renewable resource*, CRC Press, USA.
12. Subramanian, V. (2011). A Textbook of Environmental Chemistry, New Delhi: I.K International Publishing House.

B.TECH. (ENVIRONMENTAL ENGINEERING) - SEMESTER IV

PCC-ENV-302

INSTRUMENTATION TECHNIQUES FOR ENVIRONMENTAL MONITORING

NO. OF CREDITS: 4

L	T	P		
4	0	0	**SESSIONAL**	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

At the completion of this course, the learner will be able to:

- **CO1** : Understand the problem and identify suitable techniques to analyze the environmental samples.
- **CO2** : Explain and use suitable sampling methods for collection of different samples to perform physical, chemical and biological characterization of environmental pollutants.
- **CO3** : Appraise the principles, working and applications of the instrumental techniques used for analysis of physical, chemical and biological entities.
- **CO4** : Differentiate between the various analytical methods and capable to design method required for quantitative and qualitative analysis of environmental components.

UNIT I

Basics of Analytical Approach: Defining of Problem and Designing of Analytical Method; Sampling: Types and Methods for Solid, Liquid and Gaseous Matrix; Sample Storage; Sample Preparation; Measurement and Assessing of Data; Method Validation and Documentation;
Wet Chemical Methods: Titrimetry; Gravimetry

UNIT-II

Spectrometric Analytical Techniques: UV- Visible spectrophotometer, Flame photometry, atomic absorption spectrophotometry; Plasma Emission Spectroscopy; X-Ray Spectroscopy (X-Ray Fluorescence, X-Ray Diffraction); Fourier-transform Infrared Spectroscopy (FTIR); Nephelometry and Turbidimetry

UNIT-III

Chromatographic Techniques: Chromatographic Techniques (Paper Chromatography, Thin Layer Chromatography, Gas Liquid Chromatography, High Performance Liquid Chromatography, Ion-exchange Chromatography); Electrophoresis

UNIT IV

Microscopy Techniques: Optical Microscopy (Brightfield and Darkfield, Phase Contrast, Fluorescence, Confocal); Electron Microscopy (Scanning and Transmission Electron Microscopy)

REFERENCE BOOKS:

1. Hussain, C. M., & Kecili, R. (2019). *Modern Environmental Analysis Techniques for Pollutants*. Elsevier.
2. Khopkar, S.M. (2015). *Basic Concepts of Analytical Chemistry*. Wiley Eastern Ltd., New Delhi.
3. Mitra, S., & Kebbekus, B. B. (2018). *Environmental Chemical Analysis*. CRC Press.
4. Patnaik, P. (2017). *Handbook of Environmental Analysis: Chemical Pollutants in Air, Water, Soil, and Solid Wastes.* CRC Press.
5. Robinson, J. W., Frame, E. M. S., & Frame, G. M. (2014). *Undergraduate Instrumental Analysis*. CRC Press, New York

6. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2017). *Principles of Instrumental Analysis*. Cengage learning.
7. Willard, H.H., Merritt, L.L, Deen, J.A. and Settle, F.A. (2015). *Instrumental Methods of Analysis*. CBS Publishers and Distributers, New Dehi.

B.TECH. (ENVIRONMENTAL ENGINEERING) - SEMESTER III

PCC-ENV-303

STATISTICAL ANALYSIS AND ENVIRONMENTAL MODELLING

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

At the completion of this course, the learner will be able to:

- **CO1** : Obtain knowledge of probability and distributions and become capable of mathematical expectations.
- **CO2** : Acquire the skills of regression and correlation analysis, and development of statistical models and their use.
- **CO3** : Become capable of design of experiments for R&D work and testing of the related hypotheses.
- **CO4** : Understand of the environmental systems and their analysis and become acquainted with the widely used ecological and environmental models.

UNIT-I:

Basic elements and tools of statistical analysis, Measurement of central tendency and dispersion - mean, median, mode, range, standard deviation and variance, Basic concept of Probability theory, Distributions – Binomial, Poisson and Normal, T, F and chi square distributions, Measurement and distribution of attributes, sampling theory. Determinants and matrices, Systems of linear equations, Eigenvalues and eigenvectors

UNIT-II:

Types of errors, accuracy and precision, rounding off, significant figures, standard error of a mean, Hypothesis Testing - Test of significance, T-test, F-test, Q-test, rejection of data, bivariate data, Quality control charts. Functions, Limit, Continuity, Differentiability, Local maxima and minima, Taylor series, Tests for convergence, Definite and indefinite integrals, Application of definite integral to obtain area and volume, Partial and total derivatives

UNIT-III:

Relationship between variables, Correlation Analysis – Coefficient of correlation, rank correlation, Regression Analysis- principle of least squares, regression coefficient, Measure of skewness and kurtosis, ANOVA one way and two-way classification. Linear and non-linear first order ordinary differential equations (ODE), Higher order linear ODEs with constant coefficients, Cauchy's and Euler's equations, Laplace transform and its application in solving linear ODEs

UNIT-IV:

Introduction to environmental system analysis, Linear Simple and multiple Regression models, Models of Population growth and interactions - Lotka-Voltra Model and Leslie's matrix model, Point Source Stream Pollution model - Box model and Gaussian Plume Model, Advance models.

REFERENCE BOOKS:

1. C.S. Rao, *Environmental Pollution Control Engineering*, Wiley Eastern Ltd., New Age International Ltd., (1995).
2. Croxton, F.E. and Cowden, D.J. (1975): *Applied General Statistics*.
3. *Dynamics of Environmental Bioprocesses-Modelling and simulation-Snape and Dunn*.
4. *Environmental Modeling*– Jorgensen
5. *Fundamental of Statistics* – S.C. Gupta
6. Hoel, P.G. (1997). *Introduction to Mathematical Statistics.*
7. Hogg, R.V. and Raise, A.T. (1978): *Introduction to mathematical statistics*, Macmillan Pub. Co. Inc.
8. M. L. Marx and Richard Larsen *An introduction to mathematical statistics and its applications*.
9. S. C. Gupta and V. K. Kapoor, S. *Fundamental of Mathematical Statistics* –Chand &Sons Publisher.
10. *Statistical Methods* – S.P. Gupta S. Chand &Sons Publisher

B.TECH. (ENVIRONMENTAL ENGINEERING) - SEMESTER III
ESC-201
BASICS OF ELECTRONICS ENGINEERING
NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

At the completion of this course, the learner will be able to:

CO1: Understand the principles of semiconductor devices and their applications.
CO2: Design an application using operational amplifier.
CO3: Understand the working of timing circuits and oscillators.
CO4: Understand logic gates, flip flop as a building block of digital systems.
CO5: Learn the basics of Electronic communication system.

UNIT 1: 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 2: Operational amplifier and its applications:

Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in 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.

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

UNIT 3: Digital Electronics Fundamentals:

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

UNIT 4: 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.

TEXT /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

B.TECH. (ENVIRONMENTAL ENGINEERING) - SEMESTER III

ESC-203/21

ENGINEERING MECHANICS

NO. OF CREDITS: 4

L	**T**	**P**		
3	1	0	**SESSIONAL**	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

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

CO1: Understand the basic force system.
CO2: Apply principles of particle kinematics.
CO3: Grasp the concepts of particle dynamics.
CO4: Learn energy methods & momentum methods.
CO5: Learn Principles of Virtual work

UNIT 1:

Module 1: Introduction to Engineering Mechanics covering, Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static In-determinancy.

Module 2: Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

UNIT 2:

Module 3: Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines;

Module 4: Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia-Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

UNIT 3:

Module 5: Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

Module 6: Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

UNIT 4:

Module 7:Introduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation; Tutorials from the above modules covering, To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc apparatus; Helical block; To draw a load efficiency curve for a screw jack.

TEXT/REFERENCE BOOKS:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
7. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
8. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
10. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

B.TECH. (ENVIRONMENTAL ENGINEERING) - SEMESTER III

CODE: HSMC-01

EFFECTIVE TECHNICAL COMMUNICATION

NO. OF CREDITS: 3

L	**T**	**P**		
3	0	0	**SESSIONAL**	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

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

CO1: Generate the confidence to use written communication in work and personal experience beyond college.

CO2: Acquaint with the concept of a writer-reader relationship and identify the need for active participation from both writer and reader,

CO3: Acquaint with the skills needed to successfully communicate in a modern world through written materials.

UNIT 1:

Module 1: 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 2:

Module 2: 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 3:

Module 3: 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

Module 4: 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 4:

Module 5: 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. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4)
2. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York,2004
3. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN0312406843)
4. Raman Sharma, Technical Communications, Oxford Publication,London,2004.
5. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH NewDelhi2002.
6. Shiv Khera, You Can Win, Macmillan Books, NewYork,2003.
7. Xebec, Presentation Book, TMH New Delhi, 2000.(ISBN0402213)

B.TECH. (ENVIRONMENTAL ENGINEERING) - SEMESTER III

MC- 02

INDIAN CONSTITUTION OF INDIA

NO. OF CREDITS: 0

L	**T**	**P**		
2	0	0	**SESSIONAL**	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

CONSTITUTION OF INDIA– BASIC FEATURES AND FUNDAMENTAL PRINCIPLES

The Constitution of India is the supreme law of India. Parliament of India can not 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

REFERENCE BOOKS:

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

B.TECH. (ENVIRONMENTAL ENGINEERING) - SEMESTER III

PCC-ENV-304

LAB: COMPUTER-AIDED DESIGN (CAD) LAB

NO. OF CREDITS: 02

L	**T**	**P**		
0	0	4	**SESSIONAL**	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

At the completion of this course, the learner will be able to:

CO1 : Learn the techniques of 2D and 3D modelling using CAD software.
CO2 : Design surface and solid models using CAD software.
CO3 : Prepare jobs using CNC turning and machining centres.
CO4 : Inspect jobs using CMM and learn basics of robotics.

LIST OF EXPERIMENTS:

1. Introduction to CAD softwares and working with sketcher tools.
2. To generate 2D models using CAD software.
3. To generate 3D models using CAD software using commands; Round, Chamfer, Fillet, Pattern, Copy, Rotate, Move and Mirror.
4. Working with advanced modeling tools (Sweep, Blend, Variable section Sweep, Swept Blend & Helical Sweep).
5. Assembly modeling, Generating, editing and modifying drawings in CATIA/ Solid works/ ProE.
6. CAE of the cantilever beam with concentrated load and UDL.
   To perform facing and taper turning operations using CNC turning centre.
7. To perform milling and hole making operations using CNC machining centre.
8. To measure the dimension of prismatic component using CMM.
9. To measure the dimension of cylindrical component using CMM.
10. perform welding/pick-place/drawing operation using robotic assembly.

Note: At least ten experiments are to be performed in the semester. Eight experiments are to be performed from the above list and the rest may be designed/ conducted by the concerned department/institution.

B.TECH. (ENVIRONMENTAL ENGINEERING) - SEMESTER III

PCC-ENV-305
LAB: ENVIRONMENTAL CHEMISTRY AND INSTRUMENTATION LAB

NO. OF CREDITS: 2

L	T	P		
0	0	4	**SESSIONAL**	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

COURSE OUTCOMES:

At the completion of this course, the learner will be able to:

CO1: Prepare the solution of various concentrations used in analysis and trained in calculations.

CO2: Easy to access the quality of drinking water supply.

CO3: Identify water quality parameters and trained in water quality analysis.

CO4: Easily handle the water quality projects and able to solve the water quality problems.

LIST OF EXPERIMENTS:

1. To prepare the solution of different concentrations from solid and liquid chemical.
2. Determination of pH, EC and TDS of a given water sample
3. Determination of TS, TSS and TDS of a given water sample by gravimetric method.
4. Estimation of acidity and alkalinity of a given water sample. (Acid-base titration)
5. Determination of Total, hardness, calcium and magnesium content in water sample (Complexometric titration)
6. Determination of Chloride of a given water sample. (Precipitation titration)
7. Determination of Residual free chlorine in water sample.
8. Determination of cations (Na, K, Ca and Mg) in a given water/soil sample by using a Flame photometer
9. Determination the lambda max of the given compound by using UV-VIS spectrophotometer.
10. Estimation of Sulphate in water sample by using Nephelometer/ UV-VIS Spectrophotometer.
11. Determination of turbidity of given water sample using Nephelometer.
12. Determination of Uranium content in water sample using Fluorimetry.
13. Determination of Total Kjeldahl nitrogen in soil and water sample using Kjeldahl Apparatus.
14. Determination of Heavy metals in soil and water sample using MP-AES.
15. Group activity, Field visit and report submission

Note: This list of experiments is indicative. Addition and deletion in the list of experiments may be made from time to time by the department depending on the availability of resources.

REFERENCE BOOKS:

1. American Public Health Association (APHA) (2012). *Standard method for examination of water and wastewater*, 22nd edn. APHA, AWWA, WPCF, Washington.
2. Yadav, M. S. (2008). *Instrumental methods of chemical analysis*, Campus Books International. Delhi.
3. Quevauviller, P. (2006). *Analytical methods for drinking water: Advanced in sampling and analysis*, John Wiley Publisher.
4. Patnaik, P. (2010). *Handbook of environmental analysis: chemical pollutants in air, water, soil, and solid wastes*, London: CRC Press.

5. Nollet, L. M. L (2007). *Handbook of water analysis*, London: CRC Press.
6. Gupta, P. K. (2009). *Methods in environmental analysis water, soil and air*, Jodhpur: Agrobios.

Semester-IV

B.TECH. (ENVIRONMENTAL ENGINEERING) - SEMESTER IV

PCC-ENV-401

FLUID MECHANICS AND HYDRAULIC MACHINES

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

At the completion of this course, the learner will be able to:

CO1 : Understand basics of Fluid Mechanics and Machines
CO2 : Appraise about different laws of fluid mechanics
CO3 : Assess the performance parameters for hydraulic machinery.
CO4 : Develop competence with mass, energy and momentum for determining resultant forces on hydraulic structures

UNIT-I

Fluid Properties and Fluid Statics: Concept of fluid and flow, ideal and real fluids, continuum concept, properties of fluids, Newtonian and non-Newtonian fluids. Pascal's law, hydrostatic equation, hydrostatic forces on plane and curved surfaces, stability of floating and submerged bodies, relative equilibrium. Problems.

Fluid Kinematics: Eulerian and Lagrangian description of fluid flow; stream, streak and path lines; types of flows, flow rate and continuity equation, differential equation of continuity in cylindrical and polar coordinates, rotation, vorticity and circulation, stream and potential functions, flow net. Problems.

UNIT II

Fluid Dynamics: Concept of system and control volume, Euler's equation, Bernoulli's equation, venturimeter, orifices, orificemeter, mouthpieces, kinetic and momentum correction factors, Impulse momentum relationship and its applications. Problems.

Potential Flow: Uniform and vortex flow, flow past a Rankin half body, source, sink, source-sink pair and doublet, flow past a cylinder with and without circulation. Problems.

UNIT III

V***iscous Flow:*** Flow regimes and Reynold's number, Relationship between shear stress and pressure gradient, uni-directional flow between stationary and moving parallel plates, movement of piston in a dashpot, power absorbed in bearings. Problems.

Flow Through Pipes: Major and minor losses in pipes, Hagen-Poiseuilli law, hydraulic gradient and total energy lines, series and parallel connection of pipes, branched pipes; equivalent pipe, power transmission through pipes. Problems.

UNIT IV

Boundary Layer Flow: Boundary layer concept, displacement, momentum and energy thickness, von-karman momentum integral equation, laminar and turbulent boundary layer flows, drag on a flat plate, boundary layer separation and control. Streamlined and bluff bodies, lift and drag on a cylinder and an airfoil, Problems.

Turbulent Flow: Shear stress in turbulent flow, Prandtl mixing length hypothesis, hydraulically smooth and rough pipes, velocity distribution in pipes, friction coefficients for smooth and rough pipes. Problems.

TEXT BOOKS:

1. Fluid Mechanics – Streeter V L and Wylie E B, Mc Graw Hill
2. Mechanics of Fluids – I H Shames, Mc Graw Hill

REFERENCES BOOKS:

1. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas, TMH
2. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar, S.K. Kataria and Sons
3. Fluid Mechanics and Machinery – S.K. Agarwal, TMH, New Delhi

B.TECH. (ENVIRONMENTAL ENGINEERING) - SEMESTER IV
PCC-ENV-402
INDUSTRIAL PROCESSES AND POLLUTION CONTROL
NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:
At the completion of this course, the learner will be able to:

CO1 : Understand the industrial processes and sources of pollutants.
CO2 : Explain different pollutants and control mechanisms in different industries for management of pollutants.
CO3 : Appraise about the recent trends and cleaner technologies adopted in industries
CO4 : Compare industries specific processes, pollutants and their control measures.

UNIT I:
Various industrial processes, sources and types of pollutants- air pollutants, water pollutants, soil pollutants, solid waste, noise and radiations. Sources for industrial water usages and various industrial processes requiring water use and water quality. Processes responsible for deterioration in water and air quality

UNIT-II:
Various waste water streams, Control and removal of specific pollutants in industrial wastewaters, e.g., oil and grease, bio-degradable organics, chemical ls such as cyanide, fluoride, toxic organics, heavy metals, radioactivity etc. Wastewater re-uses & recycling, concept of zero discharge effluent.

UNIT-III:
Particulate and gaseous pollutant control; Hood and ducts, tall stacks; Solid waste generation and disposal management; Hazardous wastes: definitions, concepts and management aspects; Noise & radiation: generation, control and management.
Recent trends in industrial waste management, cradle to grave concept, life cycle analysis, clean technologies

UNIT IV:
Case studies of various industries covering sources, processes, pollutants and control measures: Automobile Manufacturing, Hazardous chemical manufacturing, Lubricating, Lead acid, Fire cracker manufacturing, Food processing, Dairy, Distillery, Sugar, Pulp and paper, Textile, Rubber, Asbestos and asbestos based, Pesticide manufacturing, Cement, Iron and steel, Metal plating, Thermal power plants

REFERENCE BOOKS:

1. Azad, H. S. Industrial wastewater management handbook. McGraw-Hill.
2. Freeman, H. M. (1995). Industrial pollution prevention handbook (pp. 581-582). New York: McGraw-Hill.

3. Ranade, V. V., & Bhandari, V. M. Industrial wastewater treatment, recycling and reuse. Butterworth-Heinemann.
4. Sell, N. J. Industrial pollution control: issues and techniques. John Wiley & Sons.
5. Sharma, S. K., & Sanghi, R. (Eds.). Wastewater reuse and management. Springer Netherlands.
6. Weiner, R., Matthews, R., & Vesilind, P. A. (2003). Environmental engineering. Butterworth-Heinemann.
7. Woodard, F. Industrial waste treatment handbook. Elsevier.

B.TECH. (ENVIRONMENTAL ENGINEERING) - SEMESTER IV
PCC-ENV-403
AIR & NOISE POLLUTION: MONITORING AND CONTROL
NO. OF CREDITS: 4

L	T	P		
4	0	0	**SESSIONAL**	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:
At the completion of this course, the learner will be able to:

CO1 : Understand the fundamentals of origin, impacts and control of different air pollutants.
CO2 : Explain the types, nature and behavior of air pollutants under the influence of atmospheric conditions.
CO3 : Appraise the monitoring techniques and control measures to curb the air pollution, considering the standards limits.
CO4 : Understand the technical aspects of sound waves and controlling methods for vibration and noise pollution.

UNIT I
Introduction to Air Pollution: World and Indian scenario; Sources and classification of air pollutants; Criteria Air Pollutants and their properties; Atmospheric Aerosols; Long Range Transport of Atmospheric Pollutants; Impacts of air pollutants on health, plants and materials; The Air (Prevention and Control of Pollution) Act, 1981 and its amendments, National Air Quality Standards

UNIT-II
Air pollutants sampling: Sedimentation, High-volume Filtration, Tape sampler, Impingement and Electrostatic precipitator; Collection of gaseous air pollutants: Grab sampling, Absorption in liquid, Adsorption on solids, Freeze out sampling; Indoor Air Monitoring.
Source Sampling: Representative sampling, isokinetic sampling, Flue gas analyzer principles for monitoring COx, NOx, SOx, Hydrocarbon.
Air Pollutants Dispersion and Modelling: Meteorological aspects of air pollutants dispersion, Plume behavior; Gaussian Plume Model, Line source model and Area source model.

UNIT-III
Particulate pollutants Control: Gravitational Settling Chambers, Cyclonic separator, Fabric filter System, Electrostatic precipitators, Wet scrubbers
Gaseous Pollutants Control: Absorption; spray chambers (and towers or columns), plate or tray towers, packed towers, and venturi scrubbers; Adsorption, Pressure-Swing Adsorption (PSA), Condensation: Surface and contact condensers; Combustion: Direct-flame, thermal and catalytic combustion
Vehicular Pollution Control: Air-Fuel ratio, Catalytic convertor: Selective catalytic reduction (SCR), Selective non-catalytic reduction (SCNR), Bharat Stage Emission Standards (BSES)

UNIT IV
Noise Pollution: Definition; Sources; Decibel Scale, Sound Pressure Level, Combining Decibel, Frequency Weighting Networks, Noise Indices (L10, L50, L90, Leq, LDN, TNI). Noise & vibration measurement and noise standards, Noise control and abatement measures: Active and Passive methods, Impact of noise and vibrations on human health.

REFERENCE BOOKS:

1. Bell, L.H. and Bell, D.H., 1994. *Industrial noise control: Fundamentals and applications.* New York.
2. Cheremisinoff, N.P., 2002. *Handbook of air pollution prevention and control*. Elsevier.
3. Clarke, A.G. ed., 2012. *Industrial air pollution monitoring*. Springer Science & Business Media.
4. Rao, C.S., 2007. *Environmental pollution control engineering.* New Age International.
5. Tiwary, A. and Williams, I., 2018. Air pollution: measurement, modelling and mitigation. CRC Press.
6. Vallero, D.A., 2014. *Fundamentals of air pollution*. Academic press.
7. Wang, L.K., Pereira, N.C. and Hung, Y.T. eds., 2005. *Advanced air and noise pollution control*. Totowa, NJ, USA: Humana Press.
8. Wark, K., Warner, C.F. and Wayne T, D., 1998. *Air pollution: its origin and control*. Addison-Wesley.

B.TECH. (ENVIRONMENTAL ENGINEERING) - SEMESTER IV
MCEVS-02
NATURAL RESOURCES AND BIODIVERSITY CONSERVATION
NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

At the completion of this course, the learner will be able to:

CO1: Illustrate types of resources and consequences of resource degradation.
CO2: Appraise the food and land resources and role of individual in conservation of resources.
CO3: Interpret ecological and social phenomena from a biodiversity view point.
CO4: Develop new conservation measures on new or endangered species in a given habitat.

UNIT-I:

Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems: Forest Resources: Use and Over-exploitation, deforestation. Case studies. Timber exaction mining, dams and their effects on forests and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams, benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

UNIT II:

Food Resources: World food Problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources; Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Case studies.

Land resources: Land as a resource, Soil profile and horizons, Soil formation and degradation, man induced landslides, soil erosion and desertification. Role of and individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT-III:

Biodiversity Uses, Threats and Conservation: Introduction- Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical aesthetic and option values. Biodiversity at global, National and local levels. India as a mega- diversity nation.

Hot-spots of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man- wildlife conflicts, Endangered and endemic species of India.

UNIT-IV:

Conservation of Biodiversity: In-situ and Ex-situ conservation of biodiversity, Special Projects for endangered species: Project tiger, Project Gir lion, Project elephant and Project crocodile. Role of WWF, IUCN, UNEP, Red Data Book in restoration of endangered species.

REFERENCE BOOKS:

1. Joshi, B.D., Tripathi, C.P.M and Joshi, P.C. Biodiversity and Environmental Management. APH, New Delhi, 2009.
1. Joshi, P.C. and Joshi, N. Biodiversity and conservation. APH Publishing Co-operation, New Delhi, 2009.
2. Fatik B. Mandal and Nepal C. Nandi. Biodiversity: Concepts, Conservation and Biofuture, Asian Books, 2013.

SUGGESTED WEB SOURCES:

1. http://envis.nic.in/ENVIS_html/ENVISSubject/subject.html
2. https://nptel.ac.in/courses/103/106/103106162/
3. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14
4. https://swayam.gov.in/

B.TECH. (ENVIRONMENTAL ENGINEERING) - SEMESTER IV
BSC-01
BIOLOGY
NO. OF CREDITS: 3

L	**T**	**P**		
3	0	0	**SESSIONAL**	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

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

CO1: Classify enzymes and distinguish between different mechanisms of enzyme action.
CO2: Identify DNA as a genetic material in the molecular basis of information transfer.
CO3: Analyse biological processes at the reductionist level
CO4: Apply thermodynamic principles to biological systems.
CO5: Identify and classify microorganisms.

Unit 1

Introduction: 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.

Unit 2

Classification: Purpose: To convey that classification per se is 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 utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic 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

UNIT 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.

UNIT 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.

UNIT 5

Enzymes: Purpose: To convey that without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalyzed 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.

UNIT 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.

UNIT 7

Macromolecular Analysis: Purpose: How to analyses biological processes at the reductionistic level Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

UNIT 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 CO_2 + H_2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge.

UNIT 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.

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, By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company.
4. Molecular Genetics, 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 Wm, C. Brown Publishers.

B.TECH. (ENVIRONMENTAL ENGINEERING) - SEMESTER IV
HSMC (H-102)
UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY
NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	: 25
			FINAL EXAM	: 75
			TOTAL	: 100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

This value-added course is for UG/PG students. It may be taught through digital aided learning/class room teaching. Its duration is 35 hours. Minimum 75% attendance is compulsory for students and its evaluation will be done by concerned Dept. through Viva-Voce examination/internal examination.

Pre-requisites: None. Universal Human Values 1 (desirable)

COURSE OUTCOMES:
At the completion of this course, the learner will be able to:

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.

Human Values Course
This course also discusses their role in their family. It, very briefly, touches issues related to their role in the society and the nature, which needs to be discussed at length in one more semester for which the foundation course named as "H-102 Universal Human Values 2: Understanding Harmony" is designed which may be covered in their III or IV semester. During the Induction Program, students would get and initial exposure to human values through Universal Human Values –I. This exposure is to be augmented by this compulsory full semester foundation course.

Universal Human Values 2: Understanding Harmony

Module-1: Course Introduction - Need, Basic Guidelines, Content and Process For Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; Natural Acceptance and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. 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

Module-2: Understanding Harmony In The Human Being – Harmony in Myself!

1. Understanding human being as a co-existence of the sentient ‗I' and the material ‗Body'
2. Understanding the needs of Self (‗I') and ‗Body' - happiness and physical facility
3. Understanding the Body as an instrument of ‗I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of ‗I' and harmony in ‗I'
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
6. 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.

Module-3: Understanding Harmony In The Family And Society Harmony In Human – Human Relationship

1. 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
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship

Module-4: Understanding Harmony in The Nature And Existence - Whole Existence As Coexistence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature.
3. Understanding Existence as Co-existence of mutually interacting units in all pervasive Space
4. 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.

Module-:5 Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. 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.
5. Case studies of typical holistic technologies, management models and production systems
6. 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
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

Course Outcomes: By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction. This is only an introductory foundational input. It would be desirable to follow it up by

a) faculty-student or mentor-mentee programs throughout their time with the institution
b) Higher level courses on human values in every aspect of living. e.g. as a professional

READINGS:

Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

REFERENCE BOOKS

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

ASSESSMENT

This is a compulsory non-credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:
Assessment by faculty mentor: 10 marks
Self –assessment: 10 marks
Assessment by peers: 10 marks
Socially relevant project/Group Activities/Assignments: 20 marks
Semester End Examination: 50 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

B.TECH. (ENVIRONMENTAL ENGINEERING) - SEMESTER IV
ENV-PCC-404
LAB: AIR QUALITY MONITORING
NO. OF CREDITS: 2

L	T	P		
0	0	4	**SESSIONAL**	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:
At the completion of this course, the learner will be able to:

CO1 : Explain the different methods followed for sampling and analysis of analysis of air pollutants.
CO2 : Appraise the quality of air and suggest management plans to control the air pollutants.
CO3 : Determine the air pollutants level in stationary sources and explain the dispersion pattern with reference to the meteorological conditions.
CO4 : Assess the noise level at different locations and the possible measures to control the noise level for minimizing the impacts

1. To study principle, components and working operation of Respirable Dust Sampler (RDS) for collection of respirable dust.
2. To study principle, components and working operation of Fine Dust Sampler for sampling.
3. Assessment of PM_{10} level in the ambient air.
4. Assessment of fine dust ($PM_{2.5}$) concentration in the outdoor environment.
5. Understanding of principle, component and working of gaseous sampler for sampling of gaseous air pollutants in surrounding air.
6. Determination of gaseous air pollutants concentration in the ambient air
   i. Oxides of Nitrogen (NO_x)
   ii. Oxides of Sulphur (SO_2)
   iii. Ammonia (NH_3)
   iv. Ozone (O_3)
7. Assessment of Ambient Air Quality and Air Quality Index (AQI) of the ambient air
8. Plot Wind Rose diagram to summarize meteorological condition.
9. Study of plume behavior in relation with wind velocity in your surrounding area.
10. Determination of SPM and gaseous pollutants concentration from stack emission of an industrial unit.
11. Determination of different noise indices (L_{10}, L_{50}, L_{90}, L_{eq}) at different locations (residential, industrial, commercial and silent zone) using Sound Level Meter.
12. Group Activity
13. Field Activity/ Visit and Report submission

Note: This list of experiments is indicative. Addition and deletion in the list of experiments may be made from time to time by the department depending on the availability of resources.

REFERENCE BOOKS:

1. Csuros, M. (2018*). Environmental sampling and analysis: lab manual.* Routledge.
2. Forbes, P. (2015). *Monitoring of air pollutants: sampling, sample preparation and analytical techniques.* Elsevier.
3. Gupta, P. K. (2018). *Methods in environmental analysis: water, soil and air,* 2nd Edition). Jodhpur, India: Agrobios Publication.

4. Hess-Kosa, K. (2018). *Indoor air quality: the latest sampling and analytical methods*. CRC press.
5. Lodge Jr, J. P. (2017). *Methods of air sampling and analysis.* 3rd Edition, CRC Press.
6. Maiello, M. L., & Hoover, M. D. (Eds.). (2019). *Radioactive air sampling methods*, 1st Edition, CRC press.
7. Patnaik, P. (2017). *Handbook of environmental analysis: chemical pollutants in air, water, soil, and solid wastes*, 3rd Edition, CRC Press

B.TECH. (ENVIRONMENTAL ENGINEERING) - SEMESTER IV

PCC-ENV-405

LAB: FLUID MECHANICS AND HYDRAULIC MACHINES

NO. OF CREDITS: 2

L	**T**	**P**		
0	0	4	**SESSIONAL**	: 15
			FINAL EXAM	: 35
			TOTAL	: 50

LIST OF EXPERIMENTS:

1. To determine the coefficient of impact for vanes.
2. To determine coefficient of discharge of an orifice meter.
3. To determine the coefficient of discharge of Notch (V and Rectangular types).
4. To determine the friction factor for the pipes.
5. To determine the coefficient of discharge of venturimeter.
6. To determine the coefficient of discharge, contraction & velocity of an orifice.
7. To verify the Bernoulli's Theorem.
8. To find critical Reynolds number for a pipe flow.
9. To determine the meta-centric height of a floating body.
10. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
11. To show the velocity and pressure variation with radius in a forced vertex flow.

Note: This list of experiments is indicative. Addition and deletion in the list of experiments may be made from time to time by the department depending on the availability of resources.

J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA FARIDABAD

SCHEME OF STUDIES & EXAMINATIONS
B.TECH. 3RD YEAR (SEMESTER-V)
ENVIRONMENTAL ENGINEERING (2021-22)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits
		L	T	P	Total		Theory	Practical		
PCC-ENV-501	Engineering and Environmental Surveying	3	0	0	3	25	75	-	100	3
PCC-ENV-502	Engineering Hydrology	3	0	0	3	25	75	-	100	3
PCC-ENV-503	Water Engineering: Design and Application	3	0	0	3	25	75	-	100	3
PCC-ENV-504	Environmental Microbiology	3	0	0	3	25	75	-	100	3
PCC-ENV-505	Engineering Economics	3	0	0	3	25	75	-	100	3
	Programme Elective Course-I (PEC-I)	3	0	0	3	25	75	-	100	3
MC-04	Message of Bhagwat Gita	2	0	0	2	25	75	-	100	0
PCC-ENV-506	Lab: Engineering and Environmental Surveying	0	0	2	2	15	-	35	50	1
PCC-ENV-507	Lab: Water Engineering: Design and Application	0	0	4	4	15	-	35	50	2
SEC-ENV-3P	Project-III	0	0	4	4	15	-	35	50	2
					30				**750**	**23**

J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA FARIDABAD

SCHEME OF STUDIES & EXAMINATIONS
B.TECH. 3RD YEAR (SEMESTER-VI)
ENVIRONMENTAL ENGINEERING (2021-22)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits
		L	T	P	Total		Theory	Practical		
PCC-ENV-601	Solid and Hazardous Waste Management	3	0	0	3	25	75	-	100	3
PCC-ENV-602	Wastewater Engineering: Design and Application	3	0	0	3	25	75	-	100	3
PCC-ENV-603	Soil Pollution and Remediation	3	0	0	3	25	75	-	100	3
PCC-ENV-604	Environmental Pollution, Waste Management and Sanitation	3	0	0	3	25	75	-	100	3
	Programme Elective Course-II (PEC-II)	3	0	0	3	25	75	-	100	3
	Programme Elective Course-III (PEC-III)	3	0	0	3	25	75	-	100	3
PCC-ENV-605	Lab: Solid Waste Management	0	0	4	4	15	-	35	50	2
PCC-ENV-606	Lab: Wastewater Engineering: Design and Application	0	0	4	4	15	-	35	50	2
SEC-ENV-4P	Project-IV	0	0	4	4	15	-	35	50	2
					30				**750**	**24**

J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCAFARIDABAD

SCHEME OF STUDIES & EXAMINATIONS

B. TECH 2nd YEAR (SEMESTER – VII) ENVIRONMENTAL ENGINEERING (2021-22)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits
		L	T	P	Total		Theory	Practical		
PCC-ENV-701	Environmental Impact Assessment and Audit	3	0	0	3	25	75	-	100	3
PCC-ENV-702	Geotechnical Engineering	3	0	0	3	25	75	-	100	3
PCC-ENV-703	Industrial Waste Management	3	0	0	3	25	75	-	100	3
PCC-ENV-704	Environmental Health and Safety	3	0	0	3	25	75	-	100	3
	Programme Elective Course-IV (PEC-IV)	3	0	0	3	25	75	-	100	3
	Programme Elective Course-V (PEC-V)	3	0	0	3	25	75	-	100	3
	Open Elective Course-III	3	0	0	3	25	75	-	100	3
PCC-ENV-705	Lab: Geotechnical Engineering	0	0	2	2	15	-	35	50	1
PCC-ENV-706	Lab: Environmental Impact Assessment and Audit	0	0	2	2	15	-	35	50	1
SEC-ENV-5P	Project-V	0	0	4	4	15	-	35	50	2
					29				**850**	**25**

J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCAFARIDABAD

SCHEME OF STUDIES & EXAMINATIONS

B. TECH 2nd YEAR (SEMESTER – VIII) ENVIRONMENTAL ENGINEERING (2021-22)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits
		L	T	P	Total		Theory	Practical		
SEC-ENV-5P	Industrial Training with projects	0	0	30	30	150	-	350	500	10*

* Including 02 credit or 20% weightage for project

PROGRAMME ELECTIVE COURSES (PEC)

PROGRAMME ELECTIVE COURSES-I (PEC-I) Semester-V

Sr. No.	Code	Name of the Course	Contact Hours	Credit
1.	PEC-ENV-501	Green Technology	3	3
2.	PEC-ENV-502	Surface and Ground Water Pollution	3	3
3.	PEC-ENV-503	Engineering Analysis and Design	3	3

PROGRAMME ELECTIVE COURSES-II & III (PEC-II & III) Semester-VI

Sr. No.	Code	Name of the Course	Contact Hours	Credit
1.	PEC-ENV-601	Climate Change and CDM	3	3
2.	PEC-ENV-602	Environmental Policies and Laws	3	3
3.	PEC-ENV-603	Non-Conventional Energy Systems	3	3
4.	PEC-ENV-604	Disaster Management	3	3
5.	PEC-ENV-605	Environmental and Sustainable Development	3	3
6.	PEC-ENV-606	Environmental Toxicology and Risk Assessment	3	3

PROGRAMME ELECTIVE COURSES-IV & V (PEC-IV & V) Semester-VII

Sr. No.	Code	Name of the Course	Contact Hours	Credit
1.	PEC-ENV-701	Water Resource Systems	3	3
2.	PEC-ENV-702	Engineering Geology, GIS and Remote Sensing	3	3
3.	PEC-ENV-703	Water and Soil Conservation	3	3
4.	PEC-ENV-704	Irrigation and Drainage Engineering	3	3
5.	PEC-ENV-705	Advance Surveying	3	3
6.	PEC-ENV-706	Environmental Nanotechnology	3	3

SEMESTER- V

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER V

PCC-ENV-501

ENGINEERING AND ENVIRONMENTAL SURVEYING

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

- Demonstrate a comprehensive understanding of surveying principles and techniques.
- Conduct a wide range of surveys for engineering projects.
- Apply surveying techniques to environmental assessments and monitoring.
- Analyze and interpret survey data for decision-making.
- Understanding proficiency in using surveying instruments and software.

Unit 1: Fundamentals of Surveying

Introduction to surveying: Definitions, basic concepts, and principles. Surveying instruments: Types, components, and uses. Measurement of distances: Chain surveying, tape measurements, and electronic distance measurement (EDM). Measurement of angles: Compass surveying, theodolite measurements, and trigonometric levelling. Errors in surveying: Types of errors, error propagation, and error adjustment.

Unit 2: Engineering Surveys

Types of surveys: Plane surveying, geodetic surveying, and cadastral surveying. Alignment surveys: Layout and alignment of roads, railways, and canals. Setting out of structures: Building layout, foundation marking, and structural alignment. Control surveys: Horizontal and vertical control networks, triangulation, and trilateration. Advanced surveying techniques: Total station, global positioning system (GPS), and geographic information system (GIS) applications in engineering surveys.

Unit 3: Levelling and Contouring

Levelling: Differential levelling, profile levelling, and fly levelling. Instruments used in levelling: Levelling staff, dumpy level, digital level, and automatic level. Contouring: Methods of contouring, interpolation of contours, and contour maps. Earthwork calculations: Volume computations, mass haul diagrams, and cut-fill calculations. Digital terrain modelling: Introduction to DTM, data acquisition, and terrain analysis.

Unit 4: Environmental Surveys

Environmental impact assessment: Purpose, process, and methodologies. Soil and groundwater surveys: Sampling techniques, laboratory analysis, and contamination assessment. Noise and air quality surveys:

Noise measurement, sound propagation, and air pollution monitoring. Ecological surveys: Biodiversity assessment, habitat mapping, and ecological impact analysis. Environmental monitoring: Long-term monitoring programs, data analysis, and management strategies.

TEXT/REFERENCES BOOK:

1. "Surveying and Levelling" by T.P. Kanetkar and S.V. Kulkarni.
2. "Surveying: Theory and Practice" by S.K. Duggal.
3. "Surveying: Principles and Applications" by B.C. Punmia, Ashok Kumar Jain, and Arun Kumar Jain.
4. "Elementary Surveying: An Introduction to Geomatics" by Charles D. Ghilani and Paul R. Wolf.
5. "Surveying: A Manual of Underground Surveying" by Grant Smith and D.J. Thorne.
6. "Surveying for Engineers" by J.Uren and W.F. Price.

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER V

PCC-ENV-502

ENGINEERING HYDROLOGY

NO. OF CREDITS: 3

L	**T**	**P**		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

- Understand the principles and components of hydrology.
- Apply hydrograph analysis techniques to interpret and analyze hydrological data.
- Estimate various methods to estimate runoff and design flood control measures.
- Analyze and manage groundwater resources.
- Apply hydrological knowledge in engineering projects.

Unit 1: Introduction to Hydrology

Introduction to hydrology: Scope, importance, and components of the hydrological cycle. Precipitation: Types, measurement, and analysis of precipitation data. Evapotranspiration: Concepts, factors affecting evapotranspiration, and estimation methods. Infiltration: Processes, factors affecting infiltration, and estimation techniques. Streamflow: Types of streamflow, stream gauging, and streamflow measurements.

Unit 2: Hydrological Analysis

Hydrograph analysis: Characteristics of hydrographs, unit hydrograph theory, and synthetic unit hydrographs. Rainfall-runoff modeling: Conceptual and empirical methods for rainfall-runoff transformation. Flood frequency analysis: Frequency distribution models, probability concepts, and flood estimation techniques. Drought analysis: Drought indices, severity analysis, and drought management strategies. Reservoir and channel routing: Principles of reservoir routing and channel routing methods.

Unit 3: Surface Water Hydrology

Surface water measurements: Measurement of flow in channels, weirs, and flumes. Watershed characteristics: Basin morphology, morphometric analysis, and watershed delineation. Runoff estimation: Rational method, SCS curve number method, and time-area method. Flood routing: Muskingum method, hydrologic routing, and hydraulic routing. Surface water management: Principles of reservoir design, flood control measures, and erosion control techniques.

Unit 4: Groundwater Hydrology

Groundwater occurrence and properties: Aquifers, porosity, permeability, and groundwater storage.

Groundwater exploration: Methods of groundwater exploration, drilling techniques, and well design. Groundwater flow: Darcy's law, hydraulic conductivity, groundwater flow equations, and flow nets. Well hydraulics: Steady-state and transient flow to wells, pumping tests, and aquifer parameters determination. Groundwater management: Groundwater recharge methods, groundwater pollution, and groundwater modeling.

TEXT/REFERENCES BOOK:

1. "Engineering Hydrology" by K. Subramanya.
2. "Hydrology and Water Resources Engineering" by Santosh Kumar Garg.
3. "Hydrology for Engineers" by Ray K. Linsley, Max A. Kohler, and Joseph L. H. Paulhus.
4. "Applied Hydrology" by Ven Te Chow, David R. Maidment, and Larry W. Mays.
5. "Introduction to Hydrology" by Warren Viessman Jr. and Gary L. Lewis.
6. "Hydrology and Floodplain Analysis" by Philip B. Bedient, Wayne C. Huber, and Baxter E. Vieux.

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER V

PCC-ENV-503

WATER ENGINEERING: DESIGN AND APPLICATION

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

- Understand the fundamentals of water engineering and its applications.
- Design water supply systems effectively.
- Apply wastewater engineering principles for effective treatment and management.
- Manage stormwater effectively and plan urban drainage systems.
- Address climate change challenges in water engineering.

Unit 1:

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

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

Unit 2:

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.

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

Unit 3:

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 4:

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER V

PCC-ENV-504

ENVIRONMENTAL MICROBIOLOGY

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

- Understand the fundamentals of environmental microbiology.
- Apply knowledge of microorganisms in environmental engineering.
- Demonstrate proficiency in environmental microbiology techniques.
- Identify the types of microbial pathogens and their transmission routes.
- Recognize the importance of microbial monitoring and surveillance in environmental systems.

Unit 1: Introduction to Environmental Microbiology

Introduction to environmental microbiology: Scope, importance, and role in environmental engineering. Microbial taxonomy and classification: Classification of microorganisms, identification methods, and microbial diversity. Microbial growth and nutrition: Growth requirements, microbial metabolism, and microbial interactions. Microbial ecology: Microbial habitats, microbial communities, and ecological interactions. Microbial biofilms: Formation, structure, and significance in environmental systems.

Unit 2: Microorganisms in Environmental Engineering

Microbial degradation of pollutants: Microbial transformation and degradation of organic and inorganic pollutants. Wastewater microbiology: Microorganisms in wastewater treatment processes, activated sludge systems, and anaerobic digestion. Bioremediation: Microbial processes in bioremediation, types of bioremediation, and applications in environmental cleanup. Microbial indicators of water quality: Microbial source tracking, fecal indicator bacteria, and waterborne pathogens. Microbial corrosion: Microbiologically influenced corrosion (MIC) and control measures.

Unit 3: Environmental Microbiology Techniques

Microbial enumeration: Techniques for microbial quantification, including plate counts, MPN, and filtration methods. Microbial identification: Molecular techniques such as PCR, DNA sequencing, and FISH for microbial identification. Microbial activity measurement: Microbial respiration tests, enzyme assays, and biomass estimation techniques. Microbial community analysis: Culture-dependent and culture-independent methods for analyzing microbial communities. Microbial bioassays: Toxicity testing using microorganisms, bioassay methods, and their applications.

Unit 4: Microorganisms and Environmental Health

Microorganisms and disease transmission: Waterborne, foodborne, and airborne microbial pathogens. Microbial risk assessment: Principles of microbial risk assessment, exposure assessment, and risk management. Microbial control in water and wastewater treatment: Disinfection techniques, UV treatment, and chlorine resistance. Microbial monitoring and surveillance: Monitoring strategies for microbial contamination in environmental systems. Emerging trends in environmental microbiology: Microbial biotechnology, microbial fuel cells, and microbial nanotechnology.

TEXT/REFERENCES BOOK:

1. "Environmental Microbiology" by D.R. Kalaichelvan and V. Senthamilselvi.
2. "Environmental Microbiology: A Laboratory Manual" by Neelam Rup Prakash.
3. "Environmental Microbiology: From Genomes to Biogeochemistry" by Eugene L. Madsen.
4. "Environmental Microbiology" by Ian L. Pepper, Charles P. Gerba, and Terry J. Gentry.
5. "Microbiology of Drinking Water Production and Distribution" by Gabriel Bitton.
6. "Environmental Microbiology: Fundamentals and Applications" by Jean-Claude Bertrand, Pierre Caumette, and Philippe Lebaron.

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER V

PCC-ENV-505

ENGINEERING ECONOMICS

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

- Understand the fundamental concepts of engineering economics.
- Analyze project costs and estimate project cash flows.
- Apply decision criteria and evaluation techniques to make project selection decisions.
- Perform financial evaluation using various methods and assess the cost of capital.
- Evaluate economic sustainability in engineering projects.

Unit 1: Introduction to Engineering Economics

Introduction to engineering economics: Definition, scope, and importance. Time value of money: Future value, present value, and cash flow diagrams. Interest and interest formulas: Simple interest, compound interest, and effective interest rate. Economic equivalence: Equivalence principles, time equivalence, and cost equivalence. Comparison methods: Present worth analysis, future worth analysis, and annual worth analysis.

Unit 2: Cost Estimation and Analysis

Cost concepts: Types of costs, cost classification, and cost estimation techniques. Cost indices and inflation: Price indices, inflation rates, and their impact on project costs. Cost analysis techniques: Incremental analysis, break-even analysis, and sensitivity analysis. Depreciation and taxes: Depreciation methods, tax implications, and after-tax cash flow analysis. Project cash flow analysis: Cash flow diagrams, net present value (NPV), and internal rate of return (IRR).

Unit 3: Engineering Decision Making

Decision criteria: Payback period, profitability index, and benefit-cost ratio. Capital budgeting: Capital budgeting process, project evaluation techniques, and capital rationing. Risk and uncertainty analysis: Decision trees, expected value analysis, and sensitivity analysis under uncertainty. Replacement analysis: Equipment replacement decisions, economic life, and replacement analysis techniques. Economic optimization: Optimization techniques, constraint analysis, and optimization models in engineering projects.

Unit 4: Project Financing and Economic Analysis

Financing sources: Equity financing, debt financing, and project financing options. Financial evaluation methods: Return on investment (ROI), payback period, and profitability indicators. Cost of capital:

Weighted average cost of capital (WACC), cost of equity, and cost of debt. Economic analysis of public projects: Social cost-benefit analysis, externalities, and public-private partnership (PPP). Economic sustainability: Economic indicators, triple bottom line analysis, and sustainable development in engineering projects.

TEXT/REFERENCES BOOK:

1. "Engineering Economics" by R. Panneerselvam.
2. "Engineering Economics and Financial Accounting" by A. Ramachandra Aryasri.
3. "Engineering Economics" by D. Upadhyay.
4. "Engineering Economy" by William G. Sullivan, Elin M. Wicks, and C. Patrick Koelling.
5. "Engineering Economic Analysis" by Donald G. Newnan, Ted G. Eschenbach, and Jerome P. Lavelle.
6. "Principles of Engineering Economic Analysis" by John A. White, Kenneth E. Case, and David B. Pratt.

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER V

PCC-ENV-506

LAB: ENGINEERING AND ENVIRONMENTAL SURVEYING

NO. OF CREDITS: 1

L	**T**	**P**		
0	0	2	**SESSIONAL**	**:**15
			FINAL EXAM	**:**35
			TOTAL	**:**50

COURSE OUTCOMES:

- Introduction to Chain Surveying and Compass Surveying.
- Plane Table Surveying – Radiation, intersection, Traverse, Resection Leveling.
- Tacheometry and Theodolite survey
- 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 levelling 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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER V

PCC-ENV-507

LAB: WATER ENGINEERING: DESIGN AND APPLICATION

NO. OF CREDITS: 2

L	**T**	**P**		
0	0	4	**SESSIONAL**	**:** 15
			FINAL EXAM	**:** 35
			TOTAL	**:** 50

COURSE OUTCOMES:

- Understand the fundamental principles and concepts of water engineering and its applications.
- Apply engineering techniques and tools for analysing the water quality parameters.
- Conduct experiments and tests to assess water quality.

List of Experiments:

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

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.

PROGRAMME ELECTIVE COURSES (PEC)

PROGRAMME ELECTIVE COURSES-I (PEC-I) Semester-V

1. PEC-ENV-501 Green Technology.
2. PEC-ENV-502 Surface and Ground Water Pollution.
3. PEC-ENV-503 Engineering Analysis and Design.

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER V
PEC-ENV-501
GREEN TECHNOLOGY

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

- Understand the concepts and principles of green technology and sustainable development.
- Evaluate and analyze renewable energy technologies and their applications.
- Design and develop green buildings using energy-efficient systems and sustainable materials.
- Develop strategies and techniques for effective waste management and recycling.
- Apply green technology principles and practices to address environmental challenges and promote sustainability.

Unit 1: Introduction to Green Technology

Definition and Scope of Green Technology. Principles and Concepts of Sustainable Development. Environmental Challenges and the Need for Green Technology. Life Cycle Assessment and Environmental Impact Analysis. Green Technology Innovations and Applications.

Unit 2: Renewable Energy Technologies

Solar Energy Systems and Technologies. Wind Energy Systems and Technologies. Biomass Energy Systems and Technologies. Hydroelectric Power Systems and Technologies. Geothermal Energy Systems and Technologies.

Unit 3: Green Building Design and Materials

Principles of Green Building Design. Energy-Efficient Building Systems and Techniques. Sustainable. Building Materials and Technologies. Green Building Certification Systems (e.g., LEED, GRIHA). Case Studies of Green Building Projects

Unit 4: Waste Management and Recycling

Waste Management Techniques and Strategies**.** Solid Waste Management and Recycling. E-Waste Management and Recycling. Industrial Waste Management and Pollution Prevention. Circular Economy and Sustainable Waste Management.

TEXT/REFERENCE BOOKS:

1. "Green Technology: An Introduction" by M.O. Garg and Anu Garg
2. "Sustainable Development and Green Technology" by P. Ramesh Babu
3. "Green Building: Concepts and Techniques" by Raja Rizwan Hussain
4. "Introduction to Green Technology: Concepts, Energy and Sustainability" by Desheng Dash Wu and Mohammad Shahidehpour
5. "Renewable Energy Technologies: A Practical Guide for Beginners" by Chetan Singh Solanki
6. "Green Building: Guidebook for Sustainable Architecture" by Michael Bauer

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER V

PEC-ENV-502

SURFACE AND GROUND WATER POLLUTION

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

- Understand the principles and concepts of surface and groundwater pollution.
- Identify and assess the sources, causes, and impacts of water pollution.
- Evaluate and apply methods for monitoring and assessing water quality.
- Design and implement strategies for surface and groundwater pollution control and management.
- Analyze and interpret water pollution data, and develop sustainable solutions for water resource protection.

Unit 1: Introduction to Water Pollution

Definition and Types of Water Pollution. Sources and Causes of Surface and Groundwater Pollution. Impacts of Water Pollution on Ecosystems and Human Health. Water Quality Standards and Regulations. Monitoring and Assessment of Water Pollution.

Unit 2: Surface Water Pollution

Types and Characteristics of Surface Water Pollutants. Point Source and Non-point Source Pollution. Eutrophication and Harmful Algal Blooms. Industrial Discharges and Effluent Treatment. Surface Water Quality Management and Restoration.

Unit 3: Groundwater Pollution

Groundwater Contaminants and Transport Mechanisms. Contaminant Fate and Transport Modeling. Sources and Remediation of Contaminated Groundwater. Groundwater Quality Monitoring and Assessment. Groundwater Protection and Management Strategies.

Unit 4: Water Pollution Control and Management

Water Treatment Technologies and Processes. Sustainable Stormwater Management. Watershed Management and Best Management Practices. Water Pollution Control Policy and Planning. Case Studies of Water Pollution Control and Management Projects.

TEXT/REFERENCE BOOKS:

1. "Water Pollution: Causes, Effects and Control" by Abdul Malik
2. "Environmental Pollution and Control" by P.A. Lakshmi Narayanan and P. Lakshmi
3. "Groundwater Pollution: Theory, Methodology, Modelling, and Practical Rules" by Prabhata K. Swamee.
4. "Water Pollution: Causes, Effects and Solutions" by N. Magdoff and H. Van Es
5. "Principles of Water Quality Control" by T.V. Ramachandra and R. Karthik
6. "Groundwater Contamination: Sources, Management, and Remediation" by Neven Kresic

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER V

PEC-ENV-503

ENGINEERING ANALYSIS AND DESIGN

NO. OF CREDITS: 3

L	**T**	**P**		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

- Apply mathematical methods and techniques for engineering analysis and problem-solving.
- Analyze and design structures using principles of mechanics and structural analysis.
- Analyze and design thermal and fluid systems, including energy systems and heat transfer applications.
- Analyze and design electrical circuits and systems, including electronic components and digital logic.
- Apply engineering analysis and design principles to solve complex engineering problems.

Unit 1: Mathematical Methods for Engineering Analysis

Vector Calculus and Differential Equations. Matrix Algebra and Linear Systems. Complex Analysis and Fourier Series. Numerical Methods for Engineering Analysis. Optimization Techniques.

Unit 2: Structural Analysis and Design

Statics and Mechanics of Materials**.** Analysis of Trusses, Beams, and Frames. Structural Loads and Load Combinations. Design of Structural Elements: Steel, Concrete, and Timber. Structural Stability and Foundation Design.

Unit 3: Thermal and Fluid Systems Analysis

Thermodynamics and Heat Transfer Principles. Analysis of Energy Systems: Power Plants, HVAC, and Refrigeration.

Unit 4: Fluid Mechanics

Fluid Mechanics and Fluid Flow Analysis. Analysis of Piping Systems and Heat Exchangers. Design of Thermal and Fluid Systems

TEXT/REFERENCE BOOKS:

1. "Engineering Mathematics" by B.S. Grewal
2. "Structural Analysis: Theory and Practice" by S.S. Bhavikatti
3. "Thermal Engineering: Concepts and Applications" by R.K. Rajput
4. "Circuit Theory: Analysis and Synthesis" by A. Chakrabarti
5. "Electrical and Electronics Measurements and Instrumentation" by A.K. Sawhney
6. "Advanced Engineering Mathematics" by Erwin Kreyszig
7. "Structural Analysis" by R.C. Hibbeler
8. "Thermodynamics: An Engineering Approach" by Yunus A. Cengel and Michael A. Boles
9. "Electric Circuits" by James W. Nilsson and Susan A. Riedel
10. "Microelectronic Circuits" by Adel S. Sedra and Kenneth C. Smith

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

SEMESTER – VI

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VI

PCC-ENV-601

SOLID AND HAZARDOUS WASTE MANAGEMENT

NO. OF CREDITS: 3

L	**T**	**P**		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

- Understand the concepts and principles of solid and hazardous waste management.
- Identify and assess the characteristics and impacts of solid and hazardous wastes.
- Evaluate and implement strategies for waste collection, segregation, and storage.
- Design and manage solid waste treatment and disposal systems.
- Develop plans and policies for the effective management of hazardous wastes.

Unit 1: Introduction to Solid and Hazardous Waste Management

Definition and Classification of Solid and Hazardous Wastes. Generation, Composition, and Characteristics of Solid and Hazardous Wastes. Environmental and Health Impacts of Improper Waste Management. Solid and Hazardous Waste Regulations and Policies. Sustainable Solid and Hazardous Waste Management Practices.

Unit 2: Solid Waste Collection, Segregation, and Storage

Solid Waste Collection Systems and Equipment. Waste Segregation and Source Reduction Techniques. Storage and Transport of Solid Wastes. Waste Bin Design and Placement. Community Participation and Awareness Programs.

Unit 3: Solid Waste Treatment and Disposal

Waste Treatment Technologies: Composting, Incineration, and Anaerobic Digestion. Landfill Design, Operation, and Closure. Leachate and Gas Management in Landfills. Integrated Solid Waste Management Systems. Case Studies of Successful Solid Waste Management Projects.

Unit 4: Hazardous Waste Management

Identification and Classification of Hazardous Wastes. Hazardous Waste Storage, Transportation, and Labeling. Hazardous Waste Treatment Technologies: Physical, Chemical, and Biological. Hazardous Waste Landfill Design and Operation. Risk Assessment and Remediation of Contaminated Sites.

TEXT/REFERENCES BOOK:

1. "Solid Waste Management: Principles and Practice" by A. Dasgupta
2. "Hazardous Waste Management: An Introduction" by Khanna and Arora
3. "Municipal Solid Waste Management: Processing, Energy Recovery, Global Examples" by J. Sathish Kumar
4. "Solid Waste Engineering: A Global Perspective" by William A. Worrell and P. Aarne Vesilind
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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VI

PCC-ENV-602

WASTEWATER ENGINEERING: DESIGN AND APPLICATIONS

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

- Understand the principles and concepts of wastewater engineering and treatment.
- Assess and analyze the characteristics and composition of wastewater.
- Design and evaluate wastewater collection and conveyance systems.
- Design and analyze wastewater treatment processes and systems.
- Apply wastewater treatment principles to ensure effluent compliance and explore wastewater reuse options.

Course Contents:

Unit: 1

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. Physio-chemical and biological treatment strategies and their evaluation.

Unit: 2

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

Unit: 3

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: 4

Indian standards for disposal of treated wastewaters on land and in natural streams, Treated wastewater reclamation and reuse. Recent technologies of treatment. 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.
5. Qasim, S.R., Motley, E.M., and Zhu, G. "Water Works Engineering", Prentice Hall Publication.
6. CPHEEO "Manual on Sewerage & Sewage Treatment", Ministry of urban development, Government of India, New Delhi.
7. Parker, H. "Wastewater System Engineering", Prentice Hall.
8. Garg, S.K. "Environmental Engineering Vol. II (Sewage Disposal and Air Pollution Engineering)", Khanna Publishers.
9. 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
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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VI

PCC-ENV-603

SOIL POLLUTION AND REMEDIATION

NO. OF CREDITS: 3

L	**T**	**P**		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

- Understand the principles and concepts of soil pollution and its impacts on the environment and human health.
- Identify and assess the sources, causes, and behavior of soil contaminants.
- Apply soil sampling and analysis techniques for contaminant assessment and risk evaluation.
- Evaluate and select appropriate soil remediation techniques for contaminated sites.
- Develop strategies and practices for sustainable soil management and pollution prevention.

Unit 1: Introduction to Soil Pollution

Definition and Types of Soil Pollution. Sources and Causes of Soil Pollution. Contaminants and their Behavior in Soil. Impacts of Soil Pollution on Ecosystems and Human Health. Soil Pollution Regulations and Remediation Guidelines.

Unit 2: Soil Contaminants and Analysis

Major Classes of Soil Contaminants: Heavy Metals, Organic Pollutants, and Pesticides. Sampling and Analysis Techniques for Soil Contaminants. Soil Quality Assessment and Risk Assessment Methods. Fate and Transport of Contaminants in Soil. Emerging Contaminants and Soil Pollution Issues

Unit 3: Soil Remediation Techniques

Physical Remediation Techniques: Soil Aeration, Excavation, and Soil Washing. Chemical Remediation Techniques: Soil Stabilization and Soil Flushing. Biological Remediation Techniques: Phytoremediation and Bioremediation. Integrated Approaches to Soil Remediation. Case Studies of Successful Soil Remediation Projects

Unit 4: Soil Management and Sustainable Practices

Soil Conservation and Erosion Control Measures. Soil Amendments and Nutrient Management. Sustainable Agriculture and Soil Health. Soil Reclamation and Land Restoration. Best Management Practices for Soil Pollution Prevention

TEXT/REFERENCES BOOK:

1. "Soil Pollution and Soil Protection" by Virendra Kumar Mishra
2. "Soil Pollution and Its Control" by P.D. Dwivedi
3. "Soil Pollution: Origin, Monitoring & Remediation" by S.K. Srivastava
4. "Soil Pollution: Processes and Dynamics" by R. Naidu, S.S. Kookana, and G.M. Pierzynski
5. "Principles and Practices of Soil Science: Soil Pollution" by Rattan Lal and Manoj K. Shukla
6. "Soil Remediation and Plants: Prospects and Challenges" by Khalid Hakeem, Munir Ozturk, and Nafees A. Khan

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VI

PCC-ENV-604

ENVIRONMENTAL POLLUTION, WASTE MANAGEMENT AND SANITATION

NO. OF CREDITS: 3

L	**T**	**P**		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OUTCOMES:

- Understand the principles and concepts of environmental pollution, waste management, and sanitation.
- Identify and assess the sources, causes, and impacts of pollution on the environment and human health.
- Evaluate and implement strategies for pollution control and management.
- Design and analyze waste management systems, including solid waste treatment and sanitation infrastructure.
- Develop plans and policies for sustainable environmental management, waste reduction, and sanitation improvement.

Unit 1: Introduction to Environmental Pollution

Definition and Types of Environmental Pollution. Sources and Causes of Pollution (Air, Water, and Soil). Impacts of Pollution on Ecosystems and Human Health. Environmental Regulations and Policies. Environmental Monitoring and Assessment.

Unit 2: Air and Water Pollution

Air Pollution: Sources, Effects, and Control Measures. Water Pollution: Sources, Effects, and Control Measures. Water Quality Parameters and Standards. Water and Wastewater Treatment Technologies. Air and Water Quality Monitoring and Management.

Unit 3: Solid Waste Management

Solid Waste Generation and Composition. Collection, Segregation, and Storage of Solid Waste. Waste Treatment and Disposal: Landfills, Incineration, and Recycling. Extended Producer Responsibility and Waste Reduction Strategies. Solid Waste Management Policies and Practices.

Unit 4: Sanitation and Sustainable Practices

Importance of Sanitation and Public Health. Types and Technologies of Sanitation Systems. Sanitation Infrastructure and Design Considerations. Sustainable Sanitation: Reuse and Resource Recovery. Hygiene Education and Behavior Change for Sanitation Improvement.

TEXT/REFERENCES BOOK:

1. "Environmental Pollution Control Engineering" by C.S. Rao
2. "Solid Waste Management: Principles and Practice" by A. Dasgupta
3. "Sanitation: Water and Environmental Engineering Aspects" by Santosh K. Gupta and Sudhir Kumar Gupta
4. "Environmental Pollution and Control" by P.A. Lakshmi Narayanan and P. Lakshmi
5. "Solid Waste Engineering: A Global Perspective" by William A. Worrell and P. Aarne Vesilind
6. "Sanitation: Sustainable Sanitation in Cities" by Arno Rosemarin, Nelson Ekane, and Peter Baccini

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VI

PCC-ENV-605

LAB: SOLID WASTE MANAGEMENT

NO. OF CREDITS: 2

L	**T**	**P**		
0	0	4	**SESSIONAL**	**:**15
			FINAL EXAM	**:**35
			TOTAL	**:**50

COURSE OUTCOMES:

- Understand the principles and concepts of solid waste management.
- Analyze and characterize different types of solid waste.
- Design and implement waste management strategies and techniques.
- Evaluate and assess the environmental and economic impacts of waste management practices.

LIST OF EXPERIMENTS:

1. Solid Waste Characterization and Composition Analysis
2. Estimation of Solid Waste Generation Rates
3. Segregation and Classification of Solid Waste
4. Moisture Content Determination in Solid Waste
5. Density Measurement of Solid Waste
6. Composting of Organic Waste
7. Vermicomposting of Biodegradable Waste
8. Analysis of Landfill Leachate
9. Design and Construction of a Simple Composting Bin
10. Construction and Evaluation of a Waste Sorting Station
11. Analysis of Landfill Gas Composition
12. Determination of Heavy Metal Content in Solid Waste
13. Waste to Energy Conversion Experiment
14. Waste Minimization and Recycling Assessment
15. Life Cycle Assessment of Waste Management Options

TEXT/REFERENCE BOOKS:

1. "Solid Waste Management: Principles and Practice" by A. Dasgupta
2. "Solid Waste Management: Assessment, Regulations and Engineering" by R.K. Dhir
3. "Solid Waste Engineering: Principles and Management" by G.L. Sivakumar Babu and K. Ganeshamoorthy
4. "Solid Waste Engineering: A Global Perspective" by William A. Worrell and P. Aarne Vesilind
5. "Integrated Solid Waste Management: Engineering Principles and Management Issues" by George Tchobanoglous, Hilary Theisen, and Samuel Vigil
6. "Municipal Solid Waste Management: Processing, Energy Recovery, Global Examples" by J. Sathish Kumar

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VI

PCC-ENV-606

LAB: WASTEWATER ENGINEERING: DESIGN AND APPLICATION

NO. OF CREDITS: 2

L	**T**	**P**		
0	0	4	**SESSIONAL**	**:**15
			FINAL EXAM	**:**35
			TOTAL	**:**50

COURSE OUTCOMES:

- Understand the principles and concepts of wastewater engineering.
- Analyze and characterize wastewater in terms of its physical, chemical, and biological properties.
- Design and evaluate wastewater treatment processes and systems.
- Assess and analyze the performance and efficiency of wastewater treatment technologies.

LIST OF EXPERIMENTS:

1. Determination of Wastewater Characteristics (pH, BOD, COD, etc.)
2. Settling Tests for Sedimentation Tank Design
3. Jar Test for Coagulation-Flocculation Process
4. Analysis of Activated Sludge Process (MLSS, MLVSS, SVI)
5. Determination of Sludge Volume Index (SVI)
6. Design and Operation of Trickling Filter
7. Determination of Chlorine Demand in Wastewater
8. Operation of Anaerobic Digester for Sludge Treatment
9. Design and Performance Evaluation of Wastewater Stabilization Ponds
10. Design and Operation of SBR & MBR
11. Analysis of Nutrients (Nitrogen and Phosphorus) in Wastewater

TEXT/REFERENCE BOOKS:

1. "Wastewater Engineering: Treatment and Reuse" by Metcalf & Eddy, G. R. Tchobanoglous, H. D. Stensel, and R. T. Tsuchihashi
2. "Wastewater Treatment: Concepts and Design Approach" by Karia and Christian
3. "Wastewater Engineering: Design Principles and Practice" by M. A. Shukla and C. S. P. Ojha
4. "Wastewater Engineering: Treatment and Resource Recovery" by G. Tchobanoglous, F. L. Burton, and H. D. Stensel
5. "Principles and Practices of Water and Wastewater Treatment Processes" by George Tchobanoglous, Franklin L. Burton, and H. David Stensel
6. "Wastewater Engineering: Treatment Disposal and Reuse" by M. A. Metcalf, Eddy, and Harrison P. Eddy

PROGRAMME ELECTIVE COURSES (PEC)

PROGRAMME ELECTIVE COURSES-II & III (PEC-II & III) Semester-VI

1. PEC-ENV-601 Climate Change and CDM
2. PEC-ENV-602 Environmental Policies and Laws
3. PEC-ENV-603 Non-Conventional Energy Systems
4. PEC-ENV-604 Disaster Management
5. PEC-ENV-605 Environmental and Sustainable Development
6. PEC-ENV-606 Environmental Toxicology and Risk Assessment

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VI
PEC-ENV-601
CLIMATE CHANGE AND CDM

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

OUTCOMES:

- Understand the concepts and principles of climate change and its impacts.
- Analyze the Clean Development Mechanism (CDM) and its project cycle.
- Evaluate carbon markets, finance, and investment in climate change projects.
- Analyze climate change policies, sustainable development goals, and adaptation strategies.
- Apply knowledge to address climate change challenges and develop sustainable solutions.

Unit 1: Introduction to Climate Change

Climate Change Science and Global Warming. Greenhouse Gases and their Sources. Climate Change Impacts and Vulnerabilities. Climate Change Mitigation and Adaptation Strategies. International Climate Change Agreements and Protocols

Unit 2: Clean Development Mechanism (CDM)

Basics of CDM and its Objectives. CDM Project Cycle: Design, Validation, and Registration. CDM Project Types: Renewable Energy, Energy Efficiency, Waste Management, etc.. CDM Methodologies and Baseline Development. Monitoring, Verification, and Certification of CDM Projects

Unit 3: Carbon Market and Carbon Finance

Carbon Markets: Voluntary and Compliance Markets. Carbon Credits and Carbon Offsetting. Carbon Finance and Investment in Climate Change Projects. Carbon Pricing and Emission Trading Systems. Carbon Market Instruments and Mechanisms.

Unit 4: Climate Change Policy and Sustainable Development

National and International Climate Change Policy Frameworks. Climate Change Adaptation and Resilience Strategies. Sustainable Development Goals (SDGs) and Climate Change. Climate Change Communication and Stakeholder Engagement. Case Studies of Successful Climate Change and CDM Projects.

TEXT/REFERENCE BOOKS

1. "Climate Change and Carbon Markets: A Handbook of Emissions Reduction Mechanisms" by Mohit Arora
2. "Climate Change and Sustainable Development" by N. H. Ravindranath and Jayant A. Sathaye
3. "Understanding Climate Change: Science, Policy, and Practice" by Sarah L. Burch and Sara E. Harris
4. "Carbon Trading in China: Environmental Discourse and Politics" by Alex Lo and Xuemei Bai
5. "The Carbon Market in China: Environmental Governance and Practice" by Richard G. Smith and Fei Teng

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VI

PEC-ENV-602

ENVIRONMENTAL POLICIES AND LAWS

NO. OF CREDITS: 3

L	**T**	**P**		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

OUTCOMES:

- Understand the concepts and principles of environmental policies and laws.
- Analyze the legal framework for environmental protection and conservation.
- Evaluate the implementation and enforcement of environmental laws and regulations.
- Assess the roles and responsibilities of different stakeholders in environmental decision-making.
- Apply knowledge to address contemporary environmental issues and challenges.

Unit 1: Introduction to Environmental Policies and Laws

Definition and Importance of Environmental Policies and Laws. International Environmental Conventions and Agreements. National Environmental Policies and Action Plans. Environmental Governance and Institutions. Role of Stakeholders in Environmental Decision-making.

Unit 2: Environmental Laws and Regulations

Constitutional and Legal Framework for Environmental Protection. Key Environmental Laws and Acts in India. Environmental Impact Assessment (EIA) and Environmental Clearance Process. Pollution Control Laws and Regulations. Forest and Wildlife Conservation Laws.

Unit 3: Implementation and Enforcement of Environmental Laws

Environmental Compliance and Monitoring. Roles and Responsibilities of Regulatory Agencies. Judicial System and Environmental Adjudication. Environmental Auditing and Inspection. Citizen Participation and Public Interest Litigation.

Unit 4: Contemporary Issues in Environmental Policies and Laws

Climate Change Policy and Regulation. Biodiversity Conservation and Access and Benefit Sharing (ABS). Waste Management Policies and Regulations. Sustainable Development Goals (SDGs) and Environmental Policies. Case Studies of Environmental Policy Implementation and Challenges.

TEXT/REFERENCE BOOKS

1. "Environmental Law and Policy in India: Cases, Materials, and Statutes" by Shyam Divan and Armin Rosencranz
2. "Environmental Law in India: Cases, Materials, and Statutes" by Prof. Dr. S. Krishnamurthy
3. "Environmental Law and Policy in India" by P. Leelakrishnan
4. "Environmental Law: Examples and Explanations" by Steven Ferrey
5. "Environmental Law and Policy" by James Salzman and Barton H. Thompson Jr.
6. "Environmental Law and Policy" by Richard L. Revesz and Philippe Sands

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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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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VI

PEC-ENV-603

NON- CONVENTIONAL ENERGY SYSTEMS

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

OUTCOMES:

- Understand the principles and concepts of non-conventional energy systems.
- Analyze and evaluate different non-conventional energy sources.
- Design and analyze solar energy systems and wind energy systems.
- Evaluate biomass and other non-conventional energy technologies.
- Apply knowledge to develop sustainable energy solutions using non-conventional energy sources.

Unit 1: Introduction to Non-Conventional Energy Sources

Definition and Importance of Non-Conventional Energy Systems. Solar Energy: Photovoltaics and Solar Thermal Systems. Wind Energy: Wind Turbines and Wind Farms. Biomass Energy: Biofuels and Biogas Systems. Geothermal Energy and Ocean Energy Systems.

Unit 2: Solar Energy Systems

Solar Radiation and Solar Resource Assessment. Solar Photovoltaic Systems: Components and Design. Solar Thermal Systems: Collectors and Applications. Solar Water Heating Systems and Solar Distillation. Solar Power Plants: Concentrated Solar Power (CSP) and Solar Tower Systems.

Unit 3: Wind Energy Systems

Wind Resource Assessment and Wind Speed Measurements. Wind Turbine Components and Characteristics. Wind Farm Layout and Siting Considerations. Wind Power Generation and Integration into the Grid. Offshore Wind Energy Systems and Emerging Technologies.

Unit 4: Biomass and Other Non-Conventional Energy Systems

Biomass Conversion Technologies: Combustion, Gasification, and Pyrolysis. Biofuels: Production, Processing, and Applications. Biogas Systems: Anaerobic Digestion and Bio methanation. Geothermal Energy Systems: Geothermal Heat Pumps and Power Generation. Ocean Energy Systems: Tidal Power, Wave Energy, and Ocean Thermal Energy Conversion (OTEC).

TEXT/REFERENCE BOOKS

1. "Non-Conventional Energy Systems" by G.D. Rai
2. "Renewable Energy Sources and Emerging Technologies" by B.K. Hodge
3. "Non-Conventional Energy Resources" by S.P. Sukhatme
4. "Renewable and Efficient Electric Power Systems" by Gilbert M. Masters
5. "Renewable Energy: Power for a Sustainable Future" by Godfrey Boyle
6. "Wind Energy Explained: Theory, Design and Application" by James F. Manwell, Jon G. McGowan, and Anthony L. Rogers

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VI

PEC-ENV-604

DISASTER MANAGEMENT

NO. OF CREDITS: 3

L	**T**	**P**		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

OUTCOMES:

- Understand the concepts and principles of disaster management.
- Analyze and assess the risks and vulnerabilities associated with different types of disasters.
- Design and implement disaster preparedness and response plans.
- Evaluate and implement strategies for disaster recovery, rehabilitation, and risk reduction.
- Apply knowledge to develop sustainable and resilient communities.

Unit 1: Introduction to Disaster Management

Definition, Types, and Classification of Disasters. Disaster Risk and Vulnerability Assessment. Disaster Management Cycle: Preparedness, Response, Recovery, and Mitigation. Role of National and International Agencies in Disaster Management. Disaster Management Policies, Strategies, and Frameworks.

Unit 2: Disaster Preparedness and Response

Emergency Planning and Preparedness. Early Warning Systems and Communication Strategies. Search and Rescue Operations. Emergency Medical Services and First Aid. Psychological Support and Trauma Management.

Unit 3: Disaster Recovery and Rehabilitation

Damage Assessment and Needs Analysis. Shelter and Infrastructure Restoration. Livelihood Restoration and Economic Recovery. Community Engagement and Participation. Post-Disaster Recovery Planning and Implementation.

Unit 4: Disaster Risk Reduction and Resilience

Risk Assessment and Risk Reduction Strategies. Climate Change and Disaster Risk. Sustainable Development and Resilience. Disaster Management and Urban Planning. Case Studies of Successful Disaster Management Practices.

TEXT/REFERENCE BOOKS

1. "Disaster Management: Principles and Practices" by R. B. Singh
2. "Disaster Management: Warning Response and Community Relocation" by Vinod K. Sharma
3. "Disaster Management: Concepts, Strategies, and Case Studies" by Tushar Bhattacharya
4. "Introduction to International Disaster Management" by Damon P. Coppola
5. "Disaster Risk Management: Systems Analysis and Modeling" by Christopher J. Schmidtlein, William H. Hooke, and Walter Hays
6. "Introduction to Emergency Management" by George Haddow, Jane Bullock, and Damon P. Coppola

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VI

PEC-ENV-605

ENVIRONMENTAL AND SUSTAINABLE DEVELOPEMENT

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

OUTCOMES:

- Understand the concepts and principles of environmental and sustainable development.
- Analyze the interrelationship between environment, society, and economy.
- Evaluate and apply strategies for environmental conservation and biodiversity.
- Design and assess sustainable development practices and policies.
- Apply knowledge to promote environmental governance and sustainable solutions.

Unit 1: Introduction to Environmental and Sustainable Development

Definition and Scope of Environmental and Sustainable Development. Interrelationship between Environment, Society, and Economy. Environmental Challenges and Global Sustainable Development Goals (SDGs). Environmental Ethics and Principles of Sustainable Development. Role of Stakeholders in Environmental and Sustainable Development.

Unit 2: Environmental Conservation and Biodiversity

Conservation of Natural Resources: Water, Forests, and Wildlife. Biodiversity Conservation and Ecosystem Services. Protected Areas and Wildlife Management. Sustainable Agriculture and Agroecology. Sustainable Forestry and Sustainable Fishing Practices.

Unit 3: Sustainable Development Strategies

Renewable Energy and Energy Efficiency. Sustainable Transport and Green Infrastructure. Sustainable Urban Development and Smart Cities. Circular Economy and Waste Management. Sustainable Consumption and Production Patterns.

Unit 4: Environmental Policies and Governance

National and International Environmental Policies and Agreements. Environmental Impact Assessment (EIA) and Environmental Clearance. Corporate Social Responsibility (CSR) and Environmental Reporting. Environmental Laws, Regulations, and Enforcement. Role of NGOs and Civil Society in Environmental Governance.

TEXT/REFERENCE BOOKS

1. "Environmental Studies: From Crisis to Cure" by Rajagopalan
2. "Environmental Management: Principles and Practice" by Anil Kumar De and Debarati De
3. "Sustainable Development: Principles, Policies, and Practices" by A. K. Bansal
4. "Environmental and Natural Resource Economics" by Thomas H. Tietenberg and Lynne Lewis
5. "Principles of Sustainable Development" by Robert Van Der Straeten and Willy Verstraete
6. "Sustainability: A Comprehensive Foundation" by Tom Theis and Jonathan Tomkin

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VI

PEC-ENV-606

ENVIRONMENTAL TOXICOLOGY AND RISK ASSESSMENT

NO. OF CREDITS: 3

L	**T**	**P**		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

OUTCOMES:

- Understand the concepts and principles of environmental toxicology and risk assessment.
- Analyze and evaluate the toxicology of environmental contaminants.
- Apply risk assessment methodologies for environmental pollutants.
- Evaluate and manage risks associated with environmental toxicology.
- Apply knowledge to address environmental health challenges and develop risk mitigation strategies.

Unit 1: Introduction to Environmental Toxicology

Definition and Scope of Environmental Toxicology. Sources and Fate of Environmental Pollutants. Routes of Exposure and Toxicokinetic. Mechanisms of Toxicity and Adverse Health Effects. Biomarkers and Bioindicators in Environmental Toxicology.

Unit 2: Toxicology of Environmental Contaminants

Heavy Metal Toxicology: Lead, Mercury, Arsenic, and Cadmium. Pesticide Toxicology: Organochlorines, Organophosphates, and Herbicides. Air Pollutant Toxicology: Particulate Matter, VOCs, and PAHs. Water Pollutant Toxicology: Chlorinated Solvents and Endocrine Disruptors. Emerging Contaminants and Nanotoxicology.

Unit 3: Risk Assessment and Management

Hazard Identification and Dose-Response Assessment. Exposure Assessment: Environmental Monitoring and Modeling. Risk Characterization and Risk Communication. Ecological Risk Assessment and Human Health Risk Assessment. Risk Management Strategies and Regulatory Frameworks.

Unit 4: Case Studies and Applications

Case Studies of Environmental Contaminant Exposure and Health Impacts. Environmental Toxicology in Occupational Health and Safety. Risk Assessment for Environmental Remediation and Waste Management. Risk Assessment for Food and Drug Safety. Toxicity Testing Methods and Alternatives.

TEXT/REFERENCE BOOKS

1. "Introduction to Environmental Toxicology" by Sundaravadivelu, T.
2. "Textbook of Environmental Toxicology and Chemistry" by Venugopal, V.
3. "Casarett and Doull's Toxicology: The Basic Science of Poisons" by Curtis D. Klaassen, John B. Watkins III, and Casarett & Doull
4. "Principles of Environmental Toxicology" by I. Shaw and J. Chadwick
5. "Environmental Toxicology and Chemistry" by D. G. Crosby, B. L. Fossato, and B. M. Greenberg.

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

SEMESTER- VII

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VII

PCC-ENV-701

ENVIRONMENTAL IMPACT ASSESSMENT AND AUDIT

NO. OF CREDITS: 3

L	**T**	**P**		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

OUTCOMES:

- Explain the fundamental principles and concepts of Environmental Impact Assessment (EIA) and Environmental Audits.
- Apply various methodologies and techniques for conducting EIA, including data collection, analysis, and impact assessment.
- Differentiate between different types of environmental audits and understand their role in ensuring environmental compliance and management.
- Plan and conduct an environmental audit, including setting objectives, collecting data, analyzing findings, and producing audit reports.
- Analyze real-world case studies and apply EIA and audit principles to assess potential environmental impacts, propose mitigation measures, and make informed decisions.

Unit 1:

Introduction to Environmental Impact Assessment (EIA), Understanding the concept of EIA and its importance, Historical development and evolution of EIA, International and national regulations and frameworks for EIA, Steps involved in the EIA process, Screening, scoping, and baseline studies in EIA,

Unit 2:

EIA Methodologies and Techniques, Different methodologies for conducting EIA, Data collection and analysis techniques for EIA, Predictive modeling and environmental simulations, Assessment of impacts on various environmental components (air, water, soil, biodiversity, social aspects, etc.), Mitigation measures and their integration into the EIA process

Unit 3:

Environmental Audit Process, Introduction to environmental audits and their significance, Types of environmental audits: compliance, management systems, performance, Legal and regulatory requirements for environmental audits, Establishing audit criteria and objectives, Conducting audits: planning, fieldwork, data analysis, and reporting

Unit 4:

Case Studies and Practical Applications, Real-world case studies of successful and unsuccessful EIA projects, Role of stakeholders and public participation in EIA and audits, Environmental risk assessment and management, Integrating EIA and audits into project planning and decision-making, Emerging trends in EIA and future prospects

TEXT/REFERENCE BOOKS

1. "Environmental Impact Assessment: Theory and Practice" by Peter Wathern
2. "Environmental Impact Assessment: A Guide to Best Professional Practices" by Charles H. Eccleston and Anne E. Lennard
3. Canter, L. W. (1996). "Environmental Impact Assessment." McGraw-Hill.
4. Wood, C. (2003). "Environmental Impact Assessment: A Comparative Review." Pearson Education.

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VII

PCC-ENV-702

GEOTECHNICAL ENGINEERING

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

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.

OUTCOMES:

- Understand basic terminology of geotechnical Engineering, soil classification and laboratory tests to determine properties of different types of soils
- Examine the interaction between soil and water systems to understand capillary flow, permeability and seepage
- Apply the weight-volume relationships for compaction and consolidation of soils
- Analyse the stresses in the soil system due to applied loads
- Learn the shear strength and earth pressure theories for slope stability analysis
- 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)

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VII

PCC-ENV-703

INDUSTRIAL WASTE MANAGEMENT

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

OUTCOMES:

- Explain the various types and sources of industrial waste and their environmental implications.
- Analyze and apply waste minimization strategies and pollution prevention techniques in industrial processes.
- Understand different methods of industrial waste treatment and disposal, and assess their advantages and limitations.
- Interpret and apply relevant regulations and standards governing industrial waste management.
- Evaluate the sustainability of industrial waste management practices and propose solutions based on circular economy principles.

Unit 1:

Introduction to Industrial Waste Management, Understanding the significance of industrial waste management, Types and sources of industrial waste: hazardous, non-hazardous, solid, liquid, gaseous, Environmental and health impacts of improper waste management, Regulatory frameworks and standards for industrial waste disposal

Unit 2:

Waste Minimization and Source Reduction, Principles of waste minimization and pollution prevention, Design for environment (DfE) concepts in industrial processes, implementing cleaner production techniques to reduce waste generation, Case studies on successful waste minimization strategies

Unit 3:

Treatment and Disposal of Industrial Waste, Overview of treatment methods: physical, chemical, biological, Effluent treatment and wastewater management, Solid waste treatment technologies: recycling, incineration, landfilling, Emerging trends in waste-to-energy conversion, Challenges and considerations in selecting appropriate treatment methods

Unit 4:

Industrial Waste Regulations and Sustainability, International and national regulations on industrial waste management, Role of government agencies and enforcement of waste disposal regulations, Corporate social responsibility and sustainable waste management practices, Life cycle assessment (LCA) for evaluating environmental impacts of waste management options, Circular economy principles and their application in industrial waste management

TEXT/REFERENCE BOOKS

1. "Hazardous Waste Management" by Michael D. LaGrega, Phillip L. Buckingham, and Jeffrey C. Evans
2. "Industrial Waste Treatment Handbook" by Woodard & Curran, Inc.
3. Tchobanoglous, G., Theisen, H., & Vigil, S. (2018). "Integrated Solid Waste Management: Engineering Principles and Management Issues." McGraw-Hill Education.
4. Agamuthu, P. (2019). "Solid Waste Management: Principles and Practice." Springer.

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VII

PCC-ENV-704

ENVIRONMENTAL HEALTH AND SAFETY

NO. OF CREDITS: 3

L	**T**	**P**		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

OUTCOMES:

- Understand the fundamental concepts of Environmental Health and Safety (EHS) and its role in protecting public health and the environment.
- Analyze the relationship between environmental factors and their impact on human health, and propose mitigation strategies.
- Apply principles of EHS management systems and compliance to various industries and sectors.
- Develop emergency preparedness and response plans, considering potential environmental hazards.
- Evaluate real-world case studies to assess the effectiveness of EHS practices and propose improvements.

Unit 1: Introduction to Environmental Health and Safety (EHS), Understanding the concept of EHS and its importance in various sectors, Historical development and evolution of EHS principles, Link between environmental factors, public health, and safety, Role of regulations and standards in EHS management

Unit 2: Environmental Health and Public Health, Overview of environmental factors affecting public health (air, water, soil pollution), Health risk assessment and epidemiological studies, Indoor air quality and its impact on human health, Occupational health and safety: hazards, exposure assessment, and prevention

Unit 3: Environmental Management Systems and Compliance, Introduction to Environmental Management Systems (EMS), ISO 14001: Structure, requirements, and benefits, Environmental auditing and compliance assessment, Integrating safety management into the EMS framework

Unit 4: Emergency Preparedness and Response, identifying potential environmental and safety emergencies, Developing emergency response plans and procedures, Hazardous material handling and transportation regulations, Case studies of successful and unsuccessful emergency response situations

TEXT/REFERENCE BOOKS

1. "Introduction to Environmental Health" by Jerome Nriagu
2. "Environmental Health and Safety Audits" by Lawrence B. Cahill
3. Friis, R. H. (2018). "Essentials of Environmental Health." Jones & Bartlett Learning.
4. Gitlow, H. S. (2016). "Introduction to Total Productive Maintenance (TPM)." 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

PCC-ENV 705 GEOTECHNICAL 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. termination of water content of a given moist soil sample by (i) oven drying method, (ii) pycnometer method.
2. termination of specific gravity of a given soil sample by (i) density bottle, (ii) pycnometer method.
3. termination of in situ dry density of soil mass by (i) core-cutter method, (ii) sand replacement method.
4. termination of relative density of a given soil sample.
5. termination of complete grain size distribution of a given soil sample by sieve analysis and sedimentation (hydrometer) analysis.
6. termination of consistency limits (liquid, plastic and shrinkage limits) of the soil sample.
7. fy 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. termination of compaction characteristics (OMC & MDD) of a given soil sample.
9. termination of permeability of a remolded soil sample by constant head &/or falling head method.
10. rmination of consolidation characteristics of a remolded soil sample by an oedometer test.
11. ermination of shear strength characteristics of a given soil sample by U/U test from Tri-axial Compression Machine.
12. eving 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-ENV 706 ENVIRONMENTAL IMPACT ASSESSMENT AND AUDIT 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. "Aquatic Ecosystem Assessment: A Case Study of Water Quality Impacts"
2. "Forest Biodiversity Monitoring and Impact Assessment"
3. "Urban Air Pollution Assessment and Mitigation Strategies"
4. "Soil Contamination Analysis: Impacts on Agricultural Productivity"
5. "Waste Management Efficiency Audit: Reducing Environmental Footprint"
6. "Noise Pollution Assessment in Industrial Zones"
7. "Renewable Energy Integration: Environmental and Economic Impacts"
8. "Habitat Restoration and Wildlife Monitoring for Sustainable Development"
9. "Coastal Erosion and Climate Change Resilience Evaluation"
10. "E-waste Recycling Assessment: Minimizing Environmental Hazards"

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

References:

1. Environmental Impact Assessment Methodologies by Y. Anjaneyulu
2. Environmental Impact Assessment: Theory and Practice by N. K. Uberoi
3. Environmental Impact Assessment in India: An Appraisal by P. S. Ramakrishnan and others
4. Foreign author:
5. Environmental Impact Assessment by Larry Canter and Sadhan Kumar Ghosh
6. Environmental Impact Assessment: A Guide to Best Professional Practices by Charles H. Eccleston and Charles A. Sadler
7. Environmental Impact Assessment: Practical Solutions to Recurrent Problems by Lawrence B. Cahill

PROGRAMME ELECTIVE COURSES (PEC)

PROGRAMME ELECTIVE COURSES-IV & V (PEC-IV & V) Semester-VII

1. PEC-ENV-701 Water Resource System
2. PEC-ENV-702 Engineering Geology, GIS and Remote Sensing
3. PEC-ENV-703 Water and Soil Conservation
4. PEC-ENV-704 Irrigation and Drainage Engineering
5. PEC-ENV-705 Advanced Surveying
6. PEC-ENV-706 Environmental Nanotechnology

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VII
PEC-ENV-701
WATER RESOURCE SYSTEM

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

OUTCOMES:

- Understand the principles of hydrology and hydrological modeling.
- Apply engineering concepts to assess, design, and manage water resource systems.
- Evaluate sustainable water resource practices and their applications.
- Analyze and propose solutions to address water quality and treatment challenges.
- Demonstrate problem-solving and engineering skills in real-world water resource projects.

Unit 1: Introduction to Climate Change

Unit 1: Fundamentals of Hydrology and Hydrological Modeling: Hydrological cycle and its components, Precipitation, evaporation, and runoff, Rainfall-runoff modelling,Watershed analysis and hydrological modeling

Unit 2: Water Resource Engineering and Management: Hydraulic engineering principles, Water resource assessment and planning, Water resource infrastructure (dams, reservoirs, canals), Water allocation and legal frameworks

Unit 3: Sustainable Water Resource Practices: Integrated water resources management, Environmental considerations in water resource projects, Sustainable water use and conservation, Case studies of successful water resource management

Unit 4: Water Quality and Treatment: Water quality parameters and assessment, Sources of water pollution, Water treatment technologies, Water quality protection and improvement

TEXT/REFERENCE BOOKS

1. "Environmental Hydrology" by Andy D. Moorhouse
2. "Water Quality and Treatment: A Handbook on Drinking Water" by American Water Works Association
3. "Applied Hydrology" by Ven Te Chow, David R. Maidment, and Larry W. Mays
4. "Water Resources Engineering" by Larry W. Mays"

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VII

PEC-ENV-702

ENGINEERING GEOLOGY, GIS AND REMOTE SENSING

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

OUTCOMES:

- Apply geological knowledge to assess geologic hazards and conditions relevant to engineering projects.
- Utilize GIS for spatial data analysis and decision support in engineering applications.
- Interpret and analyze remote sensing data for geological and environmental assessment.
- Integrate engineering geology, GIS, and remote sensing to make informed decisions in civil and environmental engineering projects.
- Demonstrate proficiency in geospatial data acquisition, analysis, and presentation.

Unit 1: Introduction to engineering geology, Geologic time, rock types, and geological structures, Soil formation and classification, Geologic hazards and their assessment.

Unit 2: Introduction to GIS and its components, Spatial data acquisition and analysis, Geospatial data management and visualization, GIS in engineering and environmental applications.

Unit 3: Introduction to remote sensing and its applications, Remote sensing platforms and sensors**,** Image interpretation and analysis, Remote sensing in environmental monitoring and resource management.

Unit 4: Geological data acquisition and interpretation using GIS, Remote sensing applications in geologic mapping, GIS-based site selection and analysis for engineering projects, Case studies and projects.

TEXT/REFERENCE BOOKS

1. "Engineering Geology" by Parbin Singh
2. "Geographic Information Systems" by Paul A. Longley, Michael F. Goodchild, et al.
3. "Remote Sensing and GIS" by Basudeb Bhatta
4. "Geological Engineering" by Luis Gonzalez de Vallejo, Teresa M. Mata, et al.
5. "Introduction to Remote Sensing" by James B. Campbell and Randolph H. Wynne

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VII

PEC-ENV-703

WATER AND SOIL CONSERVATION

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

OUTCOMES:

- Understand the importance of water and soil resources and the challenges they face.
- Identify erosion processes and apply erosion control techniques.
- Develop water and soil conservation plans and strategies.
- Evaluate the effectiveness of different conservation practices.
- Demonstrate critical thinking and problem-solving skills in conservation projects.

Unit 1: Introduction to Water and Soil Conservation, Importance of water and soil resources, Erosion processes and factors, Watershed management and conservation planning, Conservation policies and regulations.

Unit 2: Erosion Control and Soil Conservation, Types of soil erosion, Erosion control practices (terracing, contour farming, etc.), Soil conservation techniques (crop rotation, cover cropping), Soil and water conservation in agriculture.

Unit 3: Water Resource Management and Conservation, Water conservation strategies, Water-efficient irrigation techniques, Urban water conservation, Watershed management for water conservation.

Unit 4: Sustainable Land Use and Restoration, Land use planning for conservation, Restoration of degraded lands, Afforestation and reforestation, Case studies in successful water and soil conservation projects.

TEXT/REFERENCE BOOKS

1. "Soil and Water Conservation Engineering" by Glenn O. Schwab, Delmar D. Fangmeier, William J. Elliot
2. "Principles of Soil Conservation and Management" by Edward J. Plaster
3. "Water Resources Engineering" by Larry W. Mays
4. "Land Use Planning and Sustainable Development" by Debarati Guha-Sapir
5. "Watershed Management for Potable Water Supply: Assessing the New York City Strategy" by National Research Council

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VII

PEC-ENV-704

IRRIGATION AND DRAINAGE ENGINEERING

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

OUTCOMES:

- Understand the principles and importance of irrigation and drainage engineering.
- Design and evaluate irrigation systems for efficient water use in agriculture.
- Develop drainage solutions to address waterlogging and salinity issues.
- Analyze and apply sustainable practices in irrigation and drainage engineering.
- Demonstrate problem-solving skills in real-world irrigation and drainage projects.

Unit 1: Introduction to Irrigation and Drainage: Importance of irrigation in agriculture, Types and methods of irrigation, Principles of drainage systems, Sustainable water use in irrigation

Unit 2: Irrigation Design and Management: Crop water requirements, Design of surface and pressurized irrigation systems, Irrigation scheduling and management, Evaluation of irrigation efficiency

Unit 3: Drainage System Design: Drainage principles and objectives, Drainage system design criteria, Subsurface drainage systems, Drainage water quality and environmental considerations

Unit 4: Sustainable Practices and Emerging Technologies: Sustainable irrigation and drainage practices, Remote sensing and GIS in irrigation management, Climate change and its impact on irrigation, Case studies in successful irrigation and drainage projects

TEXT/REFERENCE BOOKS

1. "Irrigation Engineering" by N.N. Basak
2. "Irrigation and Water Power Engineering" by Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain
3. "Drainage Engineering" by James N. Luthin
4. "Sustainable Land Use Planning: The Environmental and Natural Resources Management Approach" by Willy Verheye
5. "Irrigation and Drainage Engineering" by Peter Waller and Muluneh Yitayew

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VII

PEC-ENV-705

ADVANCE SURVEYING

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

OUTCOMES:

- Understand geodetic surveying principles and datums.
- Operate and analyze data from precision measurement instruments and total stations.
- Apply advanced surveying techniques for digital terrain modeling.
- Integrate surveying data with remote sensing and GIS.
- Demonstrate proficiency in advanced surveying applications in various engineering and geospatial projects.

Unit 1: Geodetic Surveying: Introduction to geodetic surveying, Geodetic datums and coordinate systems, Geodetic control networks, Geoid modeling and GNSS (Global Navigation Satellite System) techniques

Unit 2: Precision Measurement and Total Stations: Precision measurement instruments, Total stations and electronic theodolites, High-precision leveling and trilateration, Use of robotic total stations in construction

Unit 3: Digital Terrain Modeling and 3D Laser Scanning: Digital elevation models (DEMs), Terrestrial laser scanning (LiDAR), Applications of 3D scanning in topography and construction, Point cloud data processing and analysis

Unit 4: Remote Sensing and GIS Integration: Aerial and satellite remote sensing, Integration of surveying data with GIS, Use of GIS in land information systems, Case studies in advanced surveying applications

TEXT/REFERENCE BOOKS

1. "Geodetic Surveying" by E. D. Ghilani and Paul R. Wolf
2. "Elementary Surveying: An Introduction to Geomatics" by Charles D. Ghilani and Paul R. Wolf
3. "Introduction to 3D Data: Modeling with ArcGIS 3D Analyst and Google Earth" by Heather Kennedy and Phillip Davis
4. "Principles and Applications of Geographic Information Systems" by A. Jon Kimerling, Aileen R. Buckley, et al.
5. "Introduction to Modern Photogrammetry" by Edward M. Mikhail, James S. Bethel, J. Chris McGlone

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

B.TECH. (ENVIRONMENTAL ENGINEERING) – SEMESTER VII

PEC-ENV-706

ENVIRONMENTAL NANOTECHNOLOGY

NO. OF CREDITS: 3

L	T	P		
3	0	0	**SESSIONAL**	**:**25
			FINAL EXAM	**:**75
			TOTAL	**:**100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

OUTCOMES:

- Understand the principles and properties of nanomaterials in an environmental context.
- Analyze and evaluate the applications of nanotechnology in pollution control and water purification.
- Discuss the role of nanotechnology in renewable energy solutions.
- Examine ethical and safety considerations associated with environmental nanotechnology.
- Demonstrate critical thinking and problem-solving skills through the design of nanotechnology-based solutions for environmental challenges.

Unit 1: Introduction to Environmental Nanotechnology: Overview of nanotechnology and its relevance to environmental science, Properties of nanomaterials, Nanoscale characterization techniques, Ethical and safety considerations in nanotechnology

Unit 2: Nanomaterials for Pollution Control: Nanomaterials for air pollution control, Nanocatalysts for wastewater treatment, Nanosorbents for heavy metal removal, Environmental applications of carbon nanomaterials

Unit 3: Nanotechnology in Water Purification: Nanomembranes and filtration systems, Nano-enabled desalination processes, Remediation of contaminated groundwater, Water quality monitoring using nanosensors

Unit 4: Nanotechnology for Renewable Energy: Nanoscale materials for solar energy conversion, Nanocatalysts in fuel cells and hydrogen production, Nanotechnology in energy storage (batteries and supercapacitors), Environmental impacts of renewable energy technologies

TEXT/REFERENCE BOOKS

1. "Nanotechnology for Environmental Engineering" by Nelson M. V. Guedes
2. "Environmental Nanotechnology: Applications and Impacts of Nanomaterials" by Mark Wiesner and Jean-Yves Bottero
3. "Nanotechnology for Water Treatment and Purification" by Anming Hu, John J. Kelly, and Robert S. Varma
4. "Nanotechnology for the Energy Challenge" by Javier García-Martínez
5. "Environmental Nanotechnology: Remediation and Applications" by Rajender S. Varma

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

OEC-CED403-1 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 Objective:
The objective of the course "Civil Engineering – Societal & Global Impact" is to provide students with a comprehensive understanding of the societal and global impacts of civil engineering projects. The course aims to equip students with the knowledge and skills necessary to design, implement, and evaluate civil engineering projects that are socially responsible and globally sustainable.

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

1. Understand the fundamental principles and concepts of civil engineering as they relate to societal and global contexts.
2. Identify and evaluate the societal and global impacts of civil engineering decisions, considering factors such as sustainability, equity, and social justice.
3. Explain the principles and techniques involved in assessing the societal and global impacts of civil engineering projects.
4. Design and conduct a societal and global impact assessment of a civil engineering project, demonstrating competence in all stages of the process.
5. Apply the knowledge gained to make informed decisions about the societal and global implications of civil engineering projects.
6. Develop an awareness of the ethical considerations in civil engineering practice, promoting a sense of responsibility towards sustainable development.

Course Content:

UNIT 1:
Introduction to Course and Overview; Understanding the past to look into the future: Pre-industrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution; Recent major Civil Engineering breakthroughs and innovations; Present day world and future projections, Ecosystems in Society and in Nature; the steady erosion in Sustainability; Global warming, its impact and possible causes; Evaluating future requirements for various resources; GIS and applications for monitoring systems; Human Development Index and Ecological Footprint of India Vs other countries and analysis;

UNIT 2:
Understanding the importance of Civil Engineering in shaping and impacting the world; The ancient and modern Marvels and Wonders in the field of Civil Engineering; Future Vision for Civil Engineering, Infrastructure - Habitats, Megacities, Smart Cities, futuristic visions; Transportation (Roads, Railways & Metros, Airports, Seaports, River ways, Sea canals, Tunnels (below ground, under water); Futuristic systems (ex, Hyper Loop)); Energy generation (Hydro, Solar (Photovoltaic, Solar Chimney), Wind, Wave, Tidal, Geothermal, Thermal energy); Water provisioning; Telecommunication needs (towers, above-ground and underground cabling); Awareness of various

Codes & Standards governing Infrastructure development; Innovations and methodologies for ensuring Sustainability;

UNIT 3:

Environment- Traditional & futuristic methods; Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control (Dams, Canals, River interlinking), Multi-purpose water projects, Atmospheric pollution; Global warming phenomena and Pollution Mitigation measures, Stationarity and non- stationarity; Environmental Metrics & Monitoring; Other Sustainability measures; Innovations and methodologies for ensuring Sustainability, Built environment – Facilities management, Climate control; Energy efficient built environments and LEED ratings, Recycling, Temperature/ Sound control in built environment, Security systems; Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban Arts Commissions; Conservation, Repairs & Rehabilitation of Structures & Heritage structures; Innovations and methodologies for ensuring Sustainability

UNIT 4:

Civil Engineering Projects – Environmental Impact Analysis procedures; Waste (materials, manpower, equipment) avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; Techniques for reduction of Green House Gas emissions in various aspects of Civil Engineering Projects; New Project Management paradigms & Systems (Ex. Lean Construction), contribution of Civil Engineering to GDP, Contribution to
employment(projects, facilities management), Quality of products, Health & Safety aspects for stakeholders; Innovations and methodologies for ensuring Sustainability during Project development;

Text/Reference Books:

1. Žiga Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht
2. Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition
3. NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004.
4. Allen M. (2008) Cleansing the city. Ohio University Press. Athens Ohio.

OEC-CED403-2 ESTIMATION AND COSTING

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 the course "Estimation and Costing" is to provide students with a comprehensive understanding of the principles and practices involved in estimating and costing in construction projects. The course aims to equip students with the knowledge and skills necessary to accurately estimate costs and resources for construction projects.

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

1. Understand the fundamental principles and concepts of estimation and costing in construction.
2. Identify and evaluate different types of costs involved in a construction project, including material, labor, equipment, and overhead costs.
3. Explain the process of preparing detailed estimates and cost plans for construction projects.
4. Design and conduct an estimation and costing exercise for a construction project, demonstrating competence in all stages of the process.
5. Apply the knowledge gained to make informed decisions about budgeting, resource allocation, and cost control in construction projects.
6. Develop an awareness of the ethical considerations in estimation and costing, promoting a sense of responsibility towards fair pricing and cost management.

Course Content:

UNIT 1:
Estimation / Measurements for various items- Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying

UNIT 2:
Specifications-Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures. Rate analysis-Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity.

UNIT 3:
Tender- Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids- Bid Price build up: Material, Labour,

Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management

UNIT 4:

Introduction to Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights.

Reference Book:

1. M Chakravarty, Estimating, Costing Specifications & Valuation
2. Joy P K, Handbook of Construction Management, Macmillan
3. B.S. Patil, Building & Engineering Contracts
4. Relevant Indian Standard Specifications.
5. UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification and Valuations,2016
6. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers, 2016

OEC-CED403-3 METRO SYSTEMS AND 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:

The objective of the course "Metro Systems and Engineering" is to provide students with a comprehensive understanding of the principles and practices involved in the design, construction, operation, and maintenance of metro systems. The course aims to equip students with the knowledge and skills necessary to contribute effectively to the field of metro systems engineering.

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

1. Understand the fundamental principles and concepts of metro systems engineering, including system design, construction methods, operation protocols, and maintenance practices.
2. Identify and evaluate the key components of a metro system, such as track layout, signaling systems, rolling stock, power supply, and station design.
3. Explain the process of planning, designing, constructing, operating, and maintaining a metro system.
4. Design and conduct an analysis or evaluation exercise for a metro system project, demonstrating competence in all stages of the process.
5. Apply the knowledge gained to solve real-world problems related to metro systems engineering.
6. Develop an awareness of the societal implications and environmental considerations in metro systems engineering, promoting a sense of responsibility towards sustainable development.

Course Content:

UNIT 1:

General: Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials.

UNIT 2:

Civil Engineering- Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations; Basics of Construction Planning & Management, Construction Quality & Safety Systems. Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management

UNIT 3:

Electronics And Communication Engineering- Signalling systems; Automatic fare collection; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors.

UNIT 4:

Mechanical & TVS, AC: Rolling stock, vehicle dynamics and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators. ELECTRICAL:

OHE, Traction Power; Substations- TSS and ASS; Power SCADA; Standby and Back-up systems; Green buildings, Carbon credits and clear air mechanics.

Reference Book:

1.. Railway Transportation Systems: Design, Construction and Operation, Christos. Pyrgidis, CRC Press, 2018

OEC-CED403-4 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 Objective:
The objective of the course "Safety Engineering" is to provide students with a comprehensive understanding of the principles and practices involved in designing and operating systems in a manner that protects the safety and health of workers, the public, and the environment. The course aims to equip students with the knowledge and skills necessary to identify, evaluate, and control hazards in various engineering contexts.

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

1. Understand the fundamental principles and concepts of safety engineering, including hazard identification, risk assessment, and safety control measures.
2. Identify and evaluate potential hazards in various engineering contexts, considering factors such as equipment design, operational procedures, and environmental conditions.
3. Explain the process of conducting a comprehensive safety analysis, including the use of tools and techniques such as fault tree analysis, failure mode and effects analysis, and hazard and operability study.
4. Design and implement effective safety control measures in an engineering context, demonstrating competence in selecting appropriate personal protective equipment, designing safety systems, and developing safe operational procedures.
5. Apply the knowledge gained to solve real-world problems related to safety engineering.
6. Develop an awareness of the ethical considerations in safety engineering, promoting a sense of responsibility towards protecting the safety and health of workers, the public, and the environment.

Course Content:

UNIT 1:
Introduction-Safety-Goalsof safety engineering. Need for safety. Safety and productivity Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. History of safety movement. Theories of accident causation, Safety organization- objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety. Safety policy. Safety Officer-responsibilities, authority. Safety committee need, types, advantages

UNIT 2:
Accident prevention Methods- Engineering, Education and Enforcement, Safety Education & Training - Importance, Various training methods, Effectiveness of training, Behavior oriented training. Communication-purpose, barrier to communication. Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. 5 s of housekeeping. Work permit system- objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces.

UNIT 3:

Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate. Cost of accidents- Computation of Costs- Utility of Cost data. Plant safety inspection, types, inspection procedure. Safety sampling techniques. Job safety analysis (JSA), Safety surveys, Safety audits. Safety Inventory Technique.

UNIT 4:

Accident investigation -Why? When? Where? Who? & How? . Basics- Man Environment & Systems. Process of Investigation -Tools-Data Collection-Handling witnesses- Case study. Accident analysis - Analytical Techniques-System, Safety-Change Analysis-MORT Multi Events Sequencing-TOR.

Text/References Books:

1. N.V. Krishnan, Safety Management in Industry, Jaico Publishing House,1997
2. Ronald P. Blake, Industrial Safety: Prentice Hall, New Delhi,1973 3)
3. David L. Goetsch, Occupational Safety and health, Prentice Hall
4. Ted S. Ferry, Modern Accident Investigation and Analysis, John Wiley & Sons
5. Willie Hammer, Occupational Safety Management and Engineering, Prentice Hall
6. Alan Waring, Safety Management System, Chapman & Hall
7. JohnV. Grimaldi and RollinH. Simonds, Safety Management, All India Traveller Book Seller.
8. Accident Prevention Manual for Industrial Operations: National Safety Council, Chicago.

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

Course Objective:

The objective of the course "Human Values and Professional Ethics" is to instill in students a strong understanding of ethical principles and human values, and their application in a professional context. The course aims to develop students' ability to make ethical decisions, understand the impact of their actions on others, and foster a commitment to social responsibility in their professional practice.

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

1. Understand the fundamental principles and concepts of ethics and human values.
2. Identify and evaluate ethical issues in various professional contexts.
3. Apply ethical principles and human values in decision-making processes.
4. Demonstrate the ability to reflect on ethical dilemmas and make decisions that respect human values.
5. Develop an awareness of the societal implications of professional decisions, promoting a sense of responsibility towards sustainable development.
6. Cultivate a commitment to ethical behavior and social responsibility in their professional practice.

Course Content:

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.

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