DEPARTMENT OF CIVIL ENGINEERING

ANNA UNIVERSITY, CHENNAI

OUR VISION:

Department of Civil Engineering, Anna University, shall strive hard to develop and impart technical knowledge and professional skills required for Civil Engineering and Geoinformatics Engineering practice through excellence in teaching, research and consultancy to address sustainable infrastructure development needs at local, national and international levels.

OUR MISSION:

Department of Civil Engineering, Anna University shall contribute to technological and social development by

1. Providing a firm scientific and technological base in Civil Engineering and Geoinformatics Engineering to achieve self- reliance.
2. Providing quality education through innovation in teaching practices at par with global standards.
3. Nurturing leadership and entrepreneurship qualities with ethical values.
4. Developing and disseminating latest knowledge and technologies in emerging areas of Civil Engineering and Geoinformatics Engineering
5. Sharing intellectual resources and infrastructure facilities through collaborative partnership.
6. Ensuring supporting conditions for enhancing the employability skills.

ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

REGULATIONS - 2023

CHOICE BASED CREDIT SYSTEM

B.E. CIVIL ENGINEERING (PART-TIME)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

Graduates of the programme B.E. Civil Engineering will:

PEO1	Gain knowledge and skills in Civil Engineering which will enable them to have a career and professional accomplishment in the public or private sector organizations.
PEO2	Become consultants on complex real-life Civil Engineering problems related to infrastructure development especially housing, construction, water supply, sewerage, transport and spatial planning.
PEO3	Become entrepreneurs and develop processes and technologies to meet desired infrastructure needs of society and formulate solutions that are technically sound, economically feasible and socially acceptable.
PEO4	Perform investigation for solving Civil Engineering problems by conducting research using modern equipment and software tools.
PEO5	Function in multi-disciplinary teams and advocate policies, systems, processes and equipment to support Civil Engineering.

2. PROGRAMME OUTCOMES (POs):

Graduates of the programme B. E. Civil Engineering will be able to:

PO1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem analysis	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design / development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.
PO4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage	Create, select, and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	Engineer and Society	Demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to Civil Engineering Practice.

PO7	Environment and Sustainability	Understand the Socio economic impact of Civil Engineering solutions for sustainable development
PO8	Ethics	Understand the commitment to professional ethics and responsibilities of Civil Engineers and to contribute to the comprehensive societal development
PO9	Individual and Team work	Function effectively as on individual and as member or leader in diverse teams and in multi-disciplinary settings and demonstrating a capacity for self-management and teamwork, decision-making based on open –mindedness, objectivity and rational analysis.
PO10	Communication	Communicate effectively with the engineering community and also with society at large, and write reports and make effective presentations.
PO11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

3. PROGRAMME SPECIFIC OUTCOMES (PSOs):

Graduates of the programme B.E. Civil Engineering will be able to:

PSO1	Knowledge of civil engineering discipline	Demonstrate in-depth knowledge of Civil Engineering discipline, with an ability to evaluate, analyze and synthesize existing and new knowledge.
PSO2	Critical analysis of civil engineering problems and innovation	Critically analyze complex Civil Engineering problems, apply independent judgment for synthesizing information and make innovative advances in a theoretical, practical and policy context.
PSO3	Conceptualization and evaluation of engineering solutions to civil engineering issues	Conceptualize and solve Civil Engineering problems, evaluate potential solutions and arrive at technically feasible, economically viable and environmentally sound solutions with due consideration of health, safety, and socio-cultural factors.

4. PEO / PO & PSO MAPPING:

PEO	**PO**												**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
PEO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
PEO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
PEO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
PEO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
PEO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1' = Low; '2' = Medium; '3' = High

5. MAPPING OF COURSE OUTCOME AND PROGRAMME OUTCOME:

		Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
YEAR I	SEMESTER I	Matrices and Calculus	3	2		1	1	2						3			
		Engineering Physics	2	2	1	2	1	-	-	-	-	-	-	-	-	-	-
		Engineering Chemistry	2	1	1	1	2	-	-	-	-	-	-	-	-	-	-
		Fundamentals of Electrical and Electronics Engineering	3	-	2	-	-	1	1	-	2	-	-	2	-	-	-
		Environmental Science and Sustainability	-	2	3	-	-	-	3	3	-	-	-	-	-	-	-
	SEMESTER II	Ordinary Differential Equations and Transform Techniques	3	2		1	3	2						3			
		Programming in C	3	1	3	3	2	1	-	-	2	2	2	1	-	-	-
		Engineering Mechanics	3	3	3	1	1	1	1	1	1	1	2	3	3	1	3
		Engineering Geology	2	2	3	3	2	2	2	2	2	2	2	2	2	2	2
YEAR II	SEMESTER III	Partial Differential Equations and Complex Functions	3	2		2	3	2						3			
		Strength of Materials - I	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
		Construction Materials and Techniques	3	3	3	3	3	2	2	3	2	3	3	3	3	2	2
		Surveying	3	3	3	3	3	3	2	2	3	2	1	3	3	3	3
	SEMESTER IV	Strength of Materials - II	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
		Soil Mechanics	3	3	2	2	2	2	2	2	2	2	2	3	3	2	2
		Railways, Airports and Harbour Engineering	3	3	3	3	2	2	3	2	2	2	2	2	2	2	2
		Fluid Mechanics	3	2	2	2	1	1	1	2	1	2	1	2	3	3	2
		Water Supply Engineering	3	2	3	2	3	3	3	2	2	1	2	2	3	2	3

		Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
YEAR III	SEMESTER V	Structural Analysis - I	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
		Design of Reinforced Cement Concrete Structures	3	3	3	3	2	3	2	2	3	2	1	3	3	3	3
		Foundation Engineering	3	3	2	2	2	2	2	2	2	2	2	3	3	2	2
		Highway Engineering	3	3	3	2	2	2	2	2	2	2	2	2	3	3	3
		Applied Hydraulic Engineering	3	3	2	3	1	3	2	2	1	2	1	3	3	2	3
	SEMESTER VI	Structural Analysis - II	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
		Design of Steel Structures	3	2	3	2	2	2	1	1	1	1	1	1	3	3	3
		Wastewater Engineering	3	2	3	2	2	3	3	3	2	1	2	3	3	3	3
		Principles of Management															
		Professional Elective I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
YEAR IV	SEMESTER VII	Irrigation Engineering	1	2	1	1	1	1	1	2	1	1	1	2	3	1	1
		Estimation, Costing and Valuation Engineering	3	2	2	3	3	3	3	3	3	3	3	3	3	3	3
		Professional Elective II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Professional Elective III	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	SEMESTER VIII	Human Values and Ethics															
		Professional Elective IV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Project Work	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1' = Low; '2' = Medium; '3' = High

6. MAPPING FOR PROFESSIONAL ELECTIVE COURSES [PEC]:

S. No.	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1.	Concrete Technology	3	3	3	3	3	2	2	2	2	2	2	2	3	2	2
2.	Structural Retrofit and Rehabilitation	2	2	3	3	3	2	3	2	2	1	1	2	2	3	2
3.	Construction Quality and Safety	3	3	2	2	2	2	2	1	2	2	2	2	3	3	3
4.	Energy Efficient Buildings	3	2	3	2	1	3	3	2	1	1	-	3	3	3	3
5.	Ground Improvement Techniques	3	3	2	3	3	3	2	2	2	2	2	3	2	2	2
6.	Pile Foundations	3	3	3	2	2	3	2	2	2	2	2	3	2	2	3
7.	Environmental Geoinformatics	3	3	3	3	3	3	3	1	2	2	3	3	3	3	2
8.	Geomatics for Ocean and Coastal Applications	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
9.	Smart Cities	3	2	3	2	2	2	3	2	2	2	3	2	3	3	3
10.	Traffic Engineering and Management	3	2	3	3	2	2	2	2	2	2	2	2	3	2	2
11.	Climate Change Adaptation and Mitigation	2	3	2	2	3	2	3	-	3	1	3	2	2	-	2
12.	Solid and Hazardous Waste Management	3	2	3	2	2	2	2	2	2	1	2	1	3	-	2
13.	Integrated Water Resources Management	3	2	2	2	1	2	3	2	2	2	2	3	2	2	2
14.	Rainwater Harvesting	2	2	2	2	2	2	2	2	1	1	2	2	2	2	2

‘1’ = Low; ‘2’ = Medium; ‘3’ = High

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
B.E. CIVIL ENGINEERING (PART-TIME)
REGULATIONS - 2023
CHOICE BASED CREDIT SYSTEM
CURRICULA AND SYLLABI FOR I TO VIII SEMESTERS

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	PTMA3151	Matrices and Calculus	BSC	3	1	0	4	4
2.	PTPH3151	Engineering Physics	BSC	3	0	0	3	3
3.	PTCY3151	Engineering Chemistry	BSC	3	0	0	3	3
4.	PTEE3152	Fundamentals of Electrical and Electronics Engineering	ESC	3	0	0	3	3
5.	PTCY3251	Environmental Science and Sustainability	BSC	2	0	0	2	2
			TOTAL	**14**	**1**	**0**	**15**	**15**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PTMA3251	Ordinary Differential Equations and Transform Techniques	BSC	3	1	0	4	4
2.	PTGE3153	Programming in C	ESC	2	0	4	6	4
3.	PTGE3151	Engineering Mechanics	ESC	3	1	0	4	4
4.	PTAG3305	Engineering Geology	BSC	2	0	2	4	3
			TOTAL	**10**	**2**	**6**	**18**	**15**

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PTMA3353	Partial Differential Equations and Complex Functions	BSC	3	1	0	4	4
2.	PTCE3301	Strength of Materials - I	PCC	3	0	0	3	3
3.	PTCE3302	Construction Materials and Techniques	PCC	3	0	0	3	3
4.	PTCE3303	Surveying	ESC	3	0	0	3	3
			TOTAL	**12**	**1**	**0**	**13**	**13**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PTCE3401	Strength of Materials - II	PCC	3	0	0	3	3
2.	PTCE3402	Soil Mechanics	PCC	3	0	0	3	3
3.	PTCE3403	Railways, Airports and Harbour Engineering	PCC	3	0	0	3	3
4.	PTCE3404	Fluid Mechanics	PCC	3	0	0	3	3
5.	PTCE3405	Water Supply Engineering	PCC	3	0	0	3	3
			TOTAL	**15**	**0**	**0**	**15**	**15**

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PTCE3501	Structural Analysis - I	PCC	3	0	0	3	3
2.	PTCE3502	Design of Reinforced Cement Concrete Structures	PCC	3	0	0	3	3
3.	PTCE3503	Foundation Engineering	PCC	3	0	0	3	3
4.	PTCE3504	Highway Engineering	PCC	3	0	0	3	3
5.	PTCE3505	Applied Hydraulic Engineering	PCC	3	0	0	3	3
			TOTAL	**15**	**0**	**0**	**15**	**15**

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PTCE3601	Structural Analysis - II	PCC	3	0	0	3	3
2.	PTCE3602	Design of Steel Structures	PCC	3	0	0	3	3
3.	PTCE3603	Wastewater Engineering	PCC	3	0	0	3	3
4.	PTMG3601	Principles of Management	HSMC	3	0	0	3	3
5.		Professional Elective I	PEC	3	0	0	3	3
			TOTAL	**15**	**0**	**0**	**15**	**15**

SEMESTER VII

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PTCE3701	Irrigation Engineering	PCC	3	0	0	3	3
2.	PTCE3702	Estimation, Costing and Valuation Engineering	PCC	3	0	0	3	3
3.		Professional Elective II	PEC	3	0	0	3	3
4.		Professional Elective III	PEC	3	0	0	3	3
			TOTAL	**12**	**0**	**0**	**12**	**12**

SEMESTER VIII

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PTGE3851	Human Values and Ethics	HSMC	2	0	0	2	2
2.		Professional Elective IV	PEC	3	0	0	3	3
3.		Professional Elective V	PEC	3	0	0	3	3
PRACTICALS								
4.	PTCE3811	Project Work	EEC	0	0	6	6	3
			TOTAL	**8**	**0**	**6**	**14**	**11**

TOTAL CREDITS TO BE EARNED FOR AWARD OF THE DEGREE: 111

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	SEMESTER
			L	T	P			
1.	PTMG3601	Principles of Management	3	0	0	3	3	6
2.	PTGE3851	Human Values and Ethics	2	0	0	2	2	8

BASIC SCIENCES COURSES (BSC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	SEMESTER
			L	T	P			
1.	PTMA3151	Matrices and Calculus	3	1	0	4	4	1
2.	PTPH3151	Engineering Physics	3	0	0	3	3	1
3.	PTCY3151	Engineering Chemistry	3	0	0	3	3	1
4.	PTCY3251	Environmental Science and Sustainability	2	0	0	2	2	1
5.	PTMA3251	Ordinary Differential Equations and Transform Techniques	3	1	0	4	4	2
6.	PTAG3305	Engineering Geology	2	0	2	4	3	2
7.	PTMA3353	Partial Differential Equations and Complex Functions	3	1	0	4	4	3
						TOTAL	**23**	

ENGINEERING SCIENCES COURSES (ESC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	SEMESTER
			L	T	P			
1.	PTEE3152	Fundamentals of Electrical and Electronics Engineering	3	0	0	3	3	1
2.	PTGE3153	Programming in C	2	0	4	6	4	2
3.	PTGE3151	Engineering Mechanics	3	1	0	4	4	2
4.	PTCE3303	Surveying	3	0	0	3	3	3
						TOTAL	**14**	

PROFESSIONAL CORE COURSES (PCC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	SEMESTER
			L	T	P			
1.	PTCE3301	Strength of Materials - I	3	0	0	3	3	3
2.	PTCE3302	Construction Materials and Techniques	3	0	0	3	3	3
3.	PTCE3401	Strength of Materials - II	3	0	0	3	3	4
4.	PTCE3402	Soil Mechanics	3	0	0	3	3	4
5.	PTCE3403	Railways, Airports and Harbour Engineering	3	0	0	3	3	4
6.	PTCE3404	Fluid Mechanics	3	0	0	3	3	4
7.	PTCE3405	Water Supply Engineering	3	0	0	3	3	4
8.	PTCE3501	Structural Analysis - I	3	0	0	3	3	5
9.	PTCE3502	Design of Reinforced Cement Concrete Structures	3	0	0	3	3	5
10.	PTCE3503	Foundation Engineering	3	0	0	3	3	5
11.	PTCE3504	Highway Engineering	3	0	0	3	3	5
12.	PTCE3505	Applied Hydraulic Engineering	3	0	0	3	3	5
13.	PTCE3601	Structural Analysis - II	3	0	0	3	3	6
14.	PTCE3602	Design of Steel Structures	3	0	0	3	3	6
15.	PTCE3603	Wastewater Engineering	3	0	0	3	3	6
16.	PTCE3701	Irrigation Engineering	3	0	0	3	3	7
17.	PTCE3702	Estimation, Costing and Valuation Engineering	3	0	0	3	3	7
						TOTAL	**51**	

PROFESSIONAL ELECTIVE COURSES (PEC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	PTCE3001	Concrete Technology	3	0	0	3	3
2.	PTCE3002	Structural Retrofit and Rehabilitation	3	0	0	3	3
3.	PTCE3003	Construction Quality and Safety	3	0	0	3	3
4.	PTCE3004	Energy Efficient Buildings	3	0	0	3	3
5.	PTCE3005	Ground Improvement Techniques	3	0	0	3	3
6.	PTCE3006	Pile Foundations	3	0	0	3	3
7.	PTCE3007	Environmental Geoinformatics	3	0	0	3	3
8.	PTCE3008	Geomatics for Ocean and Coastal Applications	3	0	0	3	3
9.	PTCE3009	Smart Cities	3	0	0	3	3
10.	PTCE3010	Traffic Engineering and Management	3	0	0	3	3
11.	PTCE3011	Climate Change Adaptation and Mitigation	3	0	0	3	3
12.	PTCE3012	Solid and Hazardous Waste Management	3	0	0	3	3
13.	PTCE3013	Integrated Water Resources Management	3	0	0	3	3
14.	PTCE3014	Rainwater Harvesting	3	0	0	3	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	SEMESTER
			L	T	P			
1.	PTCE3811	Project Work	0	0	6	6	3	8
TOTAL			**0**	**0**	**6**	**6**	**3**	

SUMMARY

B.E. CIVIL ENGINEERING (PART-TIME)										
S. NO.	Subject Area	Credits Per Semester								
		I	II	III	IV	V	VI	VII	VIII	
1.	HSMC	-	-	-	-	-	3	-	2	**5**
2.	BSC	12	7	4	-	-	-	-	-	**23**
3.	ESC	3	8	3	-	-	-	-	-	**14**
4.	PCC	-	-	6	15	15	9	6	-	**51**
5.	PEC	-	-	-	-	-	3	6	6	**15**
6.	EEC	-	-	-	-	-	-	-	3	**3**
Total		**15**	**15**	**13**	**15**	**15**	**15**	**12**	**11**	**111**

PTMA3151 **MATRICES AND CALCULUS** **L T P C**
3 1 0 4

UNIT I MATRICES (9+3)

Eigen values and Eigen vectors of a real matrix – Properties of Eigen values - Cayley-Hamilton theorem (excluding proof) – Diagonalization of matrices - Reduction of Quadratic form to canonical form by using orthogonal transformation - Nature of a Quadratic form.

UNIT II FUNCTIONS OF SEVERAL VARIABLES (9+3)

Limit, continuity, partial derivatives – Homogeneous functions and Euler's theorem - Total derivative – Differentiation of implicit functions - Taylor's formula for two variables - Errors and approximations – Maxima and Minima of functions of two variables – Lagrange's method of undermined multipliers.

UNIT III INTEGRAL CALCULUS (9+3)

Improper integrals of the first and second kind and their convergence – Differentiation under integrals - Evaluation of integrals involving a parameter by Leibnitz rule – Beta and Gamma functions- Properties – Evaluation of integrals by using Beta and Gamma functions – Error functions.

UNIT IV MULTIPLE INTEGRALS (9+3)

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of Solids – Change of variables in double and triple integrals.

UNIT V VECTOR CALCULUS (9+3)

Gradient of a scalar field, directional derivative – Divergence and Curl – Solenoidal and Irrotational vector fields - Line integrals over a plane curve - Surface integrals – Area of a curved surface – Volume Integral - Green's theorem, Stoke's and Gauss divergence theorems – Verification and applications in evaluating line, surface and volume integrals.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Use the matrix algebra methods for solving practical problems.
CO2: Use differential calculus ideas on several variable functions.
CO3: Apply different methods of integration in solving practical problems by using Beta and Gamma functions.
CO4: Apply multiple integral ideas in solving areas and volumes problems.
CO5: Apply the concept of vectors in solving practical problems.

TEXT BOOKS:

1. Joel Hass, Christopher Heil, Maurice D.Weir "'Thomas' Calculus", Pearson Education., New Delhi, 2018.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.
3. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, 6th Edition, New Delhi, 2013.

REFERENCES:

1. Erwin Kreyszig "Advanced Engineering Mathematics", Wiley India Pvt Ltd., New Delhi, 2015.
2. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education2nd Edition, 5th Reprint, Delhi, 2009.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics",Narosa Publications, 5 th Edition, New Delhi, 2017.
4. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7 th Edition, New Delhi , 2012.
6. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	1	1	2	-	-	-	-	-	3
CO2	3	2	-	1	1	2	-	-	-	-	-	3
CO3	3	2	-	1	1	2	-	-	-	-	-	3
CO4	3	2	-	1	1	2	-	-	-	-	-	3
CO5	3	2	-	1	1	2	-	-	-	-	-	3
AVg.	**3**	**2**		**1**	**1**	**2**						**3**

1' = Low; '2' = Medium; '3' = High

.

PTPH3151 ENGINEERING PHYSICS L T P C
3 0 0 3

UNIT I MECHANICS OF MATERIALS 9

Rigid Body – Centre of mass – Rotational Energy - Moment of inertia (M.I)- Moment of Inertia for uniform objects with various geometrical shapes. Elasticity –Hooke's law - Poisson's ratio - stress-strain diagram for ductile and brittle materials – uses- Bending of beams – Cantilever - Simply supported beams - uniform and non-uniform bending - Young's modulus determination - I shaped girders –Twisting couple – Shafts. Viscosity – Viscous drag – Surface Tension.

UNIT II OSCILLATIONS, SOUND AND THERMAL PHYSICS 9

Simple harmonic motion - Torsional pendulum –- Damped oscillations –Shock Absorber -Forced oscillations and Resonance –Applications of resonance.- Waves and Energy Transport –Sound waves – Intensity level – Standing Waves - Doppler effect and its applications - Speed of blood flow. Ultrasound – applications - Echolocation and Medical Imaging. Thermal Expansion – Expansion joints – Bimetallic strip – Seebeck effect – thermocouple -Heat Transfer Rate – Conduction – Convection and Radiation.

UNIT III OPTICS AND LASERS 9

Interference - Thin film interference - Air wedge- Applications -Interferometers–Michelson Interferometer -– Diffraction - CD as diffraction grating – Diffraction by crystals -Polarization - polarizers -– Laser – characteristics – Spontaneous and Stimulated emission- population – inversion - Metastable states - optical feedback - Nd-YAG laser, CO_2 laser, Semiconductor laser - Industrial and medical applications - Optical Fibers – Total internal reflection – Numerical aperture and acceptance angle – Fiber optic communication – Fiber sensors – Fiber lasers.

UNIT IV QUANTUM MECHANICS 9

Black body radiation (Qualitative) – Planck's hypothesis – Einstein's theory of Radiation - Matter waves–de Broglie hypothesis - Electron microscope – Uncertainty Principle – The Schrodinger Wave equation (time-independent and time-dependent) – Meaning and Physical significance of wave function - Normalization - Particle in an infinite potential well-particle in a three-dimensional box - Degenerate energy states - Barrier penetration and quantum tunneling - Tunneling microscope.\

UNIT V CRYSTAL PHYSICS 9

Crystal Bonding – Ionic – covalent – metallic and van der Walls's/ molecular bonding. Crystal systems - unit cell, Bravais lattices, Miller indices - Crystal structures - atomic packing density of BCC, FCC and HCP structures. NaCl, Diamond, Graphite, Graphene, Zincblende and Wurtzite structures - crystal imperfections- point defects - edge and screw dislocations – grain boundaries. Crystal Growth – Czocharalski method – vapor phase epitaxy – Molecular beam epitaxy- Introduction to X-Ray Diffractometer.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students shall be

CO1: Understand the important mechanical properties of materials
CO2: Express the knowledge of oscillations, sound and applications of Thermal Physics
CO3: Know the basics of optics and lasers and its applications
CO4: Understand the basics and importance of quantum physics.
CO5: Understand the significance of crystal physics.

TEXT BOOKS:

1. Raymond A. Serway, John W. Jewett, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2013.
2. D. Halliday, R. Resnick and J. Walker, Principles of Physics. John Wiley & Sons, 10th Edition, 2015
3. N. Garcia, A. Damask and S. Schwarz, Physics for Computer Science Students, Springer-Verlag, 2012.
4. Alan Giambattista, Betty McCarthy Richardson and Robert C. Richardson, College Physics, McGraw-Hill Higher Education, 2012.

REFERENCES:

1. R. Wolfson, Essential University Physics. Volume 1 & 2. Pearson, 2016.
2. D. Kleppner and R. Kolenkow. An Introduction to Mechanics, McGraw Hill Education, 2017.
3. K. Thyagarajan and A. Ghatak. Lasers: Fundamentals and Applications. Springer, 2012

CO-PO & PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	2	1							
CO2	2	2	1	2	1							
CO3	2	2	2	2	1							
CO4	2	1	1	1	1							
CO5	2	2	2	2	1							
Avg	2	2	1	2	1	-	-	-	-	-	-	-

1' = Low; '2' = Medium; '3' = High

PTCY3151 ENGINEERING CHEMISTRY L T P C
3 0 0 3

UNIT I POLYMER CHEMISTRY

Introduction: Functionality-degree of polymerization. Classification of polymers (Source, Structure, Synthesis and Intermolecular forces). Mechanism of free radical addition polymerization. Properties of polymers: Tg, tacticity, molecular weight-number average, weight average, viscosity average and polydispersity index (Problems). Techniques of polymerization: Bulk, emulsion, solution and suspension.

Engineering Plastics: Polyamides, Polycarbonates and Polyurethanes. Compounding and Fabrication Techniques: Injection, Extrusion, Blow and Calendaring

UNIT II NANOCHEMISTRY

Basics-distinction between molecules, nanomaterials and bulk materials; size-dependent properties (optical, electrical, mechanical, magnetic and catalytic). Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Characterization - Scanning Electron Microscope and Transmission Electron Microscope - Principle and instrumentation (block diagram). Applications of nanomaterials - medicine, agriculture, electronics and catalysis.

UNIT III CORROSION SCIENCE

Electrochemical cell, redox reaction, electrode potential - oxidation and reduction potential. Measurement and its application Introduction to corrosion - chemical and electrochemical corrosions-mechanism of electrochemical and galvanic corrosions-concentration cell corrosion-passivity-soil, pitting, inter-granular, water line, stress and microbiological corrosions-galvanic series-factors influencing corrosion- measurement of corrosion rate. Corrosion control-material selection and design-electrochemical protection- sacrificial anodic protection and impressed current cathodic protection. Protective coatings-metallic coatings (galvanizing, tinning), organic coatings (paints). Paints: Constituents and functions.

UNIT IV ENERGY SOURCES

Batteries - Characteristics - types of batteries – primary battery (dry cell), secondary battery (lead acid, lithium-ion-battery)- emerging batteries – nickel-metal hydride battery, aluminum air battery, batteries for automobiles and satellites - Fuel cells (Types) – H_2-O_2 fuel cell - Supercapacitors-Types and Applications, Renewable Energy: Solar- solar cells, DSSC

UNIT V WATER TECHNOLOGY

Water – sources and impurities – water quality parameters: colour, odour, pH, hardness, alkalinity, TDS, COD, BOD and heavy metals. Boiler feed water – requirement – troubles (scale & sludge, caustic embrittlement, boiler corrosion and priming & foaming. Internal conditioning – phosphate, calgon and carbonate treatment. External conditioning - demineralization. Municipal water treatment (screening, sedimentation, coagulation, filtration and disinfection-ozonolysis, UV treatment, chlorination), Reverse Osmosis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: To recognize and apply basic knowledge on different types of polymeric materials, their general preparation methods and applications to futuristic material fabrication needs.

CO2: To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

CO3: To recognize and apply basic knowledge on suitable corrosion protection technique for practical problems.

CO4: To recognize different storage devices and apply them for suitable applications in energy sectors.

CO5: To demonstrate the knowledge of water and their quality in using at different industries.

TEXT BOOKS:

1. Jain P. C. & Monica Jain., “Engineering Chemistry”, 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. Dara S.S., “A Text book of Engineering Chemistry”, Chand Publications, 2004.

REFERENCES:

1. Schdeva M.V., “Basics of Nano Chemistry”, Anmol Publications Pvt Ltd, 2011.
2. Friedrich Emich, “Engineering Chemistry”, Medtech, 2014.
3. Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, “Polymer Science” New AGE International Publishers, 2009.

CO - PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2									
CO2	2	1		2	2							
CO3	2	2	1	1	2							
CO4	2		2		2							
CO5	3	2	2	1	1							
Avg	2	1	1	1	2	-	-	-	-	-	-	-

1’ = Low; ‘2’ = Medium; ‘3’ = High

PTEE3152 FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING L T P C

3 0 0 3

UNIT I BASIC ELECTRICAL CIRCUITS 9

DC Circuits: Sources, Ohm's Law - Kirchhoff's Laws – Solution of DC circuits with Independent sources only (Steady state)

AC Circuits: AC Fundamentals: Waveforms, Average value, RMS Value, Impedance, Instantaneous Power, Real Power, Reactive Power and Apparent Power, Power Factor – Steady State Analysis of RL, RC and RLC Circuits.

UNIT II AC AND DC MACHINES 9

Magnetic Circuits fundamentals – DC Machines: Construction, Working Principle, Types and Applications of DC Generator and Motor, EMF and Torque equation.

AC Machines: Construction, Working and Applications of Transformer, Three phase Alternator, Synchronous motor, Single and Three Phase Induction Motor and BLDC motor.

UNIT III ANALOG AND DIGITAL ELECTRONICS 9

Operation and Characteristics of electronic devices: PN Junction Diodes, Zener Diode, BJT, JFET and MOSFET– Operational Amplifiers (OPAMPs) : Characteristics and basic application circuits-555 timer IC based astable and monostable multivibrator.

Basic switching circuits – Gates and Flip-Flops-Sample and hold circuit- R-2R ladder type DAC-Successive approximation based ADC.

UNIT IV SENSORS AND TRANSDUCERS 9

Solenoids, electro-pneumatic systems, proximity sensors, limit switches, piezoelectric, hall effect, photo sensors, Strain gauge, LVDT, piezo electric crystals, differential pressure transducer, optical and digital transducers, Smart sensors, Thermal Imagers.

UNIT V MEASUREMENTS AND INSTRUMENTATION 9

Functional Elements of an Instrument, Error analysis; Operating Principle - Moving Coil and Moving Iron Instruments, Power Measurement, Energy Meter, Instrument Transformers - CT and PT, Multimeter- DSO - Block Diagram Approach.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Compute the electric circuit parameters for simple problems.

CO2: Explain the working principles and characteristics of electrical machines, electronic devices and measuring instruments.

CO3: Identify general applications of electrical machines, electronic devices and measuring instruments.

CO4: Analyze the basic electrical and electronic circuits.

CO5: Explain the types and operating principles of sensors and transducers.

TEXT BOOKS:

1. Del Toro 'Electrical Engineering Fundamentals' Pearson Education, New Delhi, 2022.
2. Alan S. Moris, Principles of Measurements and Instruments, Prentice-Hall of India Pvt. Ltd., New Delhi, 1988.
3. Smarjit Ghosh 'Fundamentals of Electrical and Electronics Engineering, 2nd Edition 2010.

REFERENCES:

1. Rajendra Prasad 'Fundamentals of Electrical engineering', Third Edition, Prentice Hall of India, 2014.
2. Sanjeev Sharma 'Basics of Electrical Engineering' Wiley, 2019.
3. John Bird, Electrical Circuits theory and Technology, Taylor & Francis Ltd, Seventh Edition, 2022.
4. Doebelin, E.O., Measurements Systems – Application and Design', McGraw Hill Publishing Co, 2019.
5. D.Roy Choudhury, Shail B. Jain, Linear Integrated Circuits, New age international Publishers, 2018.

6. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	-	-	-	-	-	-	-	1	-	-	-
2	2	3	2	3	-	-	-	-	-	-	-	1	-	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	-	-	-
4	1	2	2	2	-	-	-	-	-	-	-	1	-	-	-
5	1	1	2	2	-	-	-	-	-	-	-	2	-	-	-
AVg.	2	2	2	2	-	-	-	-	-	-	-	1	-	-	-

1' = Low; '2' = Medium; '3' = High

PTCY3251 ENVIRONMENTAL SCIENCE AND SUSTAINABILITY L T P C
2 0 0 2

UNIT I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

UNIT III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 6

Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocolsSustainable Development Goals-targets, indicators and intervention areas Climate change-Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES 6

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cyclescarbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization-Socioeconomical and technological change.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

CO1 To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.

CO2 To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.

CO3 To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

CO4 To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.

CO5 To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

TEXTBOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers , 2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Pearson; 1st edition, 2011.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, CL Engineering; International edition, 2015.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES :

1. Daniel J. Sherman, David R. Montgomery, " Environmental Science and Sustainability'', W. W. Norton, Incorporated, 2nd edition, 2023.
2. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', B.S Publications, 2010.
3. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publications, Mumbai, 2001.
4. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
5. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 3rd edition, 2015.
6. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

CO - PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							3					
CO2		2	3									
CO3			2				3					
CO4							3	3				
CO5			3				2	2				
Avg	**-**	**2**	**3**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	-

1' = Low; '2' = Medium; '3' = High

PTMA3251 ORDINARY DIFFERENTIAL EQUATIONS AND TRANSFORM TECHNIQUES

L T P C
3 1 0 4

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Homogeneous linear ordinary differential equations of second order, linearity principle, general solution- Particular integral - Operator method - Solution by variation of parameters - Method of undetermined coefficients - Homogenous equations of Euler–Cauchy and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

UNIT II LAPLACE TRANSFORMS (9+3)

Existence theorem - Transform of standard functions – Transform of Unit step function and Dirac delta function – Basic properties - Shifting theorems - Transforms of derivatives and integrals – Transform of periodic functions - Initial and Final value theorem - Inverse Laplace - Convolution theorem (without proof) – Solving Initial value problems by using Laplace Transform techniques.

UNIT III FOURIER SERIES (9+3)

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

UNIT IV FOURIER TRANSFORMS (9+3)

Fourier integral theorem – Fourier transform pair - Fourier sine and cosine transforms – Properties – Transform of elementary functions - Convolution theorem (without proof) – Parsevals's identity.

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS (9+3)

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and final value theorems – Formation of difference equation – Solution of difference equation using Z - transform.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Solve higher order ordinary differential equations which arise in engineering applications.
CO2: Apply Laplace transform techniques in solving linear differential equations.
CO3: Apply Fourier series techniques in engineering applications.
CO4: Understand the Fourier transforms techniques in solving engineering problems.
CO5: Understand the Z-transforms techniques in solving difference equations.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India Pvt Ltd., New Delhi, 2015.

REFERENCES:

1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
2. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education 2nd Edition, 5th Reprint, Delhi, 2009.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics",Narosa Publications, 5th Edition, New Delhi, 2017.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi , 2012.
5. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	2	3	3	-	-	-	-	-	3
CO2	3	2	-	2	3	3	-	-	-	-	-	3
CO3	3	2	-	2	3	2	-	-	-	-	-	3
CO4	3	2	-	1	3	3	-	-	-	-	-	3
CO5	3	2	-	1	3	2	-	-	-	-	-	3
AVg.	3	2		1	3	2						3

1' = Low; '2' = Medium; '3' = High

PTGE3153 PROGRAMMING IN C

L	T	P	C
2	0	4	4

UNIT I - BASICS OF C PROGRAMMING **6+12**

Introduction to programming paradigms –- Structure of C program - C programming: Data Types - Constants - Keywords - Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements - Decision making statements - Switch statement.

PRACTICALS:

- Designing programs with algorithms/flowchart
- Programs for i/o operations with different data types
- Programs using various operators
- Programs using decision making and branching statements

UNIT II – LOOP CONTROL STATEMENTS AND ARRAYS **6+12**

Iteration statements: For, while, Do-while statements, nested loops, break & continue statements - Introduction to Arrays: Declaration, Initialization - One dimensional array -Two dimensional arrays – Searching and sorting in Arrays – Strings – string handling functions - array of strings

PRACTICALS:

- Programs using for, while, do-while loops and nested loops.
- Programs using arrays and operations on arrays.
- Programs implementing searching and sorting using arrays
- Programs implementing string operations on arrays

UNIT Ill - FUNCTIONS AND POINTERS **6+12**

Modular programming - Function prototype, function definition, function call, Built-in functions – Recursion – Recursive functions - Pointers - Pointer increment, Pointer arithmetic - Parameter passing: Pass by value, Pass by reference, pointer and arrays, dynamic memory allocation with *malloc/calloc*

PRACTICALS:

- Programs using functions
- Programs using recursion
- Programs using pointers & strings with pointers
- Programs using Dynamic Memory Allocation

UNIT IV - STRUCTURES AND UNION **6+12**

Storage class, Structure and union, Features of structures, Declaration and initialization of structures, array of structures, Pointer to structure, structure and functions, typedef , bit fields , enumerated data types, Union.

PRACTICALS:

- Programs using Structures
- Programs using Unions
- Programs using pointers to structures and self-referential structures

UNIT V – MACROS AND FILE PROCESSING **6+12**

Preprocessor directives – Simple and Conditional macros with and without parameters - Files - Types of file processing: Sequential and Random access – File operations – read, write & seek.

PRACTICALS:

- Programs using pre-processor directives & macros
- Programs to handle file operations
- Programs to handle file with structure

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1: Write simple C programs using basic constructs.

CO2: Design searching and sorting algorithms using arrays and strings.

CO3: Implement modular applications using Functions and pointers.

CO4: Develop and execute applications using structures and Unions.

CO5: Solve real world problem using files.

TOTAL PERIODS: 90 (30+60)

TEXT BOOKS:

1. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015.
2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.

REFERENCES

1. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013.
2. Ashok N Kamthane, Programming in C, Pearson, Third Edition, 2020
3. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
4. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C"' McGraw-Hill Education, 1996.
6. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013.

CO-PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	POS	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	3	1	2	2	1	-	-	-	2	-	3
2	3		3	3	1	1	-	-	-	-	-	-
3	3	3	3	3	2	-	-	-	3	-	-	-
4	3	3	3	3	2	-	-	-	3	-	3	3
5	3	3	3	3	3	2	-	-	-	-	3	3
Avg	**3**	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**3**	**2**	**3**	**3**

1 - low, 2 - medium, 3 - high

PTGE3151 ENGINEERING MECHANICS L T P C

3 1 0 4

UNIT I STATICS OF PARTICLES 9+3

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNIT II EQUILIBRIUM OF RIGID BODIES AND TRUSSES 9+3

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections – Analysis of Trusses – Method of Joints and Method of Sections.

UNIT III DISTRIBUTED FORCES 9+3

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration.

Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration , Polar Moment of Inertia , Radius of Gyration of an Area , Parallel-Axis Theorem , Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates , Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT IV FRICTION AND WORK PRINCIPLES 9+3

The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Wedges, Wheel Friction. Rolling Resistance, Ladder friction. Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact, Method of Virtual Work - Work of a Force, Potential Energy, Potential Energy and Equilibrium.

UNIT V DYNAMICS OF PARTICLES AND RIGID BODIES 9+3

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods – Kinematics of Rigid Bodies and Plane Kinetics.

TOTAL :60 PERIODS

COURSE OUTCOMES:

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

CO1 To determine the resultant forces acting on a particle in 2D and 3D and to apply methods of equilibrium on a particle in 2D and 3D.

CO2 Evaluate the reaction forces for bodies under equilibrium, to determine moment of a force, moment of a couple, to resolve force into a force-couple system and to analyze trusses

CO3 Assess the centroids of 2D sections / center of gravity of volumes and to calculate area moments of inertia for the sections and mass moment of inertia of solids.

CO4 Evaluate the frictional forces acting at the contact surfaces of various engineering systems and apply the work-energy principles on a particle. evaluate the kinetic and kinematic parameters of a particle.

CO5 Determine kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

TEXTBOOKS:

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12th Edition, 2019.
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

REFERENCES:

1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4thEdition, Pearson Education Asia Pvt. Ltd., 2005.
4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
5. Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, 5thEdition, McGraw Hill Higher Education, 2017.

CO-PO & PSO MAPPING

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	2			1				2	3	1	2
2	3	2	2	1	2			1				2	3	1	2
3	3	2	2	1	2			1				2	3	1	2
4	3	2	2	1	2			1				2	3	1	2
5	3	2	2	1	2			1				2	3	1	2
Avg	3	2	2	1	2			1				2	3	1	2

• 1' = Low; '2' = Medium; '3' = High

PTAG3305 ENGINEERING GEOLOGY L T P C
2 0 2 3

UNIT I INTRODUCTION AND GEOMORPHOLOGY 12

Significance of Geology in Civil Engineering; Internal structure of the Earth, Plate tectonics; Weathering and it types, weathering grade, engineering classification of weathered rocks. Geological works of rivers, wind, sea and glaciers as agents of erosion, transportation and deposition; physiographic forms and drainage patterns.

Practical component: Exposure to Toposheets; Identification of drainage pattern in a toposheet and preparation of drainage map; Preparation of weathered profile.

UNIT II MINERALS AND ROCKS 12

Introduction to minerals and rocks. Physical properties of Quartz, Feldspar, Mica, Olivine, Pyroxene, Amphibole and Clay minerals. Reactivity of alkaline minerals with cement and sand. Origin, texture, structure and properties Igneous (Granite, Syenite, Basalt & Dolerite), Metamorphic (Quartzite, Slate, Schist, Gneiss & Marble) and Sedimentary (Conglomerate, Sandstone, Shale & Limestone) rocks. Engineering properties of rocks.

Practical component: Identification of above mentioned minerals and rocks in hand specimens and writing their physical properties and uses. Modal analysis of rock specimens.

UNIT III STRUCTURAL GEOLOGY 12

Attitude of beds - Dip and Strike measurement. Relevance to civil engineering. Overview of folds, fractures, faults and joints in rocks. Relevance to civil engineering. Introduction to index properties of rocks- strength- structures and discontinuities in rocks, Geological factors controlling the strength of rock - influence on strength of rocks.

Practical component: Identification of rock structures, Strike and Dip measurements using Brunton Compass and Clinometer in the field.

UNIT IV GEOPROSPECTING AND GEOTECHNICAL PROPERTIES OF ROCKS 12

Reconnaissance surface investigations - Remote sensing and field surveys for geological mapping. Overview of Geophysical methods - Electrical, Seismic and GPR. Applications for subsurface investigations and groundwater exploration. Borehole core logging. Rock Mass Rating (RMR), Rock Quality Designation (RQD), Geological Strength Index (GSI), Q system for rock mass classification.

Practical component: Preparation of contour maps, Geologic cross sections, Litho-log preparation and RQD calculations.

UNIT V GEOLOGICAL CONSIDERATIONS FOR ENGINEERING STRUCTURES AND GEOHAZARDS 12

Geological conditions necessary for design and construction of Dams, Reservoirs, Tunnels and Road cuttings. Coastal protection. Earthquake - Seismic zones of India, Landslides - causes and mitigation. Tsunami - causes and mitigation. Case studies from India.

Practical component: Field study at a Dam / Reservoir / Tunnel / Road cutting site to recognize the geological conditions necessary for its construction.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Knowing the internal structure of earth and its relation to earthquakes. Landforms created by various geological agents and their importance in civil engineering

CO2 Getting knowledge on various minerals and rocks that can be used as construction materials and road aggregates. In addition, testing the suitability of rocks for foundation purposes

CO3 Studying various geological structures and their impact in engineering constructions. Further, learning the geomechanical properties of rocks and their significance in engineering projects

CO4 Gaining knowledge on the role of geological mapping, remote sensing and geophysics for surface and subsurface investigations. In addition, students will also gain knowledge on borehole logging techniques and their applications in civil engineering

CO5 Applying geological knowledge for designing and constructing major civil engineering structures, and also mitigating various geological hazards such as earthquakes, landslides and tsunamis

TEXT BOOKS:

1. Parbin Singh, A Textbook of Engineering and General Geology, S.K.Kataria and Sons, 2021.
2. Chenna Kesavulu, N. Textbook of Engineering Geology, Macmillan India Ltd., 2018.
3. Venkat Reddy, D. Engineering Geology, Vikas Publishing House Pvt. Lt, 2021
4. Gokhale, K.V.G.K, "Principles of Engineering Geology", B.S. Publications, Hyderabad 2019
5. Varghese, P.C., Engineering Geology for Civil Engineering, Prentice Hall of India Learning Private Limited, New Delhi, 2012.

REFERENCES:

1. Legget, “Geology and Engineering”, McGraw Hill Book company, 1998 Blyth, “Geology for Engineers”, ELBS 1995.
2. Krynine and Judd, “Principals of Engineering Geology and Geotechnics” Tata McGraw Hill, New Delhi, 2018.
3. Bell, F.G. Fundamentals of Engineering Geology, B.S. Publications. Hyderabad 2011

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	-	-	-	-	2	2	-	-	-	-	-	-	-	-
2	2	-	-	2	2	-	-	-	2	-	-	-	2	-	-
3	2	2	3	3	-	-	-	-	2	-	-	-	-	-	2
4	-	2	-	3	2	2	2	2	-	-	2	2	2	2	-
5	-	3	3	3	-	2	2	2	2	2	2	2	2	2	2
Avg.	2	2	3	3	2	2	2	2	2	2	2	2	2	2	2

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

PTMA3353 PARTIAL DIFFERENTIAL EQUATIONS AND COMPLEX FUNCTIONS L T P C
3 1 0 4

UNIT I PARTIAL DIFFERENTIAL EQUATIONS (9+3)

Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Lagrange’s Linear equation – Solution of linear equations of higher order with constant coefficients – Linear non-homogeneous partial differential equations.

UNIT II APPLICATIONS FOURIER SERIES TO PARTIAL DIFFERENTIAL EQUATION (9+3)

Classification of partial differential equations- Method of separation of variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two dimensional heat equation – Fourier series solutions in Cartesian coordinates.

UNIT III ANALYTIC FUNCTIONS (9+3)

Limit, Continuity and Differentiation of Complex functions - Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function – elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

UNIT IV CONFORMAL MAPPING (9+3)

Introduction to Complex mapping - Conformal mapping – Condition for conformality – Standard mappings : a+z, az, az+b, $\frac{1}{z}, z^2, e^z, \sin(z), cos(z)$, - Bilinear transformations .

UNIT V INTEGRATION OF COMPLEX FUNCTIONS (9+3)

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Cauchy's Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contours (except poles on real lines).

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the concepts of partial differential equations in a practical situations.
CO2: Obtain the solutions of the partial differential equations using Fourier series.
CO3: Concepts of complex functions in a practical situations.
CO4: Understand the conformal mapping and its applications.
CO5: Apply the complex integrations in engineering problems.

TEXT BOOKS:

1. Erwin Kreyszig "Advanced Engineering Mathematics", John Wiley & Sons., New Delhi, 2015.
2. Wylie C. R. and Barrett L. C "Advanced Engineering Mathematics", Tata McGraw-Hill., New Delhi, 2019.
3. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.

REFERENCES:

1. Mathews J. H. and Howell R. W "Complex Analysis for Mathematics and Engineering", Narosa Publishing House., New Delhi, 2012.
2. Peter V.O Neil "Advanced Engineering Mathematics", Cengage., New Delhi, 2016.
3. Dennis G Zill "Advanced Engineering Mathematics", Jones & Bartlett India P Ltd., New Delhi, 2017.
4. Dean G Duffy "Advanced Engineering Mathematics with MATLAB", CRC., USA, 2010.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	2	3	3	-	-	-	-	-	3
CO2	3	2	-	2	3	3	-	-	-	-	-	3
CO3	3	2	-	2	3	2	-	-	-	-	-	3
CO4	3	2	-	2	3	3	-	-	-	-	-	3
CO5	3	2	-	2	3	2	-	-	-	-	-	3
AVg.	3	2		2	3	2						3

1' = Low; '2' = Medium; '3' = High

PTCE3301 STRENGTH OF MATERIALS - I L T P C
3 0 0 3

UNIT I SIMPLE AND COMPOUND STRESSES 9

Rigid and deformable bodies - Types of stresses - Deformation of simple and compound bars - Thermal stresses - Biaxial state of stress - Elastic constants - Stresses and deformation of thin cylindrical and spherical shells - Stresses at a point - Stresses on inclined planes - Principal stresses and principal planes - Mohr's circle of stresses.

UNIT II BENDING OF BEAMS 9

Types of loads, supports, beams - Relationship between intensity of load, shearing force and bending moment - Shearing force and bending moment diagrams for statically determinate beams (cantilever, simply supported and overhanging beams) with concentrated load, UDL, uniformly varying load, concentrated moment - Theory of simple bending - Stress distribution at a cross section due to bending moment and shearing force - Flitched beams - Leaf springs.

UNIT III DEFLECTION OF BEAMS 9

Double integration method - Macaulay's method - Area moment method - Conjugate beam method for computation of slopes and deflections of determinant beams.

UNIT IV TORSION 9

Theory of torsion - Stresses and deflection in solid and hollow circular shafts - Power transmitted by shafts - Combined bending moment and torsion on shafts - Shaft in series and parallel - Closed and open coiled helical springs - Springs in series and parallel - Design of buffer springs.

UNIT V ANALYSIS OF TRUSSES 9

Determinate and indeterminate trusses - Analysis of determinate plane trusses - Assumptions - Method of joints - Method of sections - Deflections of pin-jointed plane frames - Lack of fit - Change in temperature - Method of tension coefficient - Application to space trusses.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the concepts of stress and strain, principal stresses and principal planes
CO2 Determine shearing forces, bending moments and their stress distributions in determinate beams
CO3 Calculate the slope and deflection of beams by different methods
CO4 Gain knowledge on theory of torsion, power transmitted by circular shafts, stresses and deformation of helical springs
CO5 Analyze determinate plane and space trusses

TEXTBOOKS:

1. Punmia B. C., Ashok Kumar Jain & Arun Kumar Jain, "Strength of Materials (SMTS 1)", Laxmi Publications, New Delhi, 2011.
2. Rajput R. K., "Strength of Materials", S. Chand and Co., New Delhi, 2015.

REFERENCES:

1. Gambhir M. L., "Fundamentals of Solid Mechanics", PHI Learning Private Limited., New Delhi, 2009.
2. Timoshenko S. B. and Gere J. M., "Mechanics of Materials", Van Nos Reinbhold, New Delhi, 1999.
3. Vazirani V. N. and Ratwani M. M., "Analysis of Structures", Vol I Khanna Publishers, New Delhi,1995.
4. Ugural A. C., "Mechanics of Materials", Wiley India Pvt. Ltd., New Delhi, 2013.
5. https://cfd.annauniv.edu/coursematerial/strength-of-materials.pdf

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3	2	2	2	3	1	1	1	2	3	3	2
2	3	3	3	3	2	3	2	3	1	1	1	2	3	2	2
3	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
4	3	3	3	3	2	2	2	2	1	1	1	2	3	2	2
5	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
Avg.	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**1**	**1**	**1**	**2**	**3**	**3**	**2**

1' = Low; '2' = Medium; '3' = High

PTCE3302 CONSTRUCTION MATERIALS AND TECHNIQUES L T P C
3 0 0 3

UNIT I STONES AND BRICKS 9

Stone as building material - Criteria for selection - Tests on stones - Bricks - Classification - Manufacturing of clay bricks - Tests on bricks - Compressive strength - Water Absorption - Efflorescence - Bricks for special application.

UNIT II LIME, CEMENT AND CONCRETE 9

Lime - Uses - Preparation of lime mortar - Cement - Ingredients - Mechanism of hydration - Cement mortar - Test on cement - Aggregates - Fine and coarse aggregates - Test on aggregates - Ingredients for concrete - Water cement ratio - Concrete blocks - Paver blocks - Hollow blocks - Lightweight concrete blocks.

UNIT III OTHER MATERIALS 9

Timber - Market forms - Plywood - Veneer - False ceiling materials - Laminates - Steel - Mechanical treatment - Aluminium - Uses - Market forms - Glass - Refractories - Composite Materials - FRP - Geo textiles - Floor finishing materials - Bitumen.

UNIT IV CONSTRUCTION PRACTICES 9

Stone masonry - Brick masonry - Cavity walls - Flooring - Formwork - Centering and shuttering - Sheet piles - Slip and moving forms - Roofs and roof covering - Plastering and pointing - Shoring - Scaffolding - Underpinning - Submerged structures.

UNIT V SERVICE REQUIREMENTS 9

Painting, distempering and white washing - Surface preparation and defects in painting and distempering and white washing - Fire Protection - Thermal insulation - Ventilation and air conditioning - Acoustics and sound insulation - Damp proofing - Termite proofing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Identify the good qualities of stones and bricks for construction
CO2 Have thorough knowledge on lime, cement and their products
CO3 Recognize the market forms of other construction materials such as timber, plywood, steel, aluminium etc.
CO4 Explore the various construction practices and practical importance
CO5 Impart knowledge on appropriate service requirements

TEXTBOOKS:

1. Varghese P. C., “Building Construction”, Second Edition, PHI Learning Ltd., 2016.
2. Gambhir and Neha Jamwal, “Building and Construction Materials”, Second Edition, McGraw Hill Education Pvt. Ltd., 2015.

REFERENCES:

1. Arora S. P. and Bindra S. P., “Building Construction”, Dhanpat Rai and Sons,1997.
2. Punmia B. C., “Building Construction”, Laxmi Publication (p) Ltd., 2008.
3. Neville A. M., “Properties of Concrete”, Fourth Edition, Pearson Education Ltd, 2012.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	2	2	3	2	2	3	2	3	3	2	2	2	2
2	3	2	3	3	3	3	2	3	2	3	3	3	3	2	2
3	2	3	2	2	2	2	3	2	2	3	3	3	3	2	2
4	3	2	3	3	3	2	2	3	3	2	2	3	2	2	3
5	3	3	3	3	3	3	3	3	3	2	3	2	3	2	3
Avg.	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**2**	**2**

1’ = Low; ‘2’ = Medium; ‘3’ = High

PTCE3303 SURVEYING L T P C
3 0 0 3

UNIT I FUNDAMENTALS AND CONVENTIONAL SURVEYING 9

Definition - Classifications - Basic principles - Equipment and accessories for ranging and chaining - Methods of ranging - Well conditioned triangles - Chain traversing - Compass - Basic principles - Types - Bearing - System and conversions - Sources of errors and local attraction - Magnetic declination - Dip - Compass traversing - Plane table and its accessories - Merits and demerits - Radiation - Intersection - Resection - Plane table traversing- Maps: Types- Scale- Co-ordinate system.

UNIT II LEVELLING 9

Level line - Horizontal line - Datum - Benchmarks - Levels and staves - Temporary and permanent adjustments - Methods of levelling - Fly levelling - Check levelling - Procedure in levelling - Booking - Reduction - Curvature and refraction - Reciprocal levelling - Precise levelling - Contouring - Methods of interpolating contours - Characteristics and uses of contours - Areas enclosed by straight lines - Irregular figures - Volumes - Earthwork calculations.

UNIT III THEODOLITE SURVEYING 9

Theodolite - Types - Horizontal and vertical angle measurements - Temporary and permanent adjustments - Trigonometric levelling - Heights and distances - Single plane method - Double plane method - Geodetic observation - Tacheometric surveying - Stadia tacheometry - Subtense method - Tangential tacheometry- Curves: Horizontal, Vertical- Setting out of curves.

UNIT IV CONTROL SURVEYING AND ADJUSTMENT 9

Horizontal and vertical control - Methods - Triangulation - Baseline - Instruments and accessories - Corrections - Satellite station - Traversing - Coordinate computation - Gale‘s table - Omitted measurement - Trilateration - Concepts of measurements and errors - The weight of an observation - Law of weight - Adjustment methods - Angles, lengths and levelling network - Simple problems.

UNIT V MODERN SURVEYING 9

Total station: Digital theodolite, EDM, electronic field book - Advantages - Parts and accessories - Working principle - Observables - Errors - COGO functions - Field procedure and applications - GPS: Advantages - System components - Signal structure - Selective availability and antispoofing receiver components and antenna - Planning and data acquisition - Data processing - Errors in GPS - Field procedure and applications- Basis of Photogrammetry and Remote Sensing- Scale, Resolution.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Gain a solid understanding of the fundamental principles and concepts of surveying, including measurements, coordinate systems, accuracy, error analysis, and surveying instruments

CO2 Plan and conduct field surveys effectively

CO3 Conduct surveys to accurately measure and map the features, contours, and elevations of a given area of land using appropriate surveying techniques and equipment

CO4 Analyse survey data using appropriate mathematical and statistical techniques, interpret the results, and generate accurate reports, drawings, and maps based on the collected data

CO5 Imparts the knowledge of modern surveying instruments

TEXT BOOKS:

1. T. P. Kanetkar and S. V. Kulkarni, “Surveying and Levelling”, Part 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 24th edition, 2010, ISBN-10: 8185825114, ISBN-13: 978-8185825113.
2. Dr B. C. Punmia, Ashok K. Jain and Arun K Jain, “Surveying Vol. I & II”, Lakshmi Publications Pvt Ltd, New Delhi, 16th edition, 2016, ISBN-10: 9788170088530, ISBN-13:978-8170088530.

REFERENCES:

1. R. Subramanian, “Surveying and Levelling”, Oxford University Press, 2nd edition, 2012, ISBN-10: 0198085427, ISBN-13: 978-0198085423.
2. James M. Anderson and Edward M. Mikhail, “Surveying, Theory and Practice”, McGraw Hill, 7th edition, 2001, ISBN-10: 0070159149, ISBN-13: 978-0070159143.
3. Bannister and S. Raymond, “Surveying”, Longman, 7th edition, 2004, ISBN-10: 0582302498, ISBN-13: 978-0582302495.
4. S. K. Roy, “Fundamentals of Surveying”, Prentice Hall of India, 2nd edition, 2004, ISBN-10: 9788120341982, ISBN-13: 978-8120341982.
5. K. R. Arora, “Surveying Vol I & II”, Standard Book House, 2019, ISBN-13: 9788189401238.
6. C. Venkatramaiah, “Textbook of Surveying”, Universities Press, 2nd edition, 2011, ISBN-10: 9788173717406, ISBN-13: 978-8173717406.
7. Günter Seeber, “Satellite Geodesy”, Walter de Gruyter, Berlin, 2nd revised and extended edition, 2003.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	2	3	1	2	3	2	1	2	3	3	3
2	3	3	3	3	2	3	2	2	3	1	1	2	3	3	3
3	3	3	3	2	3	3	2	2	3	1	1	3	3	3	3
4	3	2	3	3	3	3	1	2	3	2	1	3	3	3	3
5	3	3	3	3	3	3	2	1	3	2	1	3	3	3	3
Avg.	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**1**	**3**	**3**	**3**	**3**

1’ = Low; ‘2’ = Medium; ‘3’ = High

PTCE3401 STRENGTH OF MATERIALS - II L T P C
3 0 0 3

UNIT I ENERGY PRINCIPLES 9

Strain energy and strain energy density - Strain energy due to axial load, shear, flexure and torsion - Castigliano's theorems - Maxwell's reciprocal theorem - Principle of virtual work - Computing deflections in beams, frames and trusses.

UNIT II INDETERMINATE BEAMS 9

Static and kinematic indeterminacies - Concept of analysis - Propped cantilever and fixed beams - Fixed end moments and reactions - Theorem of three moments - Analysis of continuous beams - Shear force and bending moment diagrams.

UNIT III COLUMNS 9

Euler's column theory - Critical load for prismatic columns with different end conditions - Effective length - Rankine-Gordon formula for eccentrically loaded columns - Eccentrically loaded short columns - Middle third rule - Middle fourth rule - Core section.

UNIT IV STATE OF STRESS IN THREE DIMENSIONS 9

Determination of principal stresses and principal planes - Thick cylinders - Compound cylinders - Shrinking on stresses - Theories of failure - Maximum principal stress theory - Maximum principal strain theory - Maximum shear stress theory - Maximum strain energy theory - Energy of distortion theory - Applications.

UNIT V ADVANCED TOPICS IN BENDING OF BEAMS 9

Unsymmetrical bending of beams of symmetrical and unsymmetrical sections - Shear centre - Curved beams - Winkler Bach formula - Stresses in links and hooks.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Apply the concepts of energy principle for determining deflection of beams, frames, and trusses
CO2 Analyze indeterminate beams using theorem of three moment equations
CO3 Assess the load carrying capacity of long columns and stresses in short columns
CO4 Determine the principal stresses in three-dimensional state of stress, analyze the stresses in thick cylinders and apply various theories of failures
CO5 Gain knowledge in the concept of shear centre, unsymmetrical bending and curved beams

TEXT BOOKS:

1. Rajput R. K. "Strength of Materials", S. Chand & company Ltd., New Delhi, 2015.
2. Punmia B. C., Ashok Kumar Jain and Arun Kumar Jain, "Theory of Structures (SMTS 2)", Laxmi Publishing Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1. Srivastava A. K. and Gope P. C., "Strength of Materials", PHI Learning Private Limited, Delhi, 2014.
2. Rattan S. S., "Strength of Materials", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2011.
3. Ghosh. D, " Advanced Strength of Materials", New Age International Publishers, New Delhi, 2015.
4. Egor P. Popov, "Engineering Mechanics of Solids", 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.
5. Kamal Kumar and Ghai, "Advanced Mechanics of Materials", Khanna Publishers, Delhi, 2015.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3	2	2	2	3	1	1	1	2	3	3	2
2	3	3	3	3	2	3	2	3	1	1	1	2	3	2	2
3	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
4	3	3	3	3	2	2	2	2	1	1	1	2	3	2	2
5	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
Avg.	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**1**	**1**	**1**	**2**	**3**	**3**	**2**

1' = Low; '2' = Medium; '3' = High

PTCE3402 SOIL MECHANICS L T P C
3 0 0 3

UNIT I SOIL CLASSIFICATION AND COMPACTION 9

Formation of soil - Soil description - Particle size, shape and colour - Soil structure - Phase relationship - Index properties - Atterberg limits - Grain size distribution - BIS and Unified soil classification system. Significance - Compaction of soils - Laboratory tests - Field Compaction methods - Factors influencing compaction of soils.

UNIT II EFFECTIVE STRESS AND PERMEABILITY 9

Soil water - Static pressure in water - Effective stress concepts in soils - Capillary phenomena - Darcy's law - Determination of Co-efficient of permeability - Laboratory Determination (Constant head and falling head methods) and field measurement - Pumping out test in unconfined and confined aquifer - Factors influencing permeability of soils - Seepage - Two dimensional flow - Laplace equation - Introduction to flow nets - Determination of seepage loss and exit hydraulic gradient.

UNIT III STRESS DISTRIBUTION AND SETTLEMENT 9

Stress distribution in homogeneous and isotropic medium - Boussinesq theory - (Point load, Line load and Uniformly distributed load) Use of New marks influence chart -Components of settlement - Immediate and consolidation settlement - Terzaghi's one dimensional consolidation theory - Computation of rate of settlement - √t and log t methods- e-log p relationship.

UNIT IV SHEAR STRENGTH 9

Shear strength of cohesive and cohesionless soils - Mohr-Coulomb failure theory - Measurement of shear strength - Direct shear, Triaxial compression, Unconfined compression and Vane shear tests - Pore pressure parameters.

UNIT V SLOPE STABILITY 9

Stability Analysis - Infinite slopes and finite slopes - Total stress analysis for saturated clay - Friction circle method - Use of stability number – Method of slices - Fellenius and Bishop's method - Slope protection measures.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to:

CO1 Demonstrate an ability to identify various types of soils and its properties, formulate and solve engineering Problems

CO2 Understand the flow through soil medium and its impact of engineering solution

CO3 Evaluate the stress distribution in loaded soil medium and soil settlement due to consolidation

CO4 Determine the shear strength of soils and its impact of engineering solutions to the loaded soil medium

CO5 Demonstrate an ability to analyse the stability of finite and infinite slopes and arrive at slope protection measures

TEXTBOOKS:

1. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2015
2. Gopal Ranjan and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age Ltd. International Publisher New Delhi (India) 2006.

REFERENCES:

1. McCarthy, D.F., "Essentials of Soil Mechanics and Foundations". Prentice-Hall, 2006.
2. Coduto, D.P., "Geotechnical Engineering - Principles and Practices", Prentice Hall of India Pvt.Ltd. New Delhi, 2010.
3. Das, B.M., "Principles of Geotechnical Engineering". Brooks / Coles / Thompson Learning Singapore, 8th Edition, 2013.
4. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 2005.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	2	2	3	3	3	2	2	2	2	3	3	3	3
2	3	2	3	2	3	2	3	2	2	2	2	3	3	2	2
3	3	3	2	2	2	2	2	2	2	2	2	3	3	2	2
4	2	3	3	2	2	2	2	2	2	2	2	3	3	2	2
5	3	3	2	2	2	2	2	2	2	2	2	3	3	2	3
Avg.	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**2**

1' = Low; '2' = Medium; '3' = High

PTCE3403 RAILWAYS, AIRPORTS AND HARBOUR ENGINEERING L T P C
3 0 0 3

UNIT I RAILWAY PLANNING AND CONSTRUCTION 10

Elements of permanent way - Rails, Sleepers, Ballast, rail fixtures and fastenings, Selection of gauges - Track Stress, coning of wheels, creep in rails, defects in rails - Route alignment surveys, conventional and modern methods--Geometric design of railway, gradient, super elevation, widening of gauge on curves- Level Crossings.

UNIT II RAILWAY CONSTRUCTION AND MAINTENANCE 8

Earthwork - Stabilization of track on poor soil - Tunneling Methods, drainage and ventilation - Calculation of Materials required for track laying - Construction and maintenance of tracks -Signalling - Railway Station and yards and passenger amenities

UNIT III AIRPORT PLANNING 7

Air transport characteristics-airport classification- site selection, airport planning: objectives, components, layout characteristics, socio-economic characteristics of the Catchment area, typical Airport Layouts, parking and Circulation Area, Terminal area planning- Passenger Facilities and Services

UNIT IV AIRPORT DESIGN 10

Runway Design: Orientation, Wind Rose Diagram, correction factors as ICAO stipulations Problems on basic and actual Length, Geometric Design, Configuration and Pavement Design Principles - Elements of Taxiway Design - Airport Zones - Runway and Taxiway Markings & Lighting

UNIT V HARBOUR ENGINEERING 10

Definition of Basic Terms: Harbour, Port, Satellite Port, Docks, Waves and Tides - Planning and Design of Harbours: Requirements, Classification, Location and Design Principles - Harbour Layout and Terminal Facilities - Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins and Floating Landing Stage - Wave action on Coastal Structures and Coastal Protection Works - Environmental concern of Port Operations- Inland Water Transport.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to:

CO1 Understand the concepts and elements in Planning, Design and construction of Railways

CO2 Select appropriate methods for construction and maintenance of railway tracks and other infrastructures

CO3 Understand the concepts and elements in Planning and selection of site for Airport

CO4 Design the Runway length and evaluate the orientation of runways

CO5 Understand the terminologies, infrastructures in Harbour Engineering and Coastal regulations

TEXTBOOKS:

1. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering, Scitech Publications (India), Chennai, 2010
2. C.Venkatramaiah., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels.,Universities Press (India) Private Limited, Hyderabad, 2015.
3. Vazirani.V.N and Chandola.S.P, "Transportation Engineering-Vol.II", Khanna Publishers, New Delhi, 2015.
4. Sirinivasa Kumar R Transportation Engineering Railways, Airports, Docks and Harbours. University Press 2014
5. Saxena Subhash, C.and Satyapal Arora, A Course in Railway Engineering, Dhanapat Rai and Sons, Delhi, 1998

REFERENCES:

1. Khanna.S.K. Arora.M.G and Jain.S.S, Airport Planning and Design, Nemachand andBros, Roorkee, 1994
2. Mundrey J S, Railway Track Engineering, McGraw Hill Education (India) Private Ltd, New Delhi, 2013.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	2	1	1	1	2	2	1	1	3	3	2	3
2	3	3	3	3	3	3	3	3	2	3	2	2	2	3	2
3	2	2	3	3	2	3	3	2	2	3	2	2	3	2	2
4	3	2	3	3	3	2	3	3	2	3	2	2	2	2	2
5	2	3	3	2	2	2	3	1	1	1	1	3	2	2	2
Avg.	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

1' = Low; '2' = Medium; '3' = High

PTCE3404 FLUID MECHANICS L T P C

3 0 0 3

UNIT I FLUIDS PROPERTIES AND FLUID STATICS 9

Definitions of a fluid - Fluid properties - Methods of analysis - System and Control volume approach - Fluid pressure and it's measurements - Forces on plane and curved surfaces - Buoyancy and floatation - Meta centric height and its application.

UNIT II FLUID FLOW CONCEPTS 9

Classification of flows - Streamline, streak-line and path-lines - Stream function and velocity potentials - Flow nets; Principles of mass, energy and momentum conservation - Euler's equation of motion - Bernoulli's equation - Applications to velocity and discharge measurements - Linear momentum equation - Application to pipe bends

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 9

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT IV REAL FLUID FLOW 9

Reynolds experiment - Laminar flow in pipes and between parallel plates - Development of laminar and turbulent flows in pipes- Hagen -poiseuille's equation- Darcy-Weisbach equation - Moody's diagram - Major and minor losses in pipes - Pipes connected in series and parallel - Equivalent pipes.

UNIT V BOUNDARY LAYERS 9

Definition of boundary layers - Laminar and turbulent boundary layers - Displacement, momentum and energy thickness -von-Karman Momentum integral equation - Applications - Boundary layer separation - Control Measures.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to:

CO1 Demonstrate the difference between solid and fluid, its properties and behaviour in static conditions

CO2 Apply the conservation laws applicable to fluids and its application through fluid kinematics and dynamics

CO3 Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies

CO4 Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel

CO5 Explain the concept of boundary layer and its application to find the drag force excreted by the fluid on the flat solid surface

TEXTBOOKS:

1. Modi P.N and Seth Hydraulics and Fluid Mechanics including Hydraulic Machines, 22nd Ed., Standard Book House New Delhi, 2019.
2. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2015.

REFERENCES:

1. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012
2. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016.
3. Streeter, V.L. Wylie, E. B. and Bedford K.W, Fluid Mechanics. (9 th Ed.) Tata McGraw Hill, NewDelhi, 1998.
4. K.L. Kumar, Engineering Fluid Mechanics, (8th Ed.) S. Chand Publishing (India) Pvt. Ltd., New Delhi, 2016.
5. Philip J. Pritchard, Fox and McDonald's Introduction to Fluid Mechanics, (8th Ed.) John Weily & Sons Inc., 2010.

CO-PO & PSO MAPPING

CO	PO												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	1	1	2	1	2	1	2	3	2	1
2	3	2	1	1	1	1	1	2	1	2	1	2	3	2	1
3	3	2	3	2	1	1	1	2	1	2	1	2	3	3	2
4	3	3	3	2	1	1	1	3	1	2	1	3	3	3	3
5	3	3	2	2	1	1	1	3	1	2	1	3	3	3	3
Avg.	3	2	2	2	1	1	1	2	1	2	1	2	3	3	2

1' = Low; '2' = Medium; '3' = High

PTCE3405 WATER SUPPLY ENGINEERING L T P C
3 0 0 3

UNIT I SOURCES AND QUALITY OF WATER 9

Public water supply system - Planning, Objectives, Design period, Population forecasting; Water demand - Sources of water and their characteristics - Analytical techniques, Surface and Groundwater - Impounding Reservoir - Development and selection of source - Source Water quality - Characterization - Significance - Drinking Water quality standards.

UNIT II COLLECTION AND CONVEYANCE OF WATER 9

Water supply -Types and design of intake structures - Functions; Pipes and conduits for water - Pipe materials - Hydraulics of flow in pipes - Transmission main design - Laying, jointing and testing of pipes - appurtenances - Types and capacity of pumps - Selection of pumps and pipe materials.

UNIT III CONVENTIONAL WATER TREATMENT 9

Objectives - Unit operations and processes - Principles, functions, and design of water treatment plant units, aerators, flash mixers, Coagulation and flocculation -Design of Clarifloccuator, Plate and tube settlers - Pulsator clarifier - sand filters - Disinfection - Residue Management - Operation and Maintenance aspects.

UNIT IV ADVANCED WATER TREATMENT 9

Water softening - Iron and Manganese removal - Defluoridation - Adsorption - Desalination- R.O. Plant - demineralization process -Ion exchange- Membrane Systems - RO Reject Management - Operation & Maintenance aspects - Recent advances.

UNIT V WATER DISTRIBUTION AND SUPPLY 9

Requirements of water distribution - Components - Selection of pipe material - Service reservoirs - Functions - Network design - Analysis of distribution networks - Appurtenances - Leak detection. Principles of design of water supply in buildings - House service connection - Fixtures and fittings, systems of plumbing and types of plumbing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to:

CO1 Understand the various components of water supply scheme

CO2 design of intake structure and conveyance system for water transmission

CO3 Understand the process of conventional treatment of water and design of water treatment system

CO4 Able to understand and design the various advanced treatment system and knowledge about the recent advances in water treatment process

CO5 ability to design and evaluate water distribution system and water supply in buildings

TEXTBOOKS:

1. Garg, S.K. Environmental Engineering, Vol.I Khanna Publishers, New Delhi, 2010.
2. Modi, P.N., Water Supply Engineering, Vol.I Standard Book House, New Delhi, 2010.

REFERENCES:

1. Punmia, B.C.,Ashok Jain and Arun Jain, Water Supply Engineering, Laxmi Publications (P) Ltd., New Delhi, 2010.
2. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
3. Syed R. Qasim and Edward M. Motley Guang Zhu, Water Works Engineering Planning, Design and Operation, Prentice Hall of India Learning Private Limited, New Delhi, 2009.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	3	-	3	-	3	-	2	-	1	-	-	3	2	3
2	3	2	2	-	2	-	3	-	2	-	-	-	3	2	-
3	3	2	3	-	-	-	3	-	2	-	-	-	3	2	-
4	-	2	-	-	3	-	3	-	-	-	-	2	3	2	-
5	3	2	3	2	-	3	-	2	-	-	2	-	3	3	-
Avg.	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**2**	**3**	**2**	**3**

• 1' = Low; '2' = Medium; '3' = High

PTCE3501 **STRUCTURAL ANALYSIS - I** **L T P C**
3 0 0 3

UNIT I SLOPE DEFLECTION METHOD **9**

Slope deflection equations - Equilibrium conditions - Analysis of continuous beams and rigid frames - Rigid frames with inclined members - Support settlements - Symmetric frames with symmetric and skew-symmetric loadings.

UNIT II MOMENT DISTRIBUTION METHOD **9**

Stiffness - Distribution and carry over factors - Analysis of continuous beams - Plane rigid frames with and without sway - Support settlement - Symmetric frames with symmetric and skew-symmetric loadings.

UNIT III FLEXIBLITY METHOD **9**

Primary structures - Compatibility conditions - Formation of flexibility matrices - Analysis of indeterminate pin-jointed plane frames, continuous beams and rigid jointed plane frames by direct flexibility approach.

UNIT IV STIFFNESS METHOD **9**

Restrained structure - Formation of stiffness matrices - Equilibrium condition - Analysis of continuous beams, pin-jointed plane frames and rigid frames by direct stiffness method.

UNIT V APPROXIMATE ANALYSIS OF FRAMES 9

Approximate analysis for gravity loadings - Substitute frame method for maximum moments in beams and columns - Approximate analysis for horizontal loads - Portal method and cantilever method - Assumptions - Axial force, shearing force and bending moment diagrams.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Analyze the continuous beams and rigid frames by slope defection method

CO2 Understand the concept of moment distribution and analysis of continuous beams and rigid frames with and without sway

CO3 Analyze the indeterminate pin jointed plane frames, continuous beams and rigid frames using direct flexibility method

CO4 Understand the concept of direct stiffness method and analysis of continuous beams, pin jointed trusses and rigid plane frames

CO5 Analyze the rigid frames by approximate methods for gravity and horizontal loads

TEXTBOOKS:

1. Bhavikatti S. S., “Structural Analysis Vol. 2”, Vikas Publishing House Pvt. Ltd., New Delhi, 2016.
2. Reddy C. S., “Basic Structural Analysis”, Tata McGraw Hill Publishing Company, 2005.

REFERENCES:

1. Punmia B. C., Ashok Kumar Jain & Arun Kumar Jain, “Theory of structures (SMTS 2)”, Laxmi Publications, New Delhi, 2017.
2. Hibbeler R. C., “Structural Analysis”, VII Edition, Prentice Hall, 2012.
3. Bhavikatti S. S., “Matrix Methods of Structural Analysis”, I.K. International Publishing House Pvt. Ltd., New Delhi, 2014.
4. Vaidyanathan R., Perumal P. & Abdul Aleem M. I., “Structural Analysis, Vol. 3”, Laxmi Publications, New Delhi, 2020.
5. Negi L. S. and Jangid R. S., “Structural Analysis”, Tata McGraw Hill Publishing Co. Ltd., 2004.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3	2	2	2	3	1	1	1	2	3	3	2
2	3	3	3	3	2	3	2	3	1	1	1	2	3	2	2
3	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
4	3	3	3	3	2	2	2	2	1	1	1	2	3	2	2
5	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
Avg.	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2

1’ = Low; ‘2’ = Medium; ‘3’ = High

PTCE3502 DESIGN OF REINFORCED CEMENT CONCRETE STRUCTURES L T P C
3 0 0 3

UNIT I DESIGN CONCEPTS AND DESIGN OF BEAMS FOR FLEXURE 9

Design concepts - Concept of elastic method, ultimate load method and limit state method - Advantages of limit state method over other methods - Design of rectangular beam section by working stress method - Limit state method of design of singly reinforced, doubly reinforced and flanged beams - Use of design aids for flexure.

UNIT II LIMIT STATE DESIGN OF BEAMS FOR SHEAR, TORSION AND SERVICEABILITY 9

Limit state design of RC beams for shear and torsion - Design of RC beams for combined bending, shear and torsion - Use of design aids - Design requirement for bond and anchorage as per IS code - Detailing of reinforcement - Concept of serviceability - Serviceability requirements for deflection.

UNIT III LIMIT STATE DESIGN OF SLABS AND STAIRCASE 9

Behaviour of one way and two-way slabs - Design of one way simply supported, cantilever and continuous slabs - Design of two-way slabs for various edge conditions - Torsion reinforcement at corners - Design of flat slabs - Types of staircases - Design of dog-legged staircase.

UNIT IV LIMIT STATE DESIGN OF COLUMNS AND FOOTING 9

Types of columns - Design of short columns for axial load, combined axial load with uniaxial and biaxial bending - Use of design aids - Design of footing for masonry and reinforced walls - Design of axially and eccentrically loaded square and rectangular footings - Design of combined rectangular footings for two columns.

UNIT V DESIGN OF MISCELLANEOUS STRUCTURES 9

Design of cantilever retaining wall, RC water tanks and single-story RC building frame - Introduction to computer-aided RC design (Demo only).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Explain the various design concepts and design a beam under flexure and draw the reinforcement details

CO2 Design the beam under shear and torsion, calculate the anchorage and development length and check the serviceability requirements for RC structural elements

CO3 Design a RC slab and staircase and draw the reinforcement details

CO4 Design short columns and strip, isolated and combined footings, and draw the reinforcement details

CO5 Design a retaining wall, water tank and a framed RC building and draw the reinforcement details

TEXT BOOKS:

1. Gambhir M. L., “Fundamentals of Reinforced Concrete Design”, McGraw Hill Education India Pvt. Limited, 2017.
2. Sinha S. N., “Reinforced Concrete Design”, Tata McGraw-Hill, New Delhi, 2002.

REFERENCES:

1. Unnikrishnan Pillai and Devdas Menon, “Reinforced Concrete Design”, Third Edition, Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 3rd Edition, 2017.
2. Subramanian N., “Design of Reinforced Concrete Structures”, Oxford University Press, New Delhi, 2014.
3. Varghese P. C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India Pvt. Ltd., New Delhi, Second Edition, 2008.
4. Punmia B. C., Ashok K. Jain and Arun K. Jain, “Limit State Design of Reinforced Concrete”, Laxmi Publications (P) Ltd., New Delhi, 2016.

IS CODES

1. IS 456: 2000, “Plain and Reinforced Concrete - Code of Practice”.
2. IS 875 (1-5): 1987, “Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures”.
3. SP 16: 1980, “Design Aids for Reinforced Concrete to IS 456:1978”.
4. SP 34: 1987, “Handbook of concrete reinforcement and detailing”.
5. National Building Code of India 2016 (NBC 2016).

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	2	3	2	2	3	2	1	3	3	3	3
2	3	3	3	3	2	3	2	2	3	2	1	3	3	2	3
3	3	3	3	3	2	3	2	2	3	2	1	3	3	3	3
4	3	3	3	3	2	3	2	2	3	2	1	3	3	2	3
5	3	3	3	3	3	3	2	2	3	2	1	3	3	3	3
Avg.	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**1**	**3**	**3**	**3**	**3**

1' = Low; '2' = Medium; '3' = High

PTCE3503 FOUNDATION ENGINEERING L T P C
3 0 0 3

UNIT I SITE INVESTIGATION AND SELECTION OF FOUNDATION 9

Scope and objectives - Methods of exploration - Auguring and boring - Wash boring and rotary drilling - Depth and spacing of bore holes - Soil samples (Representative and undisturbed) - Sampling methods - Split spoon sampler, Thin wall sampler, Stationary piston sampler - Penetration tests (SPT and SCPT) - Data interpretation - Selection of foundation based on soil condition - Bore log report.

UNIT II SHALLOW FOUNDATION 9

Introduction - Location and depth of foundation - Codal provisions - Bearing capacity of shallow foundation on homogeneous deposits - Terzaghi's formula and BIS formula - Factors affecting bearing capacity - Bearing capacity from in-situ tests (SPT, SCPT and plate load) - Allowable bearing pressure - Determination of Settlement of foundations on granular and clay deposits - Total and differential settlement - Allowable settlements - Codal provision - Methods of minimizing total and differential settlements.

UNIT III FOOTINGS AND RAFTS 9

Types of Isolated footing, Combined footing, Mat foundation - Contact pressure and settlement distribution - Proportioning of foundations for conventional rigid behaviour - Minimum depth for rigid behaviour - Applications - Floating foundation - Codal provision.

UNIT IV PILE FOUNDATION 9

Types of piles and their functions - Factors influencing the selection of pile - Carrying capacity of single pile in granular and cohesive soil - Static formula - Dynamic formulae (Engineering news and Hileys) - Capacity from insitu tests (SPT, SCPT) - Negative skin friction - Uplift capacity - Group capacity by different methods (Feld's rule, Converse - Labarra formula and block failure criterion) - Settlement of pile groups - Interpretation of pile load test (routine test only), Under reamed piles - Capacity under compression and uplift - Codal provision.

UNITV RETAINING WALLS 9

Plastic equilibrium in soils - Active and passive states - Rankine's theory - Cohesionless and cohesive soil - Coulomb's wedge theory - Condition for critical failure plane - Earth pressure on retaining walls of simple configurations - Culmann Graphical method - Pressure on the wall due to line load - Stability analysis of retaining walls.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Plan and execute a detailed site investigation to select geotechnical design parameters and type of foundation

CO2 Determine the bearing capacity and settlement of shallow foundations as per the codal provisions
CO3 Proportion isolated, combined footings and raft foundations, its component or process as per the needs and specifications
CO4 Evaluate the load carrying capacity and settlement of deep foundations as per the codal provisions
CO5 Analyse the stability of retaining walls by considering the plastic equilibrium of soils

TEXTBOOKS:

1. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers and Distributers Ltd., New Delhi, 2015.
2. Gopal Ranjan and Rao A.S.R. "Basic and Applied soil mechanics", New Age International (P) Ltd, New Delhi,2006.

REFERENCES:

1. Das, B.M. "Principles of Foundation Engineering" (Eighth edition), Thompson Asia Pvt. Ltd., Singapore, 2013.
2. Kaniraj, S.R. "Design aids in Soil Mechanics and Foundation Engineering", Tata McGraw Hill publishing company Ltd., New Delhi, 2002.
3. Varghese, P.C.,"Foundation Engineering", Prentice Hall of India Private Limited, New Delhi, 2005.
4. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd., New Delhi, 2005.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	3	2	2	3	3	3	2	2	2	2	3	3	3	3
2	3	2	3	2	3	2	3	2	2	2	2	3	3	2	2
3	3	3	2	2	2	2	2	2	2	2	2	3	3	2	2
4	2	3	3	2	2	2	2	2	2	2	2	3	3	2	2
5	3	3	2	2	2	2	2	2	2	2	2	3	3	2	3
Avg.	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**2**

1' = Low; '2' = Medium; '3' = High

PTCE3504 **HIGHWAY ENGINEERING** **L T P C**
3 0 0 3

UNIT I HIGHWAY PLANNING AND ALIGNMENT 8

History of road development in India - Classification of highways - Institutions for Highway planning, design and construction at different levels - factors influencing highway alignment - Road ecology - Engineering surveys for alignment, objectives, conventional and modern methods. Typical cross sections of Urban and Rural roads - cross sectional elements.

UNIT II GEOMETRIC DESIGN OF HIGHWAYS 10

Importance of geometric design, Sight distance - stopping sight distance-overtaking sight distance - sight distance at intersections, Design of horizontal alignment - super elevation, widening of pavements, transition curves. Design of vertical alignment - gradients, summit, and valley curves-IRC standards-Road signs and safety. Urban utility services.

UNIT III DESIGN OF FLEXIBLE PAVEMENTS 9

Desirable properties of subgrade soil, road aggregates and bituminous materials, testing methods - Pavement components and their functions - Factors influencing the design of pavements - Design principles - Design of flexible pavements as per IRC.

UNIT IV DESIGN OF RIGID PAVEMENTS 9

Rigid Pavement components and their functions- Factors affecting cement concrete pavements, stresses in rigid pavements: Westergaard's theory, Wheel load stress, Temperature stresses, Frictional stresses, design of joints- dowel bars- tie bars, design of rigid pavement using IRC method

UNIT V HIGHWAY CONSTRUCTION AND MAINTENANCE 10

Construction of subgrade, subbase, base layers, bituminous and cement concrete roads modern materials and methods, Highway drainage - Special considerations for hilly roads; Pavement failures - Types and causes of failures in flexible and rigid pavements. Evaluation and Maintenance of pavements.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the concepts and standards adopted in Planning, Design and construction of Highways and its related infrastructures

CO2 Apply the knowledge of science and engineering fundamentals in designing the geometrics for an efficient Highway network and design concepts

CO3 Apply the knowledge of science and engineering fundamentals in designing flexible pavement. by adopting various design standards

CO4 Design rigid pavements based on design concepts and codal provisions

CO5 Select appropriate methods for construction, evaluation and maintenance of roadways

TEXTBOOKS:

1. Veeraragavan. A, Khanna.K and Justo.C.E.G. Highway Engineering, Nem Chand & Bros Publishers, 2014
2. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering,Scitech Publications (India), Chennai, 2010
3. C.Venkatramaiah., Transportation Engineering-Highway Engineering, Universities Press `(India) Private Limited, Hyderabad, 2015
4. Subhash C Saxena, Textbook of Highway and Traffic Engineering. CBS Publishers, 2017.
5. R.Srinivasa Kumar., Textbook of Highway Engineering Universities Press (India) Private Limited, Hyderabad, 2011

REFERENCES:

1. Partha Chakroborty and Animesh Das Principles of Transportation Engineering, PHI Learning Pvt. Ltd., 2005
2. Kadiyali. L. R. Principles and Practice of Highway Engineering, Khanna Technical Publications, Delhi, 1997.
3. Indian Road Congress (IRC), Guidelines and Special Publications on Planning and Design of Highways.
4. Sharma.S.K Principles , Practices and Design of Highway Engineering, S.Chand and Company Ltd.1995
5. Indian Road Congress (IRC), Guidelines and Special Publications on Planning and Design of Highways.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	2	2	2	2	1	1	2	2	3	2	2
2	3	3	3	2	2	2	1	2	2	2	2	2	3	3	3
3	3	3	3	2	2	2	1	1	1	2	2	2	2	3	3
4	3	3	3	2	2	2	2	1	2	2	2	2	2	3	3
5	2	2	2	3	2	2	2	2	3	2	2	2	3	3	3
Avg.	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**

1' = Low; '2' = Medium; '3' = High

PTCE3505 APPLIED HYDRAULIC ENGINEERING L T P C
3 0 0 3

UNIT I UNIFORM FLOW 9

Definition and differences between pipe flow and open channel flow -Types of Flow - Properties of open channel - Fundamental equations - Subcritical, Supercritical and Critical flow - Velocity distribution in open channel - Steady uniform flow: Chezy equation, Manning equation - Best hydraulic sections for uniform flow - Computation in Uniform Flow - Specific energy - Channel transitions (vertical and horizontal).

UNIT II VARIED FLOWS 9

Dynamic equation of gradually varied flow - GVF profile classifications - Profile determination by numerical methods: Direct step method and standard step method - Break in grades.

UNIT III RAPIDLY VARIED FLOWS 9

Application of the momentum equation for RVF - Hydraulic jump - Types -Sequent depth ratio - Energy dissipation - Unsteady RVF -Positive and negative surges - Applications.

UNIT IV TURBINES 9

Impact of jets on curved vanes -Turbines -Working principles - Classification - Impulse turbine - Pelton wheel - Reaction turbines - Francis turbine - Kaplan turbine - Draft tube - Cavitation - Performance of turbine - Specific speed - Runaway speed.

UNIT V PUMPS 9

Centrifugal pumps -Working principles -Minimum speed to start the pump - NPSH -Cavitations in pumps - Operating characteristics - Multistage pumps - Reciprocating pumps - Negative slip - Indicator diagrams and its variations - Air vessels - Savings in work done.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to:

CO1 Describe the basics of open channel flows, its classifications and analysis of uniform flow in steady state conditions with specific energy concept and its application

CO2 Analyse steady gradually varied flow, water surface profiles and its length calculation using direct and standard step methods with change in water surface profiles due to change in grades

CO3 Derive the relationship among the sequent depths of steady rapidly varied flow and estimating energy loss in hydraulic jump with exposure to positive and negative surges

CO4 Design of Pelton wheel, Francis and Kaplan turbines and explain the working principles of each turbine with draft tube theory for reaction turbines

CO5 Differentiate pumps and explain the working principle with characteristic curves and design centrifugal and reciprocating pumps

TEXT BOOKS:

1. Jain. A.K., Fluid Mechanics, Khanna Publishers, Delhi, 2010.
2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 19th edition, 2013.

REFERENCES:

1. VenTe Chow, Open Channel Hydraulics, McGraw Hill, New York, 2009.
2. Subramanya K., Flow in open channels, Tata McGraw Hill, New Delhi, 2000.
3. Chandramouli P N, Applied Hydraulic Engineering, Yes Dee Publisher, 2017.
4. Sturm T.W., Open Channel Hydraulics - Tata-McGraw Hill 2nd edition, New Delhi 2011.
5. Srivastava R. Flow through Open Channels Oxford University Press New Delhi, 2008.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	3	1	2	2	2	1	2	1	3	3	2	3
2	3	3	2	3	1	2	2	2	1	2	1	3	3	2	3
3	3	3	2	3	1	3	2	2	1	2	1	3	3	2	3
4	3	3	3	3	1	3	2	2	1	2	1	3	3	2	3
5	3	3	2	3	1	3	2	2	1	2	1	3	3	2	3
Avg.	**3**	**3**	**2**	**3**	**1**	**3**	**2**	**2**	**1**	**2**	**1**	**3**	**3**	**2**	**3**

1' = Low; '2' = Medium; '3' = High

PTCE3601 STRUCTURAL ANALYSIS - II L T P C
3 0 0 3

UNIT I INFLUENCE LINES FOR DETERMINATE STRUCTURES 9

Influence lines for reactions in statically determinate structures - Influence lines for shear force and bending moment in beam sections - Calculation of critical stress resultants due to concentrated and distributed moving loads - Influence lines for member forces in pin-jointed plane frames.

UNIT II INFLUENCE LINES FOR INDETERMINATE BEAMS 9

Influence line for support reactions, shearing force and bending moments for indeterminate beams - Propped cantilevers, Fixed beams and Continuous beams - Muller Breslau's principle.

UNIT III ARCHES 9

Arches - Types of arches - Analysis of three-hinged, two-hinged and fixed arches - Parabolic and circular arches - Settlement and temperature effects.

UNIT IV SUSPENSION BRIDGES 9

Equilibrium of cable - Length of cable - Anchorage of suspension cables - Stiffening girders - Cables with three-hinged stiffening girders - Influence lines for three-hinged stiffening girders.

UNIT V PLASTIC ANALYSIS 9

Basis of plastic analysis and design - Material behavior - Cross-section behavior - Plastic moment of resistance - Plastic modulus - Shape factor - Load factor - Plastic hinge and mechanism - Static and kinematic methods - Upper and lower bound theorems - Plastic analysis of indeterminate beams and frames.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Draw influence lines for various stress functions for determinate beams and plane trusses
CO2 Gain knowledge in drawing influence lines for determinate beams
CO3 Analyze three-hinged, two-hinged and fixed arches
CO4 Explain the load transfer mechanism in suspension cables and the purpose of stiffening girders
CO5 Explore the basis of plastic analysis and design of structures

TEXTBOOKS:

1. Punmia B. C., Ashok Kumar Jain and Arun Kumar Jain, "Theory of structures (SMTS 2)", Laxmi Publications, 2004.
2. Vaidyanathan R. and Perumal P., "Structural Analysis, Vol. 2", Laxmi Publications, 2017.

REFERENCES:

1. Negi L. S. and Jangid R. S., “Structural Analysis”, Tata McGraw-Hill Publishers, 2004.
2. Vazrani V. N. and Ratwani M. M., “Analysis of Structures, Vol.II”, Khanna Publishers, 2015.
3. Gambhir M. L., “Fundamentals of Structural Mechanics and Analysis”, PHIL earning Pvt. Ltd., 2011.
4. Ramamrutham S. and Narayanan R., "Theory of Structures", Dhanpat Rai Publishing Company, New Delhi, 2019.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3	2	2	2	3	1	1	1	2	3	3	2
2	3	3	3	3	2	3	2	3	1	1	1	2	3	2	2
3	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
4	3	3	3	3	2	2	2	2	1	1	1	2	3	2	2
5	3	3	3	3	2	3	2	3	1	1	1	2	3	3	2
Avg.	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**1**	**1**	**1**	**2**	**3**	**3**	**2**

1’ = Low; ‘2’ = Medium; ‘3’ = High

PTCE3602 DESIGN OF STEEL STRUCTURES L T P C
3 0 0 3

UNIT I INTRODUCTION TO STRUCTURAL STEEL AND DESIGN OF CONNECTIONS 9

General - Types of steel - Properties of structural steel - I. S. rolled sections - Concept of limit state design - Design of simple and eccentric bolted and welded connections - Efficiency of joint - Prying action - Design of HSFG bolts - IS 800: 2007.

UNIT II TENSION MEMBERS 9

Behavior and design of simple and built-up members subjected to tension - Shear lag effect - Design of lug angles - Tension splice.

UNIT III FLEXURAL MEMBERS 9

Design of laterally supported and unsupported beams - Design of built-up beams - Design of plate girders.

UNIT IV COMPRESSION MEMBERS 9

Design of simple and built-up compression members with lacings and battens - Design of column bases - Slab base and gusseted base.

UNIT V INDUSTRIAL STRUCTURES 9

Design of roof trusses - Loads on trusses - Purlin design using angle and channel sections - Truss design - Design of joints and end bearings - Design of gantry girder - Introduction to pre-engineered buildings.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Identify the different failure modes of bolted and welded connections, and to determine their design strengths

CO2 Select the most suitable section shape and size for tension members as per specific design criteria

CO3 Design laterally supported and unsupported beams

CO4 Select the most suitable section shape and size for compression members according to specific design criteria

CO5 Identify and compute the design loads on Industrial structures, and gantry girder

TEXT BOOKS:

1. Gambhir M. L., "Fundamentals of Structural Steel Design", McGraw Hill Education India Pvt. Ltd., 2013.
2. Subramanian N., "Design of Steel Structures", Oxford University Press, New Delhi, 2013.
3. Duggal S. K., "Limit State Design of Steel Structures", Tata McGraw Hill Publishing Company, 2005.

REFERENCES:

1. Narayanan R. et. al., "Teaching Resource on Structural Steel Design", INSDAG, Ministry of Steel Publications, 2002.
2. Bhavikatti S. S., "Design of Steel Structures by Limit State Method as per IS: 800 - 2007", IK International Publishing House Pvt. Ltd., 2009.
3. Shah V. L. and Veena Gore, "Limit State Design of Steel Structures", IS: 800 - 2007, Structures Publications, 2009.
4. IS 800: 2007, "General Construction in Steel - Code of Practice", Third Revision, Bureau of Indian Standards, New Delhi, 2007.
5. Sai Ram K. S., "Design of Steel Structures", Dorling Kindersley (India) Pvt. Ltd., New Delhi, 2nd Edition, 2015, www.pearsoned.co.in/kssairam.
6. Shiyekar M. R., "Limit State Design in Structural Steel", Prentice Hall of India Pvt. Ltd., 2nd Edition, 2013.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	2	1	1	1	1	1	1	1	3	3	3
2	3	2	3	2	2	2	1	1	1	1	1	1	3	3	3
3	3	2	3	2	2	2	1	1	1	1	1	1	3	3	3
4	3	2	3	2	2	2	1	1	1	1	1	1	3	3	3
5	3	3	2	2	2	1	1	1	1	1	1	1	3	3	3
Avg.	**3**	**2**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**3**

1' = Low; '2' = Medium; '3' = High

PTCE3603 WASTEWATER ENGINEERING L T P C
3 0 0 3

UNIT I PLANNING AND DESIGN OF SEWERAGE SYSTEM 9

Characteristics and composition of sewage-- population equivalent - Sanitary sewage flow estimation - Sewer materials - Hydraulics of flow in sanitary sewers - Sewer design - Storm runoff estimation - sewer appurtenances - sewage pumping-drainage in buildings-plumbing systems for drainage- Discharge standards for Effluents.

UNIT II PRIMARY TREATMENT OF SEWAGE 9

Objectives - Unit Operations and Processes - Selection of treatment processes - Onsite sanitation - Septic tank- Primary treatment - Principles, functions and design of sewage treatment units - screens - grit chamber-primary sedimentation tanks - Operation and Maintenance aspects.

UNIT III SECONDARY TREATMENT OF SEWAGE 9

Objectives - Selection of Treatment Methods - Principles, Functions, - Activated Sludge Process and Extended aeration systems -Rotating biological contactors, Trickling filters Waste Stabilization Ponds - Operation and Maintenance

UNIT IV ADVANCES IN SEWAGE TREATMENT 9

Sequencing Batch Reactor - Moving bed biofilm reactor-Membrane Bioreactor - UASB - Biogas recovery- Reclamation and Reuse of sewage - Constructed Wetland -Nutient removal systems.

UNIT V SEWAGE DISPOSAL AND SLUDGE MANAGEMENT 9

Dilution - Self purification of surface water bodies Oxygen sag curve - deoxygenation and reaeration - Land disposal - Sewage farming - sodium hazards - Soil dispersion system. Objectives - Sludge characterization - Sludge Thickening - Dewatering - Drying - Ultimate residue disposal - Septage Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand on the characteristics and composition of sewage, ability to estimate sewage generation and design sewer system including sewage pumping stations

CO2 Select type of treatment system and able to perform basic design of the unit operations that are used in sewage treatment. knowledge of septic tank design

CO3 Gain knowledge of selection of treatment process and biological treatment process

CO4 Acquire knowledge of advance treatment technology and reuse of sewage

CO5 Understand the, self-purification of streams and sludge and septage disposal methods

TEXTBOOKS:

1. Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers,New Delhi, 2015.
2. Duggal K.N., “Elements of Environmental Engineering” S.Chand and Co. Ltd., New Delhi, 2014.
3. Punmia, B.C., Jain, A.K., and Jain.A.K.., Environmental Engineering, Vol.II, Laxmi Publications, 2010.

REFERENCES:

1. Manual on Sewerage and Sewage Treatment Systems Part A,B and C, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
2. Metcalf and Eddy- Wastewater Engineering-Treatment and Reuse, Tata Mc.Graw-Hill Company, New Delhi, 2010.
3. Syed R. Qasim “Wastewater Treatment Plants”*Planning, Design, and Operation, Second Edition* CRC Press, Washington D.C.,2017
4. Gray N.F, “Water Technology”, Elsevier India Pvt. Ltd., New Delhi, 2006.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	2	3	-	3	3	-	-	1	3	-	-	3	3
2	3	-	3	2	2	3	3	-	2	-	-	-	3	3	3
3	3	-	3	2	-	-	3	-	2	-	-	-	3	2	3
4	2	-	3	2	3	-	3	-	-	-	2	3	3	2	3
5	2	2	3	2	2	3	3	3	-	-	2	3	3	3	3
Avg.	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**3**	**2**	**1**	**2**	**3**	**3**	**3**	**3**

1’ = Low; ‘2’ = Medium; ‘3’ = High

PTMG3601 PRINCIPLES OF MANAGEMENT L T P C
3 0 0 3

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Manager Vs Entrepreneur – Nature, scope and purpose of Management - Evolution of Management Thought – Classical theory, Scientific management, Behavioural Science, Systems and Contingency approaches – Functions, roles, and skills of an effective manager

Types of business organization - Sole proprietorship, partnership, company-public and private sector enterprises

Environment – Understanding environment of a business – Common frameworks used to evaluate a business environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – Planning process – Types of planning – Vision, mission and objectives – Setting objectives – Policies – Planning premises

Strategic Management – Types of strategies

Planning Tools and Techniques – Introduction to forecasting – Decision making steps and process – Group decision making – Creative problem-solving.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority - Span of control – Departmentalization – delegation of authority – Centralization and decentralization

Organization culture and its impact on organization effectiveness – Creating an organization culture – Characteristics of organization culture

UNIT IV STAFFING AND DIRECTING 9

Introduction to Human Resource Management – Introduction to the functions of HRM - HR Planning, Recruitment, Selection, Training and Development, Performance Management, Career planning - Job Design.

Motivation – Leadership – Communication – Process of communication – Barrier incommunication and Effective communication

UNIT V CONTROLLING 9

Process of controlling – Financial and non-financial controls in business – Budget and budgetary control – Control and performance – Use of computers and IT in Management control.

Globalization and business – Reporting - Change management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Understand and differentiate between management thoughts, and explain how management has evolved

CO2: Identify and apply appropriate planning, organizing and directing techniques for managing business

CO3: Understand and apply concepts, principles and theories of management

CO4: Select and apply the appropriate tools used in the different management functions

CO5: Identify global and contemporary issues and trends in management'

REFERENCES

1. Stephen A. Robbins and David A. Decenzo, Fundamentals of Management, Pearson Education, 9th Edition, 2016.
2. Harold Koontz and Heinz Weihrich, Essentials of management, Tata McGraw Hill, 9th Edition, 2012.
3. Stephen P. Robbins and Mary Coulter, Management, Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.

4. Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.
5. Richard Daft, Principles of Management, Cengage Learning, 2009.

CO-PO & PSO MAPPING

CO	PO									PSO		
	1	2	3	4	5	6	7	8	9	10	11	12
1							1				2	2
2				2					2	2	2	1
3				2					2		2	1
4				2	2				2	2	2	1
5							1				2	1
Avg.				**2**	**2**		**1**		**2**	**2**	**2**	**1**

1' = Low; '2' = Medium; '3' = High

PTCE3701 IRRIGATION ENGINEERING L T P C
3 0 0 3

UNIT I IRRIGATION PRINCIPLES 9

Need for irrigation - Advantages and ill effects - Development of irrigation - National Water Policy - Tamil Nadu scenario -Soil water plant relationship: Soil classification, Field capacity, permanent and temporary wilting point -Physical properties of soil that influence soil moisture characteristics - Concept of soil water potential and its components: Gravitational and Osmotic pressures- Retention of water in soils - Concept of available water - Movement of water into and within the soils - Measurement of soil moisture content.

UNIT II CROP WATER REQUIREMENT 9

Necessity and importance- Crop and crop seasons in India -Duty, Delta, Base Period- Factors affecting Duty-Irrigation efficiencies- Consumptive use of water-Irrigation requirements of crops - Irrigation scheduling: CROPWAT-Standards for irrigation water- Planning and Development of irrigation projects.

UNIT III DIVERSION AND IMPOUNDING STRUCTURES 9

Purpose and components of diversion Head works -Weirs and Barrages -Types of impounding structures - Factors affecting, location of dams -Forces on a dam -Design of Gravity dams; Earth dams, Arch dams - Spillways -Energy dissipaters.

UNIT IV CANAL IRRIGATION 9

Classification of canals- Alignment of canals - Design of irrigation canals-Regime theories:Kennedy's theory, Lacey's theory - Canal Head works - Canal regulators - Canal drops - Cross drainage works - Canal Outlets, Escapes -Lining and maintenance of canals - Other methods of Irrigation: Surface, Subsurface - Merits and Demerits.

UNIT V IRRIGATION WATER MANAGEMENT 9

Modernization techniques -Rehabilitation - Command Area Development - Systems of rice intensification - Water delivery systems - Participatory Irrigation Management - Farmers' organization and turn over - Water users' associations - Economic aspects of irrigation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the basics of soil-plant-water characteristics and the National Water Policy
CO2 Estimate the crop water requirement, after understanding the basics

CO3 Discuss the various types of hydraulic structure including dams, spillways and energy dissipaters
CO4 Design the irrigation canal, detail the canal drops and cross drainage works and to discuss on the various irrigation methods
CO5 Apply the concepts of Irrigation water management, water user association for participatory irrigation management

TEXTBOOKS:
1. R.K. Sharmaand T.K. Sharma, "Irrigation Engineering", S. Chand and Company, New Delhi, 2008.
2. S.K. Garg, "Irrigation Engineering", Laxmi Publications, New Delhi, 2008.

REFERENCES:
1. C.S.N. Murthy, Water Resources Engineering - Principles and Practice, 2nd Edition, New Age International Publishers, 2020.
2. K.R. Arora, Irrigation, Water Power and Water Resources Engineering, Standard Publishers Distributors, New Delhi, 2009.
3. N.N. Basak, Irrigation Engineering, Tata McGraw-Hill Publishing Co, New Delhi, 2008.
4. Dilip Kumar Majumdar, Irrigation Water Management, Prentice-Hall of India, New Delhi, 2008.
5. B.C. Punmia, Irrigation and Water Power Engineering, Laxmi Publishers, New Delhi, 2008.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	1	1	1	1	1	1	1	1	2	3	1	1
2	1	1	1	1	2	2	1	1	1	2	1	2	3	2	2
3	2	3	1	2	1	1	1	2	1	1	1	2	3	1	1
4	2	3	1	1	1	1	1	2	1	1	1	2	3	1	1
5	1	1	1	2	1	2	2	2	2	2	2	2	3	2	2
Avg.	1	2	1	1	1	1	1	2	1	1	1	2	3	1	1

1' = Low; '2' = Medium; '3' = High

PTCE3702 ESTIMATION, COSTING AND VALUATION ENGINEERING L T P C
3 0 0 3

UNIT I QUANTITY ESTIMATION 9
Philosophy - Purpose - Methods of estimation - Types of estimates - Approximate estimates - Detailed estimate - Estimation of quantities for buildings, roads, canals and hydraulic structures - Estimation of simple structures using computer softwares.

UNIT II RATE ANALYSIS AND COSTING 9
Standard data - Observed data - Schedule of rates - Market rates - Assessment of man hours and machineries for common civil works - Rate analysis - Rate analysis and cost estimates using computer softwares.

UNIT III SPECIFICATIONS, REPORTS AND TENDERS 9
Specifications - Detailed and general specifications - Constructions - Sources - Types of specifications - Principles for report preparation - Report on estimate of residential building - Culvert - Roads - TTT Act 2000 - Tender notices - Types - Tender procedures - Drafting model tenders, E-tendering - Digital signature certificates - Encrypting - Decrypting - Reverse auctions.

UNIT IV CONTRACTS **9**

Contract - Types of contracts - Formation of contract - Contract conditions - Contract for labour, material, design, construction - Drafting of contract documents based on IBRD / MORTH Standard bidding documents - Construction contracts - Contract problems - Arbitration and legal requirements.

UNIT V VALUATION **9**

Definitions - Various types of valuations - Valuation methods - Valuation of land - Buildings - Valuation of plant and machineries - Calculation of standard rent - Mortgage - Lease.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Explain the basic concept of quantity estimation for building, roads, canals and hydraulic structures by manual and software packages

CO2 Acquire the knowledge to calculate rate analysis and man-hours required for the common civil works by manual and software packages

CO3 Develop the specification for the materials used in construction, online and offline tender procedures and tender document preparation and report preparation

CO4 Acquire the knowledge of construction contracts and contract document preparation

CO5 Identify the valuation for building, land and plant and machineries, calculation of rent, mortgage and lease

TEXTBOOKS:

1. B. N. Dutta, “Estimating and Costing in Civil Engineering”, CBS Publishers & Distributors (P) Ltd, Twenty eighth revised edition, 2020.
2. B. S. Patil, “Civil Engineering Contracts and Estimates”, 7th edition, University Press, 2015.
3. D. N. Banerjee, “Principles and Practices of Valuation”, V Edition, Eastern Law House, 2015.

REFERENCES:

1. Hand Book of Consolidated Data - 8/2000, Vol.1, TNPWD.
2. Tamil Nadu Transparencies in Tenders Act, 1998 and rules 2000.
3. Arbitration and Conciliation Act, 1996.
4. Standard Bid Evaluation Form, Procurement of Good or Works, The World Bank, April 1996.
5. Standard Data Book for Analysis and Rates, IRC, New Delhi, 2019.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
3	3	1	1	2	2	2	2	2	2	3	2	3	3	3	3
4	3	1	1	2	2	2	2	2	2	3	2	3	3	3	3
5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg.	3	2	2	3	3	3	3	3	3	3	3	3	3	3	3

1’ = Low; ‘2’ = Medium; ‘3’ = High

PTGE3851 **HUMAN VALUES AND ETHICS** **L T P C**
2 0 0 2

COURSE DESCRIPTION

This course aims to provide a broad understanding about the modern values and ethical principles that have evolved and are enshrined in the Constitution of India with regard to the democratic, secular and scientific aspects. The course is designed for undergraduate students so that they could study, understand and apply these values in their day to day life.

COURSE OBJECTIVES:

- To create awareness about values and ethics enshrined in the Constitution of India
- To sensitize students about the democratic values to be upheld in the modern society.
- To inculcate respect for all people irrespective of their religion or other affiliations.
- To instill the scientific temper in the students' minds and develop their critical thinking.
- To promote sense of responsibility and understanding of the duties of citizen.

UNIT I DEMOCRATIC VALUES 6

Understanding Democratic values: Equality, Liberty, Fraternity, Freedom, Justice, Pluralism, Tolerance, Respect for All, Freedom of Expression, Citizen Participation in Governance – World Democracies: French Revolution, American Independence, Indian Freedom Movement.

Reading Text: Excerpts from John Stuart Mills' *On Liberty*

UNIT II SECULAR VALUES 6

Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices.

Reading Text: Excerpt from *Secularism in India: Concept and Practice* by Ram Puniyani

UNIT III SCIENTIFIC VALUES 6

Scientific thinking and method: Inductive and Deductive thinking, Proposing and testing Hypothesis, Validating facts using evidence based approach – Skepticism and Empiricism – Rationalism and Scientific Temper.

Reading Text: Excerpt from *The Scientific Temper* by Antony Michaelis R

UNIT IV SOCIAL ETHICS 6

Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.

Reading Text: Excerpt from *21 Lessons for the 21st Century* by Yuval Noah Harari

UNIT V SCIENTIFIC ETHICS 6

Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society.

Reading Text: Excerpt from *American Prometheus: The Triumph and Tragedy of J.Robert Oppenheimer* by Kai Bird and Martin J. Sherwin.

TOTAL: 30 PERIODS

REFERENCES:

1. The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press, 2016.
2. Secularism: A Dictionary of Atheism, Bullivant, Stephen; Lee, Lois, Oxford University Press, 2016.

3. The Oxford Handbook of Secularism, John R. Shook, Oxford University Press, 2017.
4. The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press,
5. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022

COURSE OUTCOMES

Students will be able to

CO1 : Identify the importance of democratic, secular and scientific values in harmonious functioning of social life

CO2 : Practice democratic and scientific values in both their personal and professional life.

CO3 : Find rational solutions to social problems.

CO4 : Behave in an ethical manner in society

CO5 : Practice critical thinking and the pursuit of truth.

PTCE3811 **PROJECT WORK** **L T P C**
0 0 6 3

SYLLABUS:

The student works on a topic relevant to civil engineering under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The student will be evaluated based on the report and the viva voce examination by a team of examiners including one external examiner.

TOTAL: 90 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Identify civil engineering problems reviewing available literature

CO2 Identify appropriate techniques to analyze complex civil engineering problems

CO3 Apply engineering and management principles through efficient handling of project have a clear idea of his/her area of work and they are in a position to carry out the work in a systematic way

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1’ = Low; ‘2’ = Medium; ‘3’ = High

PROFESSIONAL ELECTIVE COURSES

PTCE3001 CONCRETE TECHNOLOGY L T P C
3 0 0 3

UNIT I FRESH AND MECHANICAL PROPERTIES 9

Fresh concrete: Workability - Concepts and tests as per Indian codal specifications - Concrete manufacturing stages: Batching - Mixing - Transportation - Placing of concrete - Curing of concrete - Water: Quality of water for mixing and curing - Hardened concrete: Factors affecting strength of concrete - Compressive strength test - Split tensile strength - Flexure test - Modulus of elasticity.

UNIT II ADMIXTURES 9

Admixtures - Types - Natural admixtures - Fly ash - Slag - Metakaolin - Rice husk ash - Micro and nano silica - Mineral additives and fillers - Chemical admixtures: Accelerators - Retarders - Plasticizers and Super plasticizers - Air entraining admixtures - Water proofers - Coloring agent.

UNIT III MIX DESIGN 9

Mix Design - Factors influencing mix proportion - Design mix and nominal mix - Mix design by IS method using IS 10262-2019 - Variability in test results - Quality control - Sampling and acceptance criteria.

UNIT IV SPECIAL CONCRETES AND CONCRETING METHODS 9

Special concretes: Light weight concrete - Fibre reinforced concrete - Polymer concrete - Ferrocement - Ready mix concrete - Self compacting concrete - Geopolymer concrete - High performance concrete. Concrete methods: Extreme weather concreting - Vacuum concrete - Underwater concreting.

UNIT V NON-DESTRUCTIVE TEST AND DURABILITY OF CONCRETE 9

Non-destructive tests: Rebound hammer - Ultra sonic pulse velocity test - Core test - Durability of concrete - Permeability of concrete - Creep and Shrinkage - Plastic shrinkage - Drying shrinkage - Chemical attack - Sulfate attack - Chloride attack - Mechanism of corrosion - Remedial measures - Application of IoT in smart curing system for concrete.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Have thorough knowledge of the fresh and mechanical properties of concrete
CO2 Explain the effect of admixtures on the behaviour of concrete
CO3 Design concrete mix design by IS method and be aware of the acceptance criteria as per code
CO4 Explore the application of special concretes for practical purposes and special concreting methods
CO5 Describe and carry out non-destructive and durability tests on concrete

TEXTBOOKS:

1. Shetty M. S., “Concrete Technology”, Theory & Practice, S. Chand and Co., 2019.
2. Bhavikatti S. S., “Concrete Technology”, I. K. International Publishing House Pvt. Limited, 2015.
3. Gupta.B. L. and Amit Gupta, “Concrete Technology”, Jain Book Agency, 2010.

REFERENCES:

1. Kumar Mehta P., Paulo and Moteiro J. M., “Concrete-Micro Structure, Properties and Materials”, 3rd Edition, Mcgraw Hill, 2006.
2. Santhakumar A. R., “Concrete Technology”, Oxford University Press, New Delhi, 2018.
3. Job Thomas, “Concrete Technology”, Cengage learning India Pvt. Ltd., 2015.
4. Gambhir M. L., “Concrete Technology”, Tata McGraw Hill, 2012.
5. Nevile A. M., “Properties of Concrete”, Longman Publishers, 2008.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	3	3	2	2	2	2	2	1	2	3	2	2
2	2	2	2	2	2	3	3	2	1	2	1	3	3	2	2
3	3	3	3	3	2	2	1	1	1	2	2	2	2	2	2
4	3	3	2	2	3	2	2	2	2	2	2	3	3	3	3
5	3	3	3	3	3	3	3	2	2	2	2	2	3	2	3
Avg.	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**

1' = Low; '2' = Medium; '3' = High

PTCE3002 STRUCTURAL RETROFIT AND REHABILITATION L T P C
3 0 0 3

UNIT I MAINTENANCE AND REPAIR STRATIGES 9

Maintenance, repair and rehabilitation - Facets of maintenance - Importance of maintenance - Various aspects of inspection - Service life behavior - Assessment procedure for evaluating a damaged structure - Causes of deterioration.

UNIT II STRENGTH AND DURABILITY OF CONCRETE 9

Quality assurance for concrete - Strength and durability of concrete - Cracks, different types, causes - Effects due to climate, sustained elevated temperature, corrosion - Methods to assess the quality of hardened concrete.

UNIT III SPECIAL CONCRETES 9

Polymer concrete - Sulphur infiltrated concrete - Fibre reinforced concrete - High strength concrete - High performance concrete - Vacuum concrete - Self compacting concrete - Geopolymer concrete - Reactive powder concrete - Concrete made with industrial wastes.

UNIT IV TECHNIQUES FOR REPAIR AND PROTECTION METHODS 9

Epoxy injection - Shoring - Underpinning - Corrosion protection techniques - Corrosion inhibitors, corrosion resistant steels, coatings to reinforcement, cathodic protection.

UNIT V REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES 9

Strengthening of structural elements - Repair of structures distressed due to corrosion, fire, leakage and earthquake - Demolition techniques - Engineered demolition methods - Case studies - Restoration of heritage structures.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Know the importance of inspection and maintenance
CO2 Study the impacts of cracks, corrosion and climate on structures
CO3 Know about high performance concrete
CO4 Understand the materials and techniques needed for repairs
CO5 Know the failures of the structures and demolition techniques

TEXT BOOKS:

1. Shetty M. S. and Jain A. K., "Concrete Technology - Theory and Practice", S. Chand and Company, Eighth Edition, 2019.
2. B. Vidivelli, "Rehabilitation of Concrete Structures", Standard Publishes Distribution, 1st Edition, 2009.

REFERENCES:

1. "Handbook on Seismic Retrofit of Buildings", CPWD and Indian Buildings Congress, Narosa Publishers, 2008.
2. Hand Book on "Repair and Rehabilitation of RCC Buildings", Director General works, CPWD, Govt. of India, New Delhi, 2002.
3. P. C. Varghese, "Maintenance, Repair and Rehabilitation & Minor works of building", Prentice Hall India Pvt. Ltd., 2014.
4. R. Dodge Woodson, "Concrete Structures, Protection, Repair and Rehabilitation", Butterworth-Heinemann, Elsevier, New Delhi, 2012.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	-	3	-	-	-	-	2	-	1	-	2	-	-
2	2	2	-	3	-	-	3	2	2	1	-	-	2	-	-
3	-	-	3	-	3	2	-	2	-	-	-	2	-	3	2
4	-	-	2	-	3	3	3	2	-	-	-	2	-	3	3
5	2	-	3	-	2	2	2	-	-	-	-	2	-	2	2
Avg.	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**1**	**1**	**2**	**2**	**3**	**2**

1' = Low; '2' = Medium; '3' = High

PTCE3003 CONSTRUCTION QUALITY AND SAFETY L T P C
3 0 0 3

UNIT I CONSTRUCTION QUALITY MANAGEMENT 9

Importance of construction quality - Elements of quality - Quality characteristics - Quality by design - Quality conformance - Contractor quality control - Identification and traceability - Continuous chain management - Brief concept and application - Importance of specifications - Incentives and penalties in specifications - Workmanship as a mark of construction quality - Final inspection.

UNIT II CONSTRUCTION QUALITY ASSURANCE AND CONTROL 9

Construction quality assurance techniques - Inspection, testing, sampling - Documentation - Organization for quality control - Cost of quality - Introduction to TQM, Six Sigma concept in construction industry.

UNIT III CONSTRUCTION ACCIDENTS 9

Accidents and their causes - Human factors in construction safety - Costs of construction injuries - Occupational and safety hazard assessment - Problem areas in construction safety.

UNIT IV SAFETY DURING CONSTRUCTION 9

Basic terminology in safety - Types of injuries - Safety pyramid - Accident patterns - Planning for safety budget, safety culture - Introduction to OSHA regulations - Site safety programs - Job hazard analysis, accident investigation and accident indices - Violation, penalty.

UNIT V SAFE OPERATING PROCEDURES 9

Safety during alteration, demolition works - Earthwork, steel construction, temporary structures, masonry and concrete construction, cutting and welding - Construction equipment, materials handling disposal and hand tools - Other hazards - Fire, confined spaces, electrical safety.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Apply the quality standards for preparing quality system documents
CO2 Select the techniques and tools for quality assurance and control in construction
CO3 Develop the knowledge on accidents and their causes
CO4 Develop the knowledge about safety programmes and job-site safety assessment
CO5 Apply knowledge while designing for safety and safety procedures

TEXTBOOK:

1. Juran Frank, J.M. and Gryna, F.M. Quality Planning and Analysis, McGraw Hill, 2001.

REFERENCES:

1. K. B. Rajoria, Deepak Naryan and Deepak Gupta, "Practices in Construction", CBS Publishers & Distributors Pvt. Ltd., ISBN:978-93-90709-33-5, 2021.
2. Bhattacharjee S. K., "Safety Management in Construction (Principles and Practice)", Khanna Publishers, New Delhi, 2011.
3. Albert Lester, "Project Management, Planning and Control", 7th Edition, Butterworth-Heinemann, USA, 2017.
4. Patrick X. W. Zou, Riza Yosia Sunindijo, "Strategic Safety Management in Construction and Engineering", John Wiley & Sons Ltd., 2015.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	2	2	2	1	2	2	2	2	3	3	3
2	3	3	2	2	2	2	2	1	2	1	2	2	3	3	3
3	3	2	3	2	2	2	2	1	2	1	2	2	3	3	3
4	3	3	2	2	2	2	2	1	2	2	2	2	3	3	3
5	3	3	3	2	2	2	2	1	2	2	2	2	3	3	3
Avg.	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**3**

1' = Low; '2' = Medium; '3' = High

PTCE3004 ENERGY EFFICIENT BUILDINGS L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Climate adapted and climate rejecting buildings - Heat transfer - Measuring conduction - Thermal storage - Measurement of radiation - The greenhouse effect - Convection - Measuring latent and sensible heat - Psychrometry chart - Thermal comfort - Microclimate, site planning and development - Temperature - Humidity - Wind - Optimum site locations - Sun path diagrams - Sun protection - Types of shading devices - Design responses to energy conservation strategies.

UNIT II PASSIVE SOLAR HEATING AND COOLING 9

General principles of passive solar heating - Key design elements - Sunspace - Direct gain - Trombe walls, water walls - Convective air loops - Concepts - Case studies - General principles of passive cooling - Ventilation - Principles - Case studies - Courtyards - Roof ponds- Cool pools predicting ventilation in buildings - Window ventilation calculations - Room organization strategies for cross and stack ventilation - Radiation - Evaporation and dehumidification - Wind catchers - Mass effect - Air filtration and odor removal.

UNIT III DAYLIGHTING AND ELECTRICAL LIGHTING 9

Materials, components and details - Insulation - Optical materials - Radiant barriers - Glazing materials - Glazing spectral response - Day lighting - Sources and concepts - Building design strategies - Daylight apertures - Light shelves - Codal requirements - Day lighting design - Electric lighting - Light distribution - Electric lighting control for day lighted buildings - Switching controls - Coefficient of utilization - Electric task lighting - Electric light zones - Power adjustment factors.\\

UNIT IV HEAT CONTROL AND VENTILATION 9

Hourly solar radiation - Heat insulation - Terminology - Requirements - Heat transmission through building sections - Thermal performance of building sections - Orientation of buildings - Building characteristics for various climates - Thermal design of buildings - Influence of design parameters - Ventilation - Requirements - Ventilation design - Energy conservation in ventilating systems - Design for natural ventilation - Calculation of probable indoor wind speed.

UNIT V DESIGN FOR CLIMATIC ZONES 9

Energy efficiency - An overview of design concepts and architectural interventions - Embodied energy - Low embodied energy materials - Passive downdraft evaporative cooling - Design of energy efficient buildings for various zones - Various climatic conditions - Case studies of residences, office buildings and other buildings in each zones - Commonly used software packages in energy efficient building analysis and design - Energy audit - Certification.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Explain environmental energy supplies on buildings
CO2 Explain the passive solar heating, cooling system
CO3 Discuss the various aspects of day-lighting and electrical lighting in abuilding
CO4 Predict and design building ventilation and heat control for indoor comfort
CO5 Design a building for climatic zone and apply simulation programs of buildings to perform energy calculations

TEXTBOOK:

1. Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John nd Sons Inc,3rd Edition, 2014.

REFERENCES:

1. “Energy Conservation Building Code”, cau of Energy Efficiency, New Delhi, 2018.
2. “Handbook on Functional Requirements of Buildings Part 1 to 4 SP: 41 (S and T)”, 1995.
3. “Residential Energy: Cost Savings and Comfort for Existing Buildings”, John Krigger and Chris Dorsi, Published by Saturn Resource Management, 2013.
4. Majumdar M. (Ed.), “Energy - Efficient Buildings in India”, Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2009.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	2	-	-	3	3	2	1	-	-	3	3	2	1
2	3	-	2	-	-	3	3	-	-	-	-	-	3	2	1
3	3	-	2	-	-	3	3	-	-	-	-	-	3	2	2
4	3	3	3	-	-	3	3	-	-	1	-	-	3	3	3
5	3	3	3	1	2	3	3	2	-	1	-	-	2	3	3
Avg.	**3**	**2**	**3**	**2**	**1**	**3**	**3**	**2**	**1**	**1**	**-**	**3**	**3**	**3**	**3**

1’ = Low; ‘2’ = Medium; ‘3’ = High

PTCE3005 GROUND IMPROVEMENT TECHNIQUES L T P C
3 0 0 3

UNIT I PROBLEMATIC SOIL AND IMPROVEMENT TECHNIQUES 8

Geotechnical problems in alluvial, lateritic and black cotton soils - Role of ground improvement in foundation engineering - Methods of ground improvement - Selection of suitable ground improvement techniques based on soil conditions.

UNIT II DEWATERING 10

Dewatering Techniques - Well points - Vacuum and electroosmotic methods - Seepage analysis for two-dimensional flow for fully and partially penetrated slots in homogeneous deposits - Design for simple cases.

UNIT III INSITU TREATMENT OF COHESIONLESS AND COHESIVE SOILS 10

Insitu densification of cohesionless soils - Dynamic compaction - Vibroflotation, Sand compaction piles and deep compaction. Consolidation of cohesionless soils - Preloading with sand drains, and fabric drains, Stabilization of soft clay ground using stone columns and Lime piles-Installation techniques - Simple design - Relative merits of above methods and their limitations.

UNIT IV EARTH REINFORCEMENT 9

Concept of reinforcement - Types of reinforcement material - Reinforced earth wall - Mechanism - Simple design - Applications of reinforced earth; Functions of Geotextiles in filtration, drainage, separation, road works and containment applications.

UNIT V GROUTING TECHNIQUES AND SOIL STABILIZATION 8

Types of grouts - Grouting equipment and machinery - Injection methods - Grout monitoring - Stabilization with cement, lime, chemicals and industrial wastes - Stabilization of expansive soil.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Identify various problems associated with soil deposits and selection of ground improvement methods

CO2 Understand dewatering techniques and design for simple cases as per needs and specifications.

CO3 Understand the concept involved for in-situ treatment of cohesive and cohesionless soils and design for simple cases

CO4 Appreciate the concept of earth reinforcement and its applications and design for simple cases in various engineering structure.

CO5 Understand the soil grouting and stabilization techniques

TEXTBOOKS:

1. Purushothama Raj. P, “Ground Improvement Techniques”, Firewall Media, 2005.
2. Bikash Chandra chattopadhyay and Joyanta Maity, “ Ground Improvement Techniques”, PHI Learning Pvt. Ltd., 2017.

REFERENCES:

1. Koerner, R.M. “Construction and Geotechnical Methods in Foundation Engineering”, McGraw Hill, 1994.
2. Moseley, M.P., “Ground Improvement”, Blockie Academic and Professional, Chapman and Hall, Glasgow, 2004.
3. Winterkorn, H.F. and Fang, H.Y. “Foundation Engineering Hand Book”. Van Nostrand Reinhold, 1994.
4. Koerner, R.M., “Designing with Geosynthetics” (Fourth Edition), Prentice Hall, Jersey, 2012.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3	3	3	3	3	2	2	2	3	2	3	2
2	3	3	2	3	3	2	2	2	2	2	2	3	2	2	2
3	3	2	2	3	3	3	2	2	2	2	2	3	2	2	2
4	2	3	3	3	2	3	3	2	2	2	2	3	2	2	2
5	3	3	2	2	3	2	2	2	2	2	2	3	3	2	3
Avg.	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**

1' = Low; '2' = Medium; '3' = High

PTCE3006 PILE FOUNDATIONS L T P C
3 0 0 3

UNIT I PILE CLASSIFICATIONS AND LOAD TRANSFER PRINCIPLE 10

Necessity of pile foundation - classification of piles - Factors governing choice of type of pile - Load transfer mechanism - effect of pile installation on soil condition - criteria for pile socketing - responsibility of engineer and contractor

UNIT II AXIAL LOAD CAPACITY OF PILES AND PILE GROUP 10

Allowable load capacity of piles and pile groups - Static and dynamic methods - for cohesive and cohesionless soil - negative skin friction - group efficiency -Settlement of piles and pile group -IS codal provisions and IRC guide lines.

UNIT III LATERAL AND UPLIFT LOAD CAPACITIES OF PILES 9

Piles under Lateral loads - Broms method, elastic, p-y curve analyses - Batter piles - response to moment - piles under uplift loads - under reamed piles -IS codal provision - IRC guide lines.

UNIT IV STRUCTURAL DESIGN OF PILE AND PILE GROUP 9

Structural design of pile - structural capacity - pile and pile cap connection - pile cap design - shape, depth, assessment, and amount of steel - truss and bending theory- Reinforcement details of pile and pile caps- IS codal provision - IRC guide line.

UNIT V CONSTRUCTION ASPECTS AND QUALITY CONTROL 7

Piling equipment and construction methods - Evaluation of axial load capacity from field test results -Pile load test - Pile integrity test -IS codal provision.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Classify the pile foundation along with the load transfer mechanism and piling equipment
CO2 Determine the vertical load carrying capacity and the settlement of pile and pile group
CO3 Analyse the pile subjected to lateral and uplift load with reference to codal provision
CO4 Design the pile and pile caps and provide the reinforcement details according to codal provisions
CO5 Understand the piling equipment and construction methods and evaluate the axial load capacity from field test results

TEXTBOOKS:

1. Das, B.M., Principles of Foundation Engineering, Cengage Learning India Pvt. Ltd. 2016.
2. Poulos, H.G., Davis, E.H., Pile foundation analysis and design, John Wiley and Sons, New York, 1980.
3. Tomlinson, M.J. Pile Design and Construction Practice, 4th Edition, Spon Press, New York, 2004.

REFERENCES:

1. Cernica, J.N. Geotechnical Engineering Foundation Design, John Wiley and Sons, Inc. 1995.
2. Bowles, J.E., Foundation Analysis and Design, Fifth Edition, McGraw Hill, New York, 2001.
3. Donald, P., Coduto, Foundation Design Principles and Practices, Pearson India Education Services Pvt. Ltd., 2014.
4. Varghese P.C.," Foundation Engineering", PHI Learning Private Limited, New Delhi, 2012.
5. Reese,L.C., Isenhower,W.M. and Wang,S.T. Analysis and Design of Shallow and Deep Foundations, John Wiley and Sons, New York, 2005.
6. Varghese P.C.," Limit State Design of Reinforced Concrete Foundations", PHI Learning Private Limited, New Delhi, 2011.
7. Reese, L. C. and Van Impe, W. F., Single Piles and Pile Groups Under Lateral Loading, Taylor and Francis, London, 2011.
8. Satyendra Mittal, Pile Foundation - Design and Construction including Well Foundation, CBS Publishers and Distributers Pvt. Ltd., 2019.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	3	3	2	3	2	2	2	3	2	3	2
2	3	3	3	2	2	2	2	2	2	2	2	3	2	2	3
3	3	3	3	2	2	3	2	2	2	2	2	3	2	2	3
4	2	3	3	3	2	3	3	2	2	2	2	3	2	2	2
5	3	2	2	2	3	2	2	2	2	2	2	3	3	2	3
Avg.	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**3**

1' = Low; '2' = Medium; '3' = High

PTCE3007 ENVIRONMENTAL GEOINFORMATICS L T P C
3 0 0 3

UNIT I WATER AND THE ENVIRONMENT 9

Sources and demands of water - Characteristics of water - Point and non-point sources of water pollution - Spectral responses of clear and contaminated water - Chlorophyll - Remote Sensing of Water quality assessment - Classification of water quality for various purposes, Sampling procedure, quality analysis, Database creation and quality modeling using GIS. Database Creation and designing water supply network, sewerage network using GIS. Runoff estimation - Flood prediction modeling - Aquifer vulnerability modeling.

UNIT II SOIL CONSERVATION AND MANAGEMENT 9

Formation of Soils - Classification - Landforms - Soil erosion - Factors influencing soil erosion, soil contamination - Distribution and accumulation of contaminants such as toxic metals, synthetic chemicals in soil - Mining pollution - Methods of conservation - Afforestation - EMR responses with contaminated soil - Modeling soil characteristics using satellite data - Soil degradation assessment using Remote Sensing and GIS - Land reclamation.

UNIT III SOLID WASTE MANAGEMENT 9

Definition - Sources - elements of integrated waste management and roles of stakeholders - Seven elements and seven step approach to integrated solid waste management planning, identification of storage and collection location - Analysis of collection route - Site selection: Transfer station, Disposal site - Waste allocation - leachate model - Case studies.

UNIT IV AIR POLLUTION 9

Structure and composition of atmosphere - Sources and classification of air pollutants, Air Quality Standards - Chemical and Physical Components - Sampling - Mapping of atmospheric pollution - Air pollution due to industrial activity - Plume behaviors - Dispersion model: Gaussian Plume model -

Introduction to commonly used software-based models such as ADMS, AERMOD, CALINE, CALPUFF, DEGADIS, HYROAD, INDUSTRIAL SOURCE COMPLEX, SCREEN, HYSPLIT, INDEX etc. - Remote Sensing to monitor atmosphere constituents - Case Studies.

UNIT V SENSORS AND DATA FOR ENVIRONMENTAL MONITORING 9

Sensors for environmental monitoring - sensors - LIDAR- LASER Remote Sensing - EMR - absorption spectrometers - Selection of ground truth sites-sea truth observation - Radar techniques for sensing ocean surface - Thermal measurements - Application of remote sensing for oil slicks mapping - Chlorophyll detection - Fisheries resources - Coastal marine studies - Determination of temperature and sea state.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the possible applications of remote sensing and GIS in water quality analysis and network design

CO2 Understand the possible applications of remote sensing and for soil conservation

CO3 Understand the possible applications of remote sensing and for solid waste management

CO4 Understand the possible applications of remote sensing and for air pollution mapping and modeling

CO5 Understand the possible applications of remote sensing and for climate change perspectives

TEXT BOOKS:

1. Susan L. Ustin., "Manual of Remote Sensing: Remote Sensing for Natural Resource Management and Environmental Monitoring", John Wiley& Sons Inc, 2004.
2. Eric Charles Barrett., Leonard Frank Curtis, "Introduction to Environmental Remote Sensing, Chapman and Hall", 2nd edition, 1982.
3. Andrew N. Rencz., "Manual of Remote Sensing: Remote Sensing for Natural Resource Management and Environmental Monitoring", John Wiley & Sons Inc, 3rd Edition, 2004.
4. Baretl, E.C. and Culis I.F., "Introduction to Environmental Remote Sensing", 2nd edition, Chapman and Hall, New York, 2013.

REFERENCES:

1. Jr. Lintz, Joseph, David S. Simonett., " Remote sensing of environment Addision Wesley", 1976.
2. Martin Paegelow and María Teresa Camacho Olmedo., "Modelling Environmental Dynamics: Advances in Geomatic Solutions", Springer, 2008.
3. Jonathan Li and Xiaojun Yang., "Monitoring and Modeling of Global Changes: A Geomatics Perspective", Springer Remote Sensing/Photogrammetry, 2015.
4. Robert Scally., "GIS for Environmental Management", ESRI Press, 2006.
5. Andrew Skidmore., "Environmental Modelling with GIS and Remote Sensing", CRC Press, 2017.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	3	3	1	2	2	3	3	3	3	2
2	3	3	2	3	3	3	3	1	2	2	2	3	3	3	2
3	3	3	3	3	3	3	3	1	2	2	3	3	3	3	2
4	3	3	3	3	3	3	3	1	2	2	3	3	3	3	2
5	3	2	2	3	3	3	3	1	2	2	2	3	3	3	2
Avg.	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**2**	**3**	**3**	**3**	**3**	**2**

1' = Low; '2' = Medium; '3' = High

PTCE3008 GEOMATICS FOR OCEAN AND COASTAL APPLICATIONS L T P C
3 0 0 3

UNIT I FUNDAMENTAL OCEANOGRAPHY AND COASTAL PROCESSES 9

Origin and formation of large water bodies - Ocean basins - Oceanic Zones - Ocean Circulations: Global thermohaline, wind driven circulations and currents - Regional Upwelling and eddy development - Waves: structure, characteristics and wave generated currents - Current meters - Tides - Coastal erosional and accretional landforms.

UNIT II SEA WATER CHARACTERISTICS AND MEASUREMENT 9

Heat, Light and sound transmission characteristics - Seawater chemistry - Ocean Biology - Marine food web - Sea water sampling and measurement - NISKIN water sampler and DSRT - CTD profiler-CTD rosette - Bathythermograph - XBT - Sediment samplers: Dredge,GRAB and deep sea coring devices.

UNIT III COASTAL HYDRODYNAMICS AND SENSING SYSTEMS 9

Sea water intrusion - Pollution dispersion - Coastal protection structures - Platforms and sensing systems - Payloads - Past and current operational satellites: NOAA, SeaSTAR, Adeos, ERS, Topex/Poseidon, QikSCAT and sentinel 3 - Indian missions: Oceansat1 and 2, SARAL and SCATSAT.

UNIT IV REMOTE SENSING RETRIEVAL AND MAPPING 9

Ocean color remote sensing - Bio-optical algorithm and SeaDAS processing - Sea surface temperature estimation - Sea surface topography mapping: RADAR altimetry and data processing - Sea level Anomaly - Scatterometry:Sea surface wind retrieval and mapping - Bathymetry - Bathymetric LiDAR.

UNIT V COASTAL MANAGEMENT APPLICATIONS 9

Coastal zone management: Critical issues, LU/LC and wetland mapping - Coastal Regulation Zones-Potential Fishing Zone Mapping - Shoreline Change Analysis - Sea Level Rise Monitoring - Cyclone tracking and damage assessment - Tsunami early warning system and damage assessment - Use of SAR images - Ship detection - Oil spill studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the basic concepts of Ocean and Coastal processes
CO2 Gain knowledge on physical, chemical and biological characteristics of sea water
CO3 Familiarize about coastal hydro dynamism and operational sensing systems
CO4 Acquire knowledge on retrieval through remote sensing methods
CO5 Analyze the applicability of retrievals for solving critical issues and develop strategic management plan

TEXT BOOKS:

1. Ian.S.Robinson., “Discovering the Ocean from Space: The unique applications of satellite oceanoghraphy”, Springer &Praxis Publishing, 2010.
2. Seelye Martin., “An Introduction to Ocean Remote Sensing”, Cambridge University Press, 2nd edition, 2014.
3. Ian.S.Robinson., “Measuring the Oceans from Space-The principles and methods of satellite Oceanoghraphy”, Springer &Praxis Publishing, 2004.

REFERENCES:

1. Robert Stewart., “Introduction to Physical Oceanography”, University Press of Florida, 2009.
2. Motoyoshi Okeda and Frederic W.Dobson., “Oceanographic applications of Remote Sensing”, CRC Press, 1995
3. Vasilis D. Valavanis., “Geographical Information System in oceanography & Fisheries”, Taylor & Francis London &NewYork, 1st edition 2007.

4. David Halpem., “Satellites, Oceanography and Society”, Elsevier Science, 2012.
5. Alasdair J.Edward, “Remote Sensing Handbook for Tropical Coastal Management”, UNESCO publishing, 2000.
6. Karsten Mangor, Nils K. Drønen, Kasper H. Kærgaard, Sten E. Kristensen., “Shoreline Management Guidelines”, Publisher: Horsholm, DHI Water & Environment, Denmark, 4th edition, 2017
7. L.S.Robinson. “Satellite Oceanography: An introduction for Oceanographers and Remote-Sensing Scientists”, John Wiley and Praxis Publishing, 1995.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	-	-	3	-	-	-	-	-	-	3	3
2	3	2	2	3	2	-	-	3	3	3	2	2	-	-	2
3	2		3	2	3	3	3	3	2	3	3	3	3	3	3
4	3	3	2	3	3	2	3	2	3	3	3	2	3	3	-
5		3	3	3	3	3	3	3	3		3	3	3	3	3
Avg.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1’ = Low; ‘2’ = Medium; ‘3’ = High

PTCE3009 SMART CITIES L T P C
3 0 0 3

UNIT I INTRODUCTION 6

Urbanisation, need of focused development, role of Authorities, Smart city, Opportunity and Challenges- Smart infrastructures for city- Smart Cities Mission

UNIT II SMART PHYSICAL INFRASTRUCTURE 12

Infrastructure development in Smart Cities - Physical Infrastructure, Land Use - Compact/mixed-use development, Transit oriented development (TOD); Smart City Management-Transportation Unified governance structure (UMTA). Smart public transportation, Smart parking, Intelligent traffic management, Detour management; Low emission vehicles, Electric Mobility - Environmental projects etc.

UNIT III SUSTAINABILITY AND SMART PLANNING 10

Relationship Between Sustainability and Smart planning - Place making project guidelines-Surveillance, Smart Street Lighting, Intelligent Emergency Services, Intelligent Disaster Forecasting and Management, GIS-based Spatial Decision Support Systems, Smart Communication Services

UNIT IV APPLICATION OF TECHNOLOGIES IN SMART CITIES 8

Role of Technologies in Smart Cities - Integrated Command and Control Center (ICCC), Data Analytics, Data driven strategies implementation in smart cities

UNIT V SMART CITIES PROJECT MANAGEMENT 9

Need for project management, Philosophy and concepts; Project phasing and stages; Project organizational structuring: Planning and Scheduling: Project cost analysis; Procurement and Contracting: PPP: Project Monitoring and Evaluation: Risk Management; Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the basics of urbanisation and the role of smart cities
CO2 Gain knowledge on implementation of smart physical infrastructure
CO3 Understand the role of smart planning for sustainable development
CO4 Comprehend the knowledge of technologies in smart city planning
CO5 Reviewing the case studies of smart city projects

REFERENCES:

1. P Sharma , "Sustainable Smart cities in India, Challenges and Future Perspectives", Springer Link, 2017
2. Sameer Sharma,"Smart Cities Unbounded- Ideas and Practice of Smart Cities in India", Bloomsbury India, 2018.
3. Binti Singh, ManojParmar, "Smart City in India Urban Laboratory, Paradigm or Trajectory? Routledge India,2019
4. https://smartcities.gov.in/guidelines#block-habikon-content
5. https://smartnet.niua.org/learn/library

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	1	3	2	3	1	1	2	2	1	3	3	2
2	3	3	3	2	1	3	3	2	3	1	3	1	3	3	3
3	3	1	3	2	1	1	3	3	2	2	3	2	3	2	3
4	3	2	2	2	3	2	3	2	3	1	3	2	3	2	2
5	2	2	3	3	2	2	2	2	3	3	2	2	2	3	3
Avg	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**3**	**3**

1' = Low; '2' = Medium; '3' = High

PTCE3010 TRAFFIC ENGINEERING AND MANAGEMENT L T P C
3 0 0 3

UNIT I TRAFFIC CHARACTERISTICS 8

Traffic characteristics: Human, vehicular, and Road Characteristics- characteristics of traffic flow - uninterrupted traffic flow -interrupted traffic flow, Fundamentals of Traffic Flow, Urban Traffic problems in India.

UNIT II TRAFFIC SURVEYS 9

Traffic Surveys - Speed, journey time and delay surveys - Vehicle Volume Survey - Methods and interpretation - Origin Destination Survey - Methods and presentation - Parking Survey - Methods, interpretation and presentation - Statistical applications in traffic studies and traffic forecasting - Capacity and Level of Service

UNIT III DESIGN AND CONTROL 10

Channelization -At-grade Intersections - uncontrolled, Rotary and Signalised intersections, signal coordination - basics & types, Grade Separation - methods-merits and demerits

UNIT IV ROAD SAFETY 8

Traffic signs and road markings, Road accidents - Causes, Significance of accident data, Condition and collision diagrams - Statistical Interpretation and Analysis of accident Data, identification of blackspots- Safety countermeasures, Accident prevention, accident cost, Road Safety Audit - Overview, stages of road safety audit

UNIT V TRAFFIC MANAGEMENT 10

Traffic System Management: Regulatory Techniques- one-way street, Reversible Street, Reversible lane, turning movement restrictions, closing streets, Bus Priority Techniques - Priority manoeuvres - With-flow bus lane and contra-flow bus lane; Self- Enforcing Techniques- Demand Management Techniques (TDM) Road pricing, parking control, Tolls, Staggering of office/educational institution hours, work from home - Introduction to Intelligent Transportation Systems (ITS).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the principles and standards adopted in Planning and Design of Traffic system

CO2 Apply the knowledge of science and engineering fundamentals in conducting traffic surveys and analyze the problems

CO3 Designing various types of control and regulatory measures to meet an efficient traffic network

CO4 Select appropriate methods to ensure the safety of the road users and analyze the environmental issues related to traffic network

CO5 Understand various traffic management measures in addressing the demand, pricing and ITS applications

TEXTBOOKS:

1. Kadiyali. L.R., Traffic Engineering and Transport Planning, Khanna Publishers, Delhi, 2019.
2. Khanna .K and Justo C.E.G. and Veeraragavan, A Highway Engineering, Nem Chand Bros., Roorkee, Revised 10th Edition, 2014.
3. Srinivasa Kumar, “Introduction to Traffic Engineering”, Universities Press, 2018

REFERENCES:

1. Partha Chakroborty and Animesh Das Principles of Transportation Engineering, PHI Learning Pvt. Ltd., 2011.
2. Papacosta.P.S and Prevedouros.P.D, “Transportation Engineering and Planning, third edition.
3. Indian Roads Congress (IRC) Specifications: Guidelines and special publications on Traffic Planning and Management.
4. C. Jotin Khisty, Kent Lall, Transportation Engineering: An Introduction, Prentice Hall, 1998.
5. Hobbs. F.D. Traffic Planning and Engineering, University of Brimingham, Peragamon Press Ltd, 1994.
6. Taylor MAP and Young W, Traffic Analysis - New Technology and New Solutions, Hargreen Publishing Company , 1998.
7. Jason C.Yu Transportation Engineering, Introduction to Planning, Design and Operations, Elsevier, 1992.
8. Salter. R.I and Hounsell N.B, Highway Traffic Analysis and design, Macmillan Press Ltd.1996.
9. Roger P.Roess, William R.Mcshane and Elena S.Prassas, Traffic Engineering-Second Edition, Prentice Hall Publishers,, Upper Saddle River, New Jersey 1998.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	1	1	2	1	1	2	2	2	3	2	1
2	2	3	3	3	3	1	1	2	3	2	3	2	3	3	2
3	3	3	3	2	2	2	2	2	2	3	2	2	3	3	2
4	2	2	2	3	2	2	1	2	3	3	3	2	3	3	2
5	3	2	2	3	3	2	2	2	2	2	2	2	2	1	3
Avg	**3**	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

PTCE3011 CLIMATE CHANGE ADAPTATION AND MITIGATION L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Atmosphere - weather and Climate - climate parameters - Temperature, Rainfall, Humidity, Wind - Global ocean circulation - El Nino and its effect - Carbon cycle

UNIT II ELEMENTS RELATED TO CLIMATE CHANGE 9

Greenhouse gases - Total carbon dioxide emissions by energy sector - industrial, commercial, transportation, residential - Impacts - air quality, hydrology, green space - Causes of global and regional climate change - Changes in patterns of temperature, precipitation and sea level rise - Greenhouse effect

UNIT III IMPACTS OF CLIMATE CHANGE 9

Effects of Climate Changes on living things - health effects, malnutrition, human migration, socioeconomic impacts- tourism, industry and business, vulnerability assessment- infrastructure, population and sector - Agriculture, forestry, human health, coastal areas

UNIT IV MITIGATING CLIMATE CHANGE 9

IPCC Technical Guidelines for Assessing Climate Change Impact and Adaptation -Identifying adaption options - designing and implementing adaption measures - surface albedo environment-reflective roofing and reflective paving - enhancement of evapotranspiration - tree planting programme - green roofing strategies - energy conservation in buildings - energy efficiencies - carbon sequestration.

UNIT V ALTERNATE FUELS AND RENEWABLE ENERGY 9

Energy source - coal, natural gas - wind energy, hydropower, solar energy, nuclear energy, geothermal energy - biofuels - Energy policies for a cool future - Energy Audit.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Have an insight into carbon cycle, physical basis of the natural greenhouse effect, including the meaning of the term radiative forcing, climate change, global warming and measures to adapt and to mitigate the impacts of climate change

CO2 Have an understanding on the growing scientific consensus established through the IPCC as well as the complexities and uncertainties

CO3 Plan climate change mitigation and adaptation projects including the use of alternate fuels and renewable energy

CO4 Gain in-depth knowledge on climate models

CO5 Post process the modeloutputs for climate impact assessment, know about adaptation strategies

TEXTBOOKS:

1. Ruddiman W.F, freeman W.H. and Company, “Earth‟s Climate Past and Future”, 2001
2. Velma. I. Grover “Global Warming and Climate” Change. Vol I an II. Science Publishers, 2005.
3. Dash Sushil Kumar, “Climate Change - An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007

REFERENCES:

1. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK, 2007
2. Thomas E, Lovejoy and Lee Hannah “Climate Change and Biodiversity”, TERI Publishers, 2005
3. Jan C. van Dam, Impacts of “Climate Change and Climate Variability on Hydrological Regimes”, Cambridge University Press, 2003.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	3	-	-	-	-	-	-	-	1	-	2	-	-	-
2	-	-	-	-	-	2	3	-	-	-	-	-	2	-	-
3	2	3	-	2	3	-	-	-	-	-	-	3	-	-	-
4	2	-	2	2	3	-	-	-	3	-	-	-	-	-	-
5	-	3	-	-	3	2	-	-	3	2	3	2	-	-	2
Avg	**2**	**3**	**2**	**2**	**3**	**2**	**3**	**-**	**3**	**1**	**3**	**2**	**2**	**-**	**2**

1' = Low; '2' = Medium; '3' = High

PTCE3012 SOLID AND HAZARDOUS WASTE MANAGEMENT L T P C
3 0 0 3

UNIT I WASTE CLASSIFICATION AND REGULATORY REQUIREMENTS 9

Sources and types of solid and hazardous wastes - need for solid and hazardous waste management - salient features of latest Indian legislations on management and handling of solid wastes, hazardous wastes, biomedical wastes, electronic wastes, construction and demolition wastes, plastics and discarded lead acid batteries - elements of integrated waste management and roles of stakeholders - seven elements and seven step approach to integrated solid waste management planning.

UNIT II WASTE CHARACTERIZATION SOURCE REDUCTION AND RECYCLING 9

Waste sampling and characterization plan - waste generation rates and variation - physical composition, chemical and biological properties - hazardous characteristics - ignitability, corrosivity and TCLP tests -source reduction, segregation and onsite storage of wastes - waste exchange - extended producer responsibility - recycling of plastics, C&D wastes and E wastes.

UNIT III WASTE COLLECTION TRANSPORT AND MATERIAL RECOVERY 9

Door to door collection of segregated solid wastes - analysis of hauled container and stationery container collection systems - compatibility, storage, labeling and handling of hazardous wastes - principles and design of transfer and transport facilities - hazardous waste transport and manifests - mechanical processing and material separation technologies - Size reduction - size separation - density separation - magenetic separation - compaction - principles and design of material recovery facilities - physico chemical treatment of hazardous wastes - solidification and stabilization - case studies on waste collection and material recovery

UNIT IV BIOLOGICAL AND THERMAL PROCESSING OF WASTES 9

Biological and thermos-chemical conversion technologies - composting - biomethanation - incineration - pyrolysis- plasma arc gasification -principles and design of biological and thermal treatment facilities - MSW processes to energy with high-value products and specialty By-products - operation of facilities and environmental controls - treatment of biomedical wastes - case studies and emerging waste processing technologies.

UNIT V WASTE DISPOSAL 9

Sanitary and secure landfills - components and configuration- site selection - liner and cover systems - geo-synthetic clay liners and geo-membranes - design of sanitary landfills and secure landfills-leachate collection, treatment and landfill gas management - landfill construction and operational controls - landfill closure and environmental monitoring - landfill bioreactors - rehabilitation of open dumps and biomining of dumpsites-remediation of contaminated sites- Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Explain the various functional elements of solid and hazardous waste management including the associated legal, health, safety, and cultural issues as well as responsibilities of different stakeholders

CO2 Apply the knowledge of science and engineering fundamentals to characterize different types of solid and hazardous wastes, assess the factors affecting variation and assess performance of waste treatment and disposal systems

CO3 Design of systems and processes to meet specified needs of waste minimization, storage, collection, transport, recycling, processing and disposal.

CO4 Select appropriate methods for processing and disposal of solid and hazardous wastes, taking into account the impact of the solutions in a sustainability context

CO5 Conduct research pertinent to solid and hazardous waste management and communicate effectively to different stakeholders as well as engage in independent lifelong learning

REFERENCES:

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill India, First edition, 2015.
2. CPHEEO, “Manual on Municipal Solid waste management,Vol I, II and III, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2016.
3. William A. Worrell, P. Aarne Vesilind, Christian Ludwig, Solid Waste Engineering - A Global erspective, 3rd Edition, Cengage Learning, 2017.
4. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York,2010.
5. John Pitchtel,Waste Management Practices, CRC Press,Taylor and Francis Group,2014.
6. Gary C. Young, Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons, Wiley, 2010
7. Cherry P M, Solid and Hazardous Waste Management, CBS publishers and distributors Pvt Ltd, 2018.
8. Rao M.N, Razia Sultana, Sri Harsha Kota, solid and hazardous waste management - Science and Engineering , Butterworth-Heinemann, 2016

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	3	-	-	-	2	2	-	-	-	-	-	3	-	2
2	3	2	-	2	2	-	-	-	2	-	-	-	2	-	2
3	-	-	3	-	-	-	-	-	2	-	-	-	3	-	2
4	-	2	-	-	2	2	2	2	-	-	2	-	3	-	2
5	-	2	-	2	-	-	-	-	-	1	-	1	-	-	2
Avg	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**3**	**-**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High

PTCE3013 INTEGRATED WATER RESOURCES MANAGEMENT L T P C
3 0 0 3

UNIT I THE CONCEPT OF IWRM 9

Water as a global issue: Key challenges - Definition of IWRM- Key elements and pillars of IWRM - Principles - Evolution of IWRM - IWRM relevance in water resources management - IWRM in Global, Regional and Local water partnership - Sustainable Development Goals.

UNIT II ECONOMIC AND LEGAL REGULATORY SETTINGS 9

Basic notion of law and governance: Principles of International and National law in the area of water management - Economic view of water issues: economic characteristics of water good and services - Water economic instruments - Current water pricing policy- Scope to relook pricing

UNIT III EMERGING ISSUES IN WATER MANAGEMENT 9

Emerging Issues - Drinking water management in the context of climate change - Flood - Drought - Pollution - Links between water, health and poverty: options to include water management interventions for health - Health protection and promotion in the context of IWRM - Global burden of Diseases

UNIT IV IWRM AND WATER RESOURCES DEVELOPMENT IN INDIA 9

Ecological sustainability --Watershed development and conservation - Ecosystem regeneration - Wastewater reuse - Sustainable livelihood - Rural Development- IWRM and irrigation- Food security- Water for food production: Water footprint - Virtual water trade for achieving global water and food security.

UNIT V CONCEPTUAL FRAMEWORK OF IWRM 9

Institutional transformation - Bureaucratic reforms - Inclusive development- Capacity building -- Problems and policy issues - Solutions for effective integrated water management - Case studies

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the context and principles of IWRM; Compare the conventional and integrated ways of water management.

CO2 Understand the economic and legal aspects of IWRM.

CO3 Analyse the emerging issues due to climate change and make linkages between water, health and poverty.

CO4 Evaluate the impact of integrated water management on watershed, ecology, agriculture and livelihood of people.

CO5 Develop an integrated framework and arrive at effective solutions for water management problems.

TEXTBOOKS:

1. V. Thomas Cech, Principles of water resources: history, development, management and policy, 4th ed. John Wiley and Sons Inc., New York, 2018.
2. P. Mollinga, et al., Integrated Water Resources Management, Water in South AsiaVolume I, Sage Publications, 2006.

REFERENCES:

1. “Integrated Water resources Management Plan”, Cap-Net, GWP- IWRM Training module [Online], March 2005. Available: https://www.gwp.org/contentassets/f998a402e3ab49ea891fa49e77fba953/iwrmp-training-manual-and-operational-guide.pdf
2. Technical Advisory Committee, “Effective Water Governance, Technical Advisory Committee Background paper No: 7”, Global water partnership, Stockholm, Sweden [Online], 2003. Available:https://www.gwp.org/globalassets/global/toolbox/publications/background-papers/07-effective-water-governance-2003-english.pdf
3. Technical Advisory Committee, “Integrated Water Resources management, Technical Advisory Committee Background Paper No: 4”, Global water partnership, Stockholm, Sweden [Online], 2002.
   Available:https://www.gwp.org/globalassets/global/toolbox/publications/background-papers/04-integrated-water-resources-management-2000-english.pdf
4. Technical Advisory Committee, “Dublin principles for water as reflected in comparative assessment of institutional and legal arrangements for Integrated Water Resources Management, Technical Advisory Committee Background paper No: 3”, Global water partnership, Stockholm, Sweden [Online], 1999. Available: https://www.gwp.org/globalassets/global/toolbox/publications/background-papers/03-the-dublin-principles-for-water-as-reflected-in-a-comparatice-assessment-of-institutional-and-legal-arrangements-for-iwrm-1999.pdf

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	1	1	2	2	1	2	2	1	3	2	2	1
2	2	2	2	1	1	2	2	2	2	2	2	3	2	2	1
3	3	2	2	2	1	2	3	2	2	2	1	3	2	2	1
4	3	2	2	2	1	2	3	2	3	2	2	3	2	2	2
5	2	3	3	3	1	2	3	2	3	2	2	3	2	3	3
Avg.	3	2	2	2	1	**2**	3	2	2	2	2	3	2	2	2

1' = Low; '2' = Medium; '3' = High

PTCE3014 RAINWATER HARVESTING L T P C
3 0 0 3

UNIT I BASICS OF RWH 8

Water and its sources - Need for water conservation - Types of water demand - Conservation Methods - Global and Indian perspectives - National mission and goals towards rainwater harvesting - National water policy - Legislation on rainwater harvesting in India and Tamil Nadu.

UNIT II HYDROLOGY AND GROUND WATER 10

Hydrological cycle - Precipitation - Rainfall measurement - Rain-gauges - Hyetograph - Infiltration - Runoff estimation - Rooftop runoff estimation. Ground water - Aquifer Properties - Darcy law and well hydraulics - Steady flow.

UNIT III METHODS OF RAINWATER HARVESTING 7

Rainwater harvesting potential of an area - Traditional harvesting practices - Rooftop harvesting - Methods of RWH structures - Site selection for rainwater harvesting - Surface runoff Harvesting - Ground water recharge - Artificial recharge.

UNIT IV DESIGN OF RAINWATER HARVESTING STRUCTURES 10

Design Considerations - Components of Rainwater harvesting system - Simple roof water collection system - Design of Storage structure - Design of Recharge structures - Recharge pit - Recharge trench - Recharge well - Gully plug - Contour bund - Percolation tank - Check dam - Recharge shaft - Efficiency of RWH system

UNIT V MANAGEMENT OF RWH AND CASE STUDIES 10

Difficulties in RWH - At catchment level - At household level - Evaluation of RWH systems - Maintenance of RWH structures - Modernisation of RWH system - Case studies on best practice of RWH in urban - Success stories of Contemporary practices of RWH in India.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the student is expected to be able to:

CO1 Understand the need and importance of water conservation through global and Indian practices of rainwater harvesting

CO2 Understand and apply the concepts of hydrology and groundwater in the estimation of runoff and recharge potentials

CO3 Understand the various types of rainwater harvesting methods and apply it on the field

CO4 Design the various RWH structures to harvest the rainwater in surface and subsurface

CO5 Explain the difficulties of RWH, evaluation methods and maintenance through various case studies.

TEXT BOOKS:

1. H.M Raghunath “Ground Water” 3rd Edition, New Age International 2007.
2. Jayarami Reddy.P, “A Text book of Hydrology” Firewall media Publication, 2005.
3. Ramakrishnan S, “Ground Water”, Scitech Publications (India) Pvt Ltd., 2010.

REFERENCES:

1. Rain water Harvesting Techniques to Augment Ground Water: Ministry of Water Resources Central Ground Water Board Faridabad, 2003.
2. Rainwater Harvesting: Indian Railway Institute of Civil Engineering Pune, October 2015.
3. A Manual on “Rainwater Harvesting and Conservation”: Government of India, Consultancy Service Organization Central Public Works Department, New Delhi.
4. “A Water Harvesting Manual for Urban Areas” issued by Centre for Science and Environment.
5. Empowering Village Communities for A Sustainable Water Future - A Resource Book for Jaldoots, 2019, Prepared by Central Ground Water Board, Dept. of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti, Govt. of India and MARVI - Managing Aquifer Recharge and Sustaining Groundwater Use through Village-level Intervention.

CO-PO & PSO MAPPING

CO	PO’s												PSO’s		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	2	2	2	1	1	1	2	2	2	1
2	3	3	2	2	3	2	1	1	1	1	2	2	2	2	2
3	2	2	2	2	2	2	2	1	1	1	1	2	2	2	2
4	3	3	3	3	3	3	2	2	2	1	3	2	3	3	3
5	2	2	2	2	2	2	2	2	2	1	2	2	3	3	3
Avg.	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**

• 1’ = Low; ‘2’ = Medium; ‘3’ = High