Pimpri Chinchwad Education Trust's

PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

(An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune)

Curriculum Structure and Syllabus
of
Third Year B.Tech Civil Engineering
(Regulations 2023)

Effective from Academic Year 2026-27

(Updated with minor changes)

Institute Vision

To be one of the top 100 Engineering Institutes of India in coming five years by offering exemplarily Ethical, Sustainable and Value Added Quality Education through a matching ecosystem for building successful careers.

Institute Mission

1. Serving the needs of the society at large through establishment of a state-of-art Engineering Institute.
2. Imparting right Attitude, Skills, Knowledge for self-sustenance through Quality Education
3. Creating globally competent and Sensible engineers, researchers and entrepreneurs with ability to think and act independently in demanding situations

EOMS Policy

"We at PCCOE are committed to offer exemplarily Ethical, Sustainable and Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders.

We shall strive for technical development of students by creating globally competent and sensible engineers, researchers and entrepreneurs through Quality Education.

We are committed for Institute's social responsibilities and managing Intellectual property.

We shall achieve this by establishing and strengthening state-of-the-art Engineering Institute through continual improvement in effective implementation of Educational Organizations Management Systems (EOMS)."

Course Approval Summary

A) Board of Studies - Department of Civil Engineering

Sr. No	Name of the course	Course code	Page number	Signature and stamp of BoS
1	Hydrology & Water Resources Engineering	BCI25PC12	14	
2	Hydrology & Water Resources Engineering Lab	BCI25PC13	16	
3	Transportation Engineering	BCI25PC14	17	
4	Transportation Engineering Lab	BCI25PC15	19	
5	Design of Steel Structures	BCI25PC16	21	
6	Design of Steel Structures Lab	BCI25PC17	23	
7	Integrated Water Resources Management	BCI25PE01	25	
8	Integrated Water Resources Management Lab	BCI25PE02	27	
9	Architecture & Town Planning	BCI25PE03	29	
10	Architecture & Town Planning Lab	BCI25PE04	31	
11	Advanced Mechanics of Structures	BCI25PE05	32	
12	Advanced Mechanics of Structures Lab	BCI25PE06	34	
13	Foundation Engineering	BCI25PE07	35	
14	Foundation Engineering Lab	BCI25PE08	37	
15	Water and Waste Water Engineering	BCI26PC18	39	
16	Environment Engineering Lab	BCI26PC19	41	
17	Design of Reinforced Concrete Structures	BCI26PC20	43	
18	Design of Reinforced Concrete Structures Lab	BCI26PC21	45	
19	Project Management and Economics	BCI26PC22	47	
20	Dams and Hydraulic Structures	BCI26PE11	49	
21	Dams and Hydraulic Structures Lab	BCI26PE12	51	
22	Sustainable Engineering	BCI26PE13	52	
23	Sustainable Engineering Lab	BCI26PE14	54	
24	3D concrete Printing	BCI26PE15	56	
25	3D concrete Printing Lab	BCI26PE16	58	
26	Elements of Earthquake Engineering	BCI26PE17	60	
27	Elements of Earthquake Engineering Lab	BCI26PE18	62	
28	Advanced Transportation Engineering- I	BCI26PE19	64	
29	Advanced Transportation Engineering- I Lab	BCI26PE20	66	
30	Geospatial Techniques	BCI26PE31	68	
31	Geospatial Techniques Lab	BCI26PE32	70	
32	Waste Management for Smart Cities	BCI26PE33	71	
33	Waste Management for Smart Cities Lab	BCI26PE34	73	

Approved by Academic Council:

Chairman, Academic Council
Pimpri Chinchwad College of Engineering

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CURRICULUM FRAMEWORK
(Regulations 2023)
LIST OF ABBREVIATIONS

Sr. No.	Abbreviation	Type of Course
1	BSC	Basic Science Course
2	ESC	Engineering Science Course
3	PCC	Programme Core Course
4	PEC	Programme Elective Course
5	MDM	Multidisciplinary Minor
6	OEC	Open Elective Course
7	VSEC	Vocational and Skill Enhancement Course
8	AEC	Ability Enhancement Course
9	EEM	Entrepreneurship/Economics/Management Course
10	IKS	Indian Knowledge System
11	VEC	Value Education Course
12	ELC	Experiential Learning Courses
13	LLC	Liberal Learning Courses

COURSE WISE CREDIT DISTRIBUTION

Sr No.	Type of Course	No. of Courses	Total Credits	
			NO.	%
1.	Basic Science Course	8	14	8.75
2.	Engineering Science Course	6	12	7.5
3.	Programme Core Course	26	48	30
4.	Programme Elective Course	11	18	11.25
5.	Multidisciplinary Minor	6	14	8.75
6.	Open Elective Course	3	6	3.75
7.	Vocational and Skill Enhancement Course	4	8	5
8.	Ability Enhancement Course	2	4	2.5
9.	Entrepreneurship/Economics/Management Course	2	4	2.5
10.	Indian Knowledge System	1	2	1.25
11.	Value Education Course	2	4	2.5
12.	Experiential Learning Courses	4	22	13.75
13.	Liberal Learning Courses	2	4	2.5
TOTAL		**77**	**160**	**100**

SEMESTER WISE CREDIT DISTRIBUTION

Sr. No.	TYPE OF COURSE	NO. OF CREDIT/ SEMESTER								TOTAL
		1	2	3	4	5	6	7	8	
1.	Basic Science Course	7	7	-	-	-	-	-	-	14
2.	Engineering Science Course	7	5	-	-	-	-	-	-	12
3.	Programme Core Course	-	2	8	8	12	10	8	-	48
4.	Programme Elective Course	-	-	-	-	4	6	6	2	18
5.	Multidisciplinary Minor	-	-	2	2	4	2	4	-	14
6.	Open Elective	-	-	4	2	-	-	-	-	6
7.	Vocational and Skill Enhancement Course	2	2	2	-	-	2	-	-	8
8.	Ability Enhancement Course	-	2	-	2	-	-	-	-	4
9.	Entrepreneurship/Economics/Management Course	-	-	2	2	-	-	-	-	4
10.	Indian Knowledge System	2	-	-	-	-	-	-	-	2
11.	Value Education Course	-	-	2	2	-	-	-	-	4
12.	Experiential Learning Courses	-	-	-	2	-	-	4	16	22
13.	Liberal Learning Courses	2	2	-	-	-	-	-	-	4
TOTAL		**20**	**20**	**20**	**20**	**20**	**20**	**22**	**18**	**160**

SEMESTER WISE COURSE DISTRIBUTION

Sr. No.	TYPE OF COURSE	NO. OF COURSES/ SEMESTER								TOTAL
		1	2	3	4	5	6	7	8	
1.	Basic Science Course	4	4	-	-	-	-	-	-	8
2.	Engineering Science Course	3	3	-	-	-	-	-	-	6
3.	Programme Core Course	-	1	5	5	6	5	4	-	26
4.	Programme Elective Course	-	-	-	-	2	4	4	1	11
5.	Multidisciplinary Minor	-	-	1	1	2	1	1		6
6.	Open Elective	-	-	2	1	-	-	-	-	3
7.	Vocational and Skill Enhancement Course	1	1	1	-	-	1	-	-	4
8.	Ability Enhancement Course	-	1	-	1	-	-	-	-	2
9.	Entrepreneurship/Economics/Management Course	-	-	1	1	-	-	-	-	2
10.	Indian Knowledge System	1	-	-	-	-	-	-	-	1
11.	Value Education Course	-	-	1	1	-	-	-	-	2
12.	Experiential Learning Courses	-	-	-	1	-	-	1	2	4
13.	Liberal Learning Courses	1	1	-	-	-	-	-	-	2
Total		**10**	**11**	**11**	**11**	**10**	**11**	**10**	**3**	**77**

Curriculum Structure

TY B Tech

Civil Engineering

Semester V & VI

CURRICULUM STRUCTURE

Third Year B. Tech. (Civil Engineering) (Regulations2023) Semester-V

(With effect from Academic Year 2026-27)

Course Code	Course Type	Course Name	Credit Scheme				Teaching Scheme (Hours/ week)					Evaluation Scheme and Marks						
												FA		SA	TW	PR	OR	Total
			L	P	T	Total	L	P	T	O	Total	FA 1	FA 2					
BCI25PC12	PCC	Hydrology & Water Resources Engineering	3	-	-	3	3	-	-	1	4	20	20	60	-	-	-	**100**
BCI25PC13	PCC	Hydrology & Water Resources Engineering Lab	-	1	-	1	-	2	-	-	2	-	-	-	25	-	25	**50**
BCI25PC14	PCC	Transportation Engineering	3	-	-	3	3	-	-	1	4	20	20	60	-	-	-	**100**
BCI25PC15	PCC	Transportation Engineering Lab	-	1	-	1	-	2	-	-	2	-	-	-	25	-	25	**50**
BCI25PC16	PCC	Design of Steel Structures	2	-	-	2	2	-	-	1	3	10	10	30	-	-	-	**50**
BCI25PC17	PCC	Design of Steel Structures Lab	-	2	-	2		4	-	-	4	-	-	-	50	-	50	**100**
BCI25PE01/ 03/05/07	PEC	PEC 1	3	-	-	3	3	-	-	1	4	20	20	60	-	-	-	**100**
BCI25PE02/ 04/06/08	PEC	PEC 1 Lab	-	1	-	1		2	-	-	2	-	-	-	50	-	-	**50**
-	# MDM	Multidisciplinary Minor (MDM 3)	3	-	-	3	3	-	-	-	3	20	20	60	-	-	-	**100**
-	# MDM	MDM 3 Lab	-	1	-	1		2	-	-	2	-	-	-	50	-	-	**50**
Total			**14**	**6**	**-**	**20**	**14**	**12**	**-**	**4**	**30**	**90**	**90**	**270**	**200**	**-**	**100**	**750**

L- Lecture, T- Tutorial, P- Practical, CR- Credit, FA – Formative Assessment, SA –Summative Assessment,

TW – Term Work, PR- Practical Exam, OR – Oral Exam**,** O- other i.e. self directed learning, self study, outside the class efforts.

Note: # Refer separate booklet for Multidisciplinary Minor (MDM) courses

Students must ensure that the same course (content) is not selected under multiple categories such as core courses, Professional Electives, Open Electives or through minor Degree in multidisciplinary studies (MDMS) where choices are given. Each course can only be credited once towards the degree requirements. Students are required to acknowledge and agree to this condition before proceeding with registration.

Semester –V

List of courses – Professional Elective Course (PEC) – 1

Course Code	Course Name	
BCI25PE01 BCI25PE02	Integrated Water Resources Management Integrated Water Resources Management Lab	Choose any one
BCI25PE03 BCI25PE04	Architecture & Town Planning Architecture & Town Planning Lab	
BCI25PE05 BCI25PE06	Advanced Mechanics of Structures Advanced Mechanics of Structures Lab	
BCI25PE07 BCI25PE08	Foundation Engineering Foundation Engineering Lab	

CURRICULUM STRUCTURE

Third Year B. Tech. (Civil Engineering) (Regulation 2023) Semester-VI

(With effect from Academic Year 2026-27)

Course Code	Course Type	Course Name	Credit Scheme				Teaching Scheme (Hours/ week)					Evaluation Scheme and Marks						
			L	P	T	Total	L	P	T	O	Total	FA		SA	TW	PR	OR	Total
												FA 1	FA 2					
BCI26PC18	PCC	Water and Waste Water Engineering	3	-	-	3	3	-	-	1	4	20	20	60	-	-	-	**100**
BCI26PC19	PCC	Environment Engineering Lab	-	1	-	1	-	2	-	-	2	-	-	-	25	25	-	**50**
BCI26PC20	PCC	Design of Reinforced Concrete Structures	3	-	-	3	3	-	-	1	4	20	20	60	-	-	-	**100**
BCI26PC21	PCC	Design of Reinforced Concrete Structures Lab	-	1	-	1	-	2	-	-	2	-	-	-	25	-	25	**50**
BCI26PC22	PCC	Project Management and Economics	2	-	-	2	2	-	-	1	3	10	10	30	-	-	-	**50**
BCI26PE11/ //13//15/17/ 19	PEC	PEC 2	2	-	-	2	2	-	-	1	3	10	10	30	-	-	-	**50**
BCI26PE12/ 14/16/18/20	PEC	PEC 2 Lab	-	1		1	-	2	-	-	2	-	-	-	50	-	-	**50**
BCI26PE31/ 33/35/37/39	PEC	PEC 3	2	-	-	2	2	-	-	1	3	10	10	30	-	-	-	**50**
BCI26PE32/ 34/36/38/40	PEC	PEC 3 Lab	-	1		1	-	2	-	-	2	-	-	-	50	-	-	**50**
-	# MDM	Multidisciplinary Minor 4	2	-	-	2	2	-	-	-	2	10	10	30	-	-	-	**50**
BCI26VS04	VSEC	Skill Enhancement Lab	-	2	-	2		4	-	-	4	-	-	-	50	-	50	**100**
Total			**14**	**6**	**0**	**20**	**14**	**12**	-	**5**	**31**	**80**	**80**	**240**	**200**	**25**	**75**	**700**

Note: # Refer separate booklet for Multidisciplinary Minor (MDM) courses

$ Refer separate booklet for Exit Policy courses of Civil Engineering Program

L- Lecture, T- Tutorial, P- Practical, CR- Credit, FA – Formative Assessment, SA –Summative Assessment,
TW – Term Work, PR- Practical Exam, OR – Oral Exam, O: other i.e. self directed learning, self study, outside the class efforts.

Semester –VI

List of PEC courses – Professional Elective Course (PEC)– 2

Course Code	Course Name	
BCI26PE11 BCI26PE12	Dams and Hydraulic Structures Dams and Hydraulic Structures Lab	Choose any one
BCI26PE13 BCI26PE14	Sustainable Engineering Sustainable Engineering Lab	
BCI26PE15 BCI26PE16	3D concrete Printing 3D concrete Printing Lab	
BCI26PE17 BCI26PE18	Elements of Earthquake Engineering Elements of Earthquake Engineering Lab	
BCI26PE19 BCI26PE20	Advanced Transportation Engineering- I Advanced Transportation Engineering- I Lab	

List of PEC courses – Professional Elective Course (PEC) – 3

Course Code	Course Name	
BCI26PE31 BCI26PE32	Geospatial Techniques Geospatial Techniques Lab	Choose any one
BCI26PE33 BCI26PE34	Waste Management for Smart Cities Waste Management for Smart Cities Lab	
BCI26PE35 BCI26PE36	Construction Equipment and Finance Management Construction Equipment and Finance Management Lab	
BCI26PE37 BCI26PE38	Pre-stressed Concrete Structures Pre-stressed Concrete Structures Lab	
BCI26PE39 BCI26PE40	Advanced Foundation Engineering Advanced Foundation Engineering Lab	

Course Syllabus

TY B.Tech Civil Engineering

Semester-V

Program:	B. Tech. (Civil Engineering)				Semester :		V	
Course:	Hydrology and Water Resources Engineering				Code:		BCI25PC12	
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
3	3	-	-	1	20	20	60	100

Prior Knowledge:

1. Knowledge of fundamentals of fluid mechanics and geology
2. Knowledge of fundamentals of statistics is essential

Course Objectives: This course aims at enabling students,

1. To impart knowledge of precipitation and runoff
2. To build the concept of groundwater hydrology
3. To make aware of reservoir planning and irrigation concepts
4. To get acquainted with hydraulic structures

Course Outcomes: After learning the course, the students should be able to:

1. Analyze precipitation and its abstractions
2. Evaluate yield through Aquifer
3. Analyze runoff using concepts of hydrograph
4. Evaluate reservoir capacity using concepts of mass inflow curve and sedimentation
5. Evaluate water requirement of crops
6. Gain the knowledge of hydraulic structures

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to Hydrology** Introduction: Hydrological cycle, brief introduction of government organizations, precipitation: types of precipitation, measurement, analysis of precipitation data, evaporation, evapotranspiration, infiltration, climate change.	7
2	**Groundwater Hydrology** Occurrence and distribution of ground water, specific yield of aquifers, Darcy's law, permeability, safe yield of basin, hydraulics of wells under steady flow condition in confined and unconfined aquifers, specific capacity of well, tube wells, open wells and their construction, Groundwater recharge methods.	8
3	**Run Off** Introduction, factors affecting runoff, rainfall-runoff relationships and empirical techniques to determine runoff, Runoff hydrograph: Introduction, factors affecting flood hydrograph, components of hydrograph, base flow separation, unit hydrograph theory, S-curve hydrograph, uses and limitations of unit hydrograph. Floods: Estimation of peak flow, rational formula and other methods, flood frequency analysis, Introduction to flood routing.	8
4	**Reservoir Planning** Introduction, investigation for reservoir planning, applications of mass curve and demand curves, fixation of reservoir capacity from annual inflow and outflow, reservoir sedimentation- phenomenon, measures to control reservoir sedimentation, density currents, significance of trap efficiency, useful life of reservoir.	8
5	**Irrigation and Canal structures** Methods of irrigation, water requirements of crops, calculations of canal and reservoir capacities, Piped distribution network for irrigation (PDN) : Introduction, advantages and disadvantages of PDN over conventional, canal distribution network and its application, canal and canal structures, canal lining, canal revenue assessment methods, introduction to cross drainage works.Introduction to working of AI powered irrigation system	8

6	**Introduction to Hydraulic Structures** Gravity dam, various components of dam, forces acting on gravity dam, low and high gravity dam. Earth dam : Introduction, causes of failure of earthen dam. Spillways and energy dissipaters (Introduction), Diversion head works – Weir and barrages.	**6**
	Total	**45**

Self-directed learning- Probable Maximum Precipitation , Stream flow measurement , Synthetic unit Hydrograph , Flood control , Concept of Groundwater monitoring , Introduction to Storm Water Mathematical Modelling concepts.

Text Books:

1. Engineering Hydrology by K. Subramanya,6th Edition, Tata McGraw Hill, 2024
2. Hydrology and Water Resources Engineering, Vol-1, S. K. Garg, 27th Edition, Khanna Publishers, New Delhi, 2023.
3. Irrigation Engineering and Hydraulic Structures, Vol.II, S.K.Garg, 38th Edition, Khanna Publishers, New Delhi, 2023.

Reference Books:

1. Irrigation, Water Resources and Water Power Engineering, P. N. Modi, 8th Edition, Standard Book House, 2012.
2. Irrigation and Water power Engineering, Dr. Punmia and Dr. Pande, 16th Edition, Standard Publisher, 2016.
3. Groundwater Hydrology, Todd, 3th Edition, John Wiley & Sons, 2011.
4. Irrigation Engineering, H.M.Raghunath,1st Edition, Wiley India Pvt. Ltd.,2016.

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1.https://www.imdpune.gov.in/
2. https://old.amu.ac.in/emp/studym/99994128.pdf
3. https://pubs.usgs.gov/wsp/2220/report.pdf
4. https://indiawris.gov.in/wris/
5. http://www.cwc.gov.in/water-resources-information-system-wris
6. http://cgwb.gov.in/

Program:	B. Tech. (Civil Engineering)			Semester :		V	
Course:	Hydrology and Water Resources Engineering Lab			Code:		BCI25PC13	
	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
Credits	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	2	-	25	25	-	50

Prior Knowledge: Fundamentals of fluid mechanics and Statistics is essential

Course Objectives :
1. To impart knowledge of rainfall data, measurement of infiltration and evaporation
2. To provide knowledge of catchment area and application of Q-GIS software in hydrology
3. To impart knowledge of runoff and storage capacity of reservoir.

Course Outcomes: After learning the course, the students should be able to:
1. Demonstrate measurement of evaporation and infiltration and get awareness of hydraulic structures
2. Apply the principle of delineating catchment area on toposheet and using Q-GIS software
3. Analyze rainfall data, runoff and determine reservoir capacity.

Detailed Syllabus

Term work consists of a journal containing details of assignments and visit report (Any eight, site visit and assignment 4 & 12 is compulsory).
1. Analysis of rainfall data (double mass curve technique/missing rainfall data)
2. Measurement of / video demonstration of evaporation by pan evaporimeter
3. Measurement of / video demonstration of infiltration by infiltrometer
4. Marking catchment area on a topo-sheet and working out average annual precipitation and determining yield by various methods - Application of open-source Q-GIS software for delineation of catchment/watershed .
5.Application of Q-GIS software in groundwater assessment
6.Experiment on determination of groundwater flow
7.Determination of peak flood discharge in a basin using unit hydrograph technique
8. Frequency analysis (return period, hydrologic event)
9.Determination of storage capacity of a reservoir using mass curve of inflow and outflow
10. Site visit to meteorological station.
11. Application of HEC-RAS for Hydrologic routing.
12. Literature collection of types of dams (minimum 5 dams) or case study of failure of any hydraulic structure.

Text Books:
1. Engineering Hydrology by K. Subramanyam,6th Edition, Tata McGraw Hill, 2024
2. Hydrology and Water Resources Engineering, Vol-1, S. K. Garg, 27th Edition, Khanna Publishers, New Delhi, 2023.
3. Irrigation Engineering and Hydraulic Structures, Vol.II, S.K.Garg, 38th Edition, Khanna Publishers, New Delhi, 2023.

Reference Books:
1. Irrigation, Water Resources and Water Power Engineering, P. N. Modi, 8th Edition, Standard Book House, 2012.
2. Irrigation and Water power Engineering, Dr. Punmia and Dr. Pande, 16th Edition, Standard Publisher, 2016.
3. Groundwater Hydrology, Todd, 3rd Edition, John Wiley & Sons,2011.
4.Q-GIS for Hydrological Applications: Recipes for Catchment Hydrology and Water Management, Hans Van Der Kwast, Kurt Menke-Locate Press
5. Irrigation Engineering, H.M.Raghunath,1stEdition,Wiley India Pvt. Ltd., 2016.

e-Resources
1.https://www.imdpune.gov.in/
2. https://old.amu.ac.in/emp/studym/99994128.pdf
3. https://pubs.usgs.gov/wsp/2220/report.pdf
4. https://indiawris.gov.in/wris/
5. http://www.cwc.gov.in/water-resources-information-system-wris
6. http://cgwb.gov.in/

Program:	B. Tech. (Civil Engineering)				Semester :			V
Course:	Transportation Engineering				Code:			BCI25PC14
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
3	3	-	-	1	20	20	60	100

Prior Knowledge:

1. Basic Civil & Environmental Engineering
2. Geotechnical Engineering for characteristics of soil
3. Engineering Geology & Rock Mechanics for design of road geometry

Course Objectives: After Completing this course, student will have adequate background to understand and/or solve the problem involving:

1. Surveys needed for collecting different kinds of data related to highways
2. Geometric design and pavement design of highways

Course Outcomes: After learning the course, the students should be able to:

1. Explain the importance of highway development, pavement materials, their properties, and relevant tests used in highway construction
2. Calculate design traffic parameters for flexible/Rigid pavements.
3. Apply geometric design principles for highway alignment, sight distance, and drainage design.
4. Explain different pavement construction techniques and their applications.
5. Explain urban transport planning steps and basic demand modeling techniques.
6. Explain the role of ITS and AI in improving transportation.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Highway Development & Planning:** Historic development of road construction, highway development in India. Necessity of highway planning, classification of roads, road patterns, planning surveys, Highway planning in India. **Pavement Materials and Mix Design:** Materials used in highway construction and related tests: Subgrade Soil and CBR Test on it, stone aggregates; Bituminous binders; Bituminous paving mixes; Viscosity based grading of bitumen; Modified Bitumen (Cutbacks, Emulsions, Crumbed Rubber Modified Bitumen – CRMB, Polymer Modified Bitumen-PMB, Foamed Bitumen); Marshall Stability Mix Design and Test (All 5 test parameters). Introduction to SuperPave Mix design.	8
2	**Pavement Design:** Computation of design traffic for flexible pavements: Vehicle Damage Factor VDF, Lane distribution factor LDF, Traffic growth rate. Stresses in flexible pavements and design guidelines as per IRC 37-2018. Components and factors affecting design of rigid pavements. Stresses in rigid pavements (ESWL) and design guidelines as per IRC 58-2015.Joints in concrete pavements and related problems. Introduction to Pavement design Software.	9
3	**Geometric Design of Highways:** Introduction; highway cross section elements, typical cross section (TCS) for different types of roads; Sight distances, Design of horizontal alignment: horizontal curve, superelevation& its attainment, transition curves, widening on curves; Design of vertical alignment: gradients, grade compensation, design of summit curves & valley curves; Highway drainage: importance of highway drainage, subsurface and surface drainage systems. Introduction to Geometric Design Software.	8

4	**Modern Trends in Highway Materials & Construction.** Introduction to GSB, WBM, WMM, cemented base. Understanding bituminous works: prime coat, tack coat, seal coat. Study of different types of asphalt mixes: BSG, AC, BM, DBM, premix carpet..	**5**
5	**Basics of Urban Transportation Planning:** Need and importance of transportation planning in cities. Understanding travel patterns and types of trips. Steps in planning: trip generation, trip distribution, mode choice, route assignment with simple examples. Introduction to factors that influence travel demand and basic idea of gravity mode. Introduction to Transport System Management (TSM) and Demand Management Strategies. Overview of Smart Mobility Solutions and ITS Applications in Urban Areas. Introduction to planning software (e.g**CUBE, PTV-VISUM**)	**7**
6	**Emerging Transportation technologies:** **a. Intelligent Transportation Systems (ITS)** Introduction to Intelligent Transportation Systems and their significance in modern traffic management. Components and architecture of ITS. Key applications: Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), and Incident Detection Systems. Benefits of ITS in improving safety, efficiency, and sustainability of transport systems. **b. AI in Transportation:** Introduction to the role of Artificial Intelligence in transportation. Key challenges addressed by AI in traffic engineering, safety, and infrastructure planning. Applications in autonomous vehicles, intelligent traffic management, and logistics optimization. Recent advancements in AI-driven transportation system design and decision-making.	**8**
	Total	**30**

Self-directed learning: Highway Development in India - Importance of Transportation, Different modes of Transportation, Characteristics of road transport, importance of roads in India, Scope of highway engineering.

Text Books:

1. Khanna, S. K., Justo, C. E. G. &Veeraragavan, A. (2018). *Highway engineering* (10th ed.). New Delhi: Nem Chand & Bros.
2. Kadiyali, L. R. (2017). *Principles and practices of highway engineering* (9th ed.). Delhi: Khanna Publishers.
3. Garber, N. J., &Hoel, L. A. (2014). *Traffic and highway engineering* (4th ed.). Cengage Learning.
4. O'Flaherty, C. A. (2002). *Highways: Traffic planning & engineering*. Edward Arnold, UK.

Reference Books:

1. Bindra, S. P. (2003). *A course in highway engineering*. Dhanpat Rai& Sons.
2. Rao, G. V. (2007). *Principles of transportation engineering*. Tata McGraw-Hill.
3. Rangwala, S. C. (2017). *Highway engineering*. Charotar Publishing House.
4. Chakraborty, P., & Das, A. (2017). *Principles of transportation engineering*. Prentice Hall of India.
5. Gupta, B. L., & Gupta, A. (2005). *Highway and bridge engineering*. Standard Publishers Distributors.

Codes:

1. Aggregate Tests: IRC SP 72-2015, IS 2386 (Part 1, 3, 4, 5)-1963, IS 6241-1971, IS 6241-2024.
2. Bitumen Tests: IS 1202-1978, IS 1203-1978, IS 1205-1978, IS 1208-1978, IS 1209-1978, IS 2720 (Part 27)-1977, IRC SP 11-1988, IRC SP 53-2010
3. Aggregate-Bitumen Combined Test: ASTM D1559, IRC SP 53-2010, IS 1206 (Part 1 & 2)-1978
4. Soil Subgrade Test: IS 2720 (Part 16)-1987, IRC 37-2012, IRC SP 72-2015
5. Flexible Pavement Design: IRC 37-2018- Guidelines for the Design of Flexible Pavements.
6. Rigid Pavement Design: IRC 58-2015- Guidelines for the Design of Plain Jointed Rigid Pavements
7. Design standards for rural highways: IRC:73-2023: Geometric design standards for rural (non- urban) highways.
8. Design standards for urban highways: IRC:86-1983: Geometric design standards for urban roads in plains.

e-Resources

1. https://archive.nptel.ac.in/courses/105/101/105101087/ (NPTEL- By: Dr. Tom V Mathew)
2. https://ocw.mit.edu/collections/transportation (MIT- Open courseware)
3. https://www.icevirtuallibrary.com

Program:	B. Tech. (Civil Engineering)			Semester :		V	
Course:	Transportation Engineering Lab			Code:		BCI25PC15	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	2	-	25	25	-	50

Prior Knowledge: Nil

Course Objectives :
1. To impart the knowledge related to standard methods of testing of Aggregate/ Bitumen/Soil.
2. To Make students aware about the codal provisions and test method for the designing of bituminous mix

Course Outcomes: After learning the course, the students should be able to:
1. Identify the quality of aggregates by performing standard tests as per IS codes
2. Evaluate the strength characteristics of bitumen by performing tests as per IS codes
3. Determine the strength of bituminous mix as per standard test procedure
4. Calculate the bearing capacity of soil required for designing a pavement.

Detailed Syllabus

A. Lab Experiments: (Any Nine)

I. Tests on Aggregate:
1. Aggregate Impact Value Test
2. Aggregate Crushing Strength Test
3. Los Angeles Abrasion Test
4. Shape Test (Flakiness Index and Elongation Index)
5. Specific Gravity and Water Absorption Test by basket method
6. Stripping Value Test
7. Soundness Test

II.Tests on Bitumen:
1. Penetration Test
2. Ductility Test
3. Softening Point Test
4. Flash Point & Fire Point Test
5. Specific Gravity Test
6. Bitumen Extraction Test
7. Viscosity Test

III. Tests on Aggregate Bitumen Combined:
1.Marshall Stability Test

IV. Tests on Soil Subgrade: (Not Mandatory):
1.California Bearing Ratio Test (CBR Test)

B. Technical site visits to (Any One)
1. Road Construction and/or RAP Site.
2. Cold or Hot mix Plant.

Text Books:

1. Khanna, S. K., Justo, C. E. G., &Veeraragavan, A. (2013). Highway materials and pavement testing. Nem Chand & Bros.
2. Khanna, S. K., & Justo, C. E. G. (2018). *Highway engineering* (10th ed.). New Delhi: Nem Chand & Bros.
3. Roess, R. P., Prassas, E. S., &McShane, W. R. (2019). *Traffic engineering* (5th ed.). Pearson.
4. Kadiyali, L. R. (2017). *Principles and practices of highway engineering* (9th ed.). Khanna Publishers, Delhi.

Reference Books:

1. Bindra, S. P. (2003). *A course in highway engineering*. DhanpatRai& Sons.
2. Rao, G. V. (2007). *Principles of transportation engineering*. Tata McGraw-Hill.
3. Rangwala, S. C. (2017). *Highway engineering*. Charotar Publishing House.
4. Chakraborty, P., & Das, A. (2017). *Principles of transportation engineering*. Prentice Hall of India.
5. Gupta, B. L., & Gupta, A. (2005). *Highway and bridge engineering*. Standard Publishers Distributors.

Codes:

1. **Aggregate Tests:** IRC SP 72-2015, IS 2386 (Part 1, 3, 4, 5)-1963, IS 6241-1971, IS 6241-2024.
2. **Bitumen Tests:** IS 1202-1978, IS 1203-1978, IS 1205-1978, IS 1208-1978, IS 1209-1978, IS 2720 (Part 27)-1977, IRC SP 11-1988, IRC SP 53-2010
3. **Aggregate-Bitumen Combined Test:** ASTM D1559, IRC SP 53-2010, IS 1206 (Part 1 & 2)-1978
4. **Soil Subgrade Test:** IS 2720 (Part 16)-1987, IRC 37-2012, IRC SP 72-2015

e-Resources

1. https://archive.nptel.ac.in/courses/105/101/105101087/ (NPTEL- By: Dr. Tom V Mathew)
2. https://ocw.mit.edu/collections/transportation (MIT- Open courseware)
3. https://www.icevirtuallibrary.com

Program:	B. Tech. (Civil Engineering)				Semester:			V
Course:	Design of Steel Structures				Code:			BCI25PC16
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	1	10	10	30	50

Prior Knowledge:
1. Engineering Mechanics
2. Strength of Materials
3. Mechanics of Structures

Course Objectives: After Completing this course, student will have adequate background to understand and solve the problem involving:
1. To provide a basic understanding of types of Steel Sections, load calculations, load transfer phenomenon, behavioral analysis, design and detailing of the structure for different load combinations.
2. To produce graduates who could pursue careers in Structural Steel Design.
3. To produce graduate civil engineers who can excel in post graduate programs.

Course Outcomes: After learning the course, the students should be able to:
1. Understand the types of steel sections, structural fasteners and their behaviour and connections.
2. Classify the steel sections and design the tension & compression members.
3. Design beam sections in steel structure IS code method.
4. Design column & column Bases.

Detailed Syllabus

Unit	Description	Duration (H)
1	Steel as a structural material: Various grades of structural steel, properties, various rolled steel sections (including cold formed sections, structural pipe (tube) sections) and their properties. Introduction to I.S. 800, 808, 816, 875, 1893 etc. **Structural Fasteners:** a) Behaviour of bolted and welded connections (types, Designations, properties, permissible stresses), failure of bolted and welded joints. Strength of bolt and strength of weld. Efficiency of joints. Design of simple bolted and welded connections.	8
2	**Design of axially loaded members:** (a) Tension members (b) Compression members.	7
3	**Design of beams:** Laterally restrained and unrestrained, (symmetrical as well as unsymmetrical section for flexure, Shear, and deflection). Curtailment of flange plates.	8
4	**Design of Column:** Design of Axially loaded Column using single rolled steel section Design of axially loaded built up columns (Laced and battened) **Design of Column bases:** Slab base, Gusseted base	7
	Total	30

Self-directed learning-Design of Beam Column, Design of moment resistant base, Design of Shear Connections. Design of welded Plate Girder with stiffener design.

Text Books:
1. Design of Steel Structures by B. S. Negi, Tata McGraw Hill India, 1995.
2. Limit State Design of Steel Structures by S. S. Bhavikatti, I.K. International Publishing House Pvt. Limited.
3. Limit State Design of Steel Structures by M. R. Shiyekar, PHI Learning Private Limited, New Delhi.

Reference Books:
1. Limit State Design of Steel Structures Dr. Ramchandra & Virendra Gehlot, Standard Publishers; Delhi.
2. Design of Steel Structures by S. Ramamrutham, Dhanpat Rai Publications Company.
3. Limit State Design of Steel Structures by S. K. Duggal
4. Design of Steel Structures as per IS:800-2007 by N. Subramaniam, Oxford university press.

5. Limit State Design of Steel Structures by V. L. Shah & Karve, Structures Publications Pune.
6. Limit State Design of Steel Structures by S. Krishnanathan, Dreamtech Press Pvt. Ltd. New Delhi.

IS Codes:

1. IS 800-2007: General Construction in Steel, Code of Practice, Bureau of Indian Standards, New Delhi.
2. IS 875-Part 1-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (I) dead loads-unit weights of building materials and stored materials, Bureau of Indian Standards, New Delhi.
3. IS 875-Part 2-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (II) imposed loads, Bureau of Indian Standards, New Delhi.
4. IS 875-Part 3-2015: Code of practice for design loads (other than earthquake) for buildings and structures: Part (II) imposed loads, Bureau of Indian Standards, New Delhi.
5. S.P. (38): Handbook of Typified designs for structures with Steel roof Trusses, Bureau of Indian Standards 1987.
6. IS 808 – 2021: Hot Rolled Steel Beam Column Channel and Angle Sections - Dimensions and Properties
7. IS 816 -1969: Code of practice for use of metal arc welding for general construction in mild steel.

e-Resources

1. https://archive.nptel.ac.in/courses/105/105/105105162/
2. https://www.coursera.org/learn/design-basics-of-steel-buildings
3. https://www.classcentral.com/course/youtube-design-of-steel-structures-47758
4. https://unacademy.com/course/complete-course-on-design-of-steel-structures-654/5T9O8774
5. https://www.udemy.com/course/design-of-steel-structures-as-per-is800/?srsltid=AfmBOopTV0PIK31vpvtCEcidno2nGU8ZMwwNJbksL0N5_vUalWjszi3Q&couponCode=ST11MT170325G3

Program:	B. Tech. (Civil Engineering)			Semester:		V	
Course:	Design of Steel Structures Lab			Code:		BCI25PC17	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
2	-	4	-	50	50	-	100

Prior Knowledge:
1. Engineering Mechanics
2. Strength of Materials
3. Mechanics of Structures

Course Objectives: After Completing this course, student will have adequate background to:
1. To classify the different types of Structural Steel sections and their properties.
2. To design structural components of Industrial buildings as per IS:800 2007.
3. To prepare Structural Drawings for Structural Steel Industrial Buildings as per IS:800 2007 & SP38.

Course Outcomes: After learning the course, the students should be able to:
1. Classify the types of structural steel and rolled steel sections given in Steel Table.
2. Apply design concept of structural components of Industrial buildings as per IS:800 2007.
3. Apply knowledge to Prepare Structural drawings showing details of different elements of the buildings as per SP:38.

Detailed Syllabus

Term work consists of a journal containing the following assignments, and site visit report. Note: Part A & B are compulsory and any one from Sr. No.07 and 08 from Part C along with Sr. No. 9. Term work consists of following experiments, assignment, and report of site visit. Term work marks will be based on continuous assessment.

Full imperial size hand drawn drawing sheets on

Part A
1. Types of structural steel sections, stress strain curve for steel.
2. Types of Trusses & truss member connection.
3. Types of joints, types of connections
4. Structural details of column and beam splices

Part B
5. Design of industrial building including roof truss, purlins, bracings, column, column base and connections. Analysis of truss by using software and cross check manually. Full imperial size hand drawn drawing sheets presenting the design details.
6. Design of Gantry Girder, Full imperial size hand drawn drawing sheet presenting the design details.

Note: Manual designs performed can be cross checked/validated or compared with design output given by software for any one structural component of industrial building.

Part C
7. Assignment on Design of any one structural component using excel Programming.
8. Analysis of Pre-engineered Industrial shed using software.
9. Report of a site visit mentioning structural details with relevant sketches of structural connections.
10. Application of AI in structural steel design

Text Books:
1. Negi, B.S. ―Design of Steel Structures‖, Tata McGraw Hill India, 1995.
2. Shah & Gore, ―Limit State Design of Steel Structures‖.
3. M. R. Shiyekar, ―Limit State Design of Steel Structures.

Reference Books:

1. Limit State Design of Steel Structures by Dr. Ramchandra&VirendraGehlot, Standard Publishers; Delhi.
2. Design of Steel Structures by S. Ramamrutham, DhanpatRai Publications Company.
3. Limit State Design of Steel Structures by S. K. Duggal
4. Limit State Design of Steel Structures by S. S. BhavikAtti, I.K. International Publishing House Pvt. Limited.
5. Design of Steel Structures by B. S. Negi, Tata McGraw Hill India, 1995.
6. Design of Steel Structures as per IS:800-2007 by N. Subramaniam, Oxford university press.
7. Limit State Design of Steel Structures by V. L. Shah &Karve, Structures Publications Pune.
8. Limit State Design of Steel Structures by M. R. Shiyekar, PHI Learning Private Limited, New Delhi.

IS Codes:

1. IS 800-2007: General Construction in Steel, Code of Practice, Bureau of Indian Standards, New Delhi.
2. IS 875-Part 1-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (I) dead loads-unit weights of building materials and stored materials, Bureau of Indian Standards, New Delhi.
3. IS 875-Part 2-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (II) imposed loads, Bureau of Indian Standards, New Delhi.
4. IS 875-Part 3-2015: Code of practice for design loads (other than earthquake) for buildings and structures: Part (II) imposed loads, Bureau of Indian Standards, New Delhi.
5. S.P. (38): Handbook of Typified designs for structures with Steel roof Trusses, Bureau of Indian Standards 1987.
6. IS 808 – 2021: Hot Rolled Steel Beam Column Channel and Angle Sections - Dimensions and Properties
7. IS 816 -1969: Code of practice for use of metal arc welding for general construction in mild steel.

Program:	B. Tech. (Civil Engineering)				Semester :		V	
Course:	Integrated Water Resources Management (PEC-1)				Code:		BCI25PE01	
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
3	3	-	-	1	20	20	60	100

Prior Knowledge: Water Resources Engineering, Public Health Engineering, Remote sensing and GIS

Course Objectives: This course aims at enabling students,

1. To introduce about concept of IWRM and its necessity in view of climate change, components of IWRM, decision support system
2. To make aware of river water quality assessment for achieving the health and sustainability
3. To make them competent to prepare IWRM plan
4. Impart knowledge about legal aspects, Decision support system, System engineering

Course Outcomes: After learning the course, the students should be able to:

1. Understand principles, challenges, application of IWRM approaches and prepare strategic plan.
2. Examine crop water requirements under varying climatic conditions and design effective irrigation planning models.
3. Assess the impact of anthropogenic activities on surface and ground water quality, and formulate strategies for sustainable water management, comparing with the standards.
4. Interpret economic theories related to water resources and justify their application in sustainable water management.
5. Understand legal regulatory settings, and guidelines of inter-basin water transfers for IWRM
6. Examine the impact of hydraulic structures on river surface profiles and sediment transport and recommend optimization strategies

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to IWRM:** Concept, definitions, objectives, principles, challenges and needs, components, approaches of IWRM, water as a global issue, introduction of global water partnership (GWP), introduction of central water commission (CWC), national water policy (only introductory), Various government institutions and regulatory authorities viz. MWRRA, MMISF ACT , CWC, World Bank , GWP etc	7
2	**Irrigation planning & IWRM :** Irrigation in the concept of integrated water resources, water requirement for crops, climate change impacts on irrigation planning, irrigation methods and efficiencies of these methods, current water pricing, ground water quality protection, sea water intrusion into fresh water aquifers due to human activities, ground water recharge, participatory irrigation management (PIM), water distribution society's (WDS), introduction of water and land management institute (WALMI).	8
3	**Considerations for Water Supply & Health:** Importance of assessment of river water quality, prevention, control of surface & ground water pollution, cost effective water quality monitoring for basins, environmental impact assessment (EIA), regulations by various government authorities, need of training to water users for sustainability, application of polluters pays principle, need of treatment facilities for domestic sewage and industrial effluents to control river water pollution, discussion of any one case study.	7

4	**Water Economics and Sustainability:** Water as economic good, economic value of water, water scarcity, importance of Water to the Indian economy, principles of planning and financing of water resources project: discussion on any two case studies, sustainability principles for water management, framework for planning a sustainable water future, economics and decision making.	**8**
5	**Legal Regulatory Settings & IWRM:** Global and national perspectives of water crisis, UN laws on non-navigable uses of international water courses, current water laws and regulation (national, state & local), water rights & priorities, CWC laws & guidelines, inter-basin water transfers and integrated water resources management, importance of arbitration in IWRM, Dublin Principles (1992), discussion of one case study.	**7**
6	**Flood Control & Power Generation:** Role of dams in flood control and power generation and its importance in IWRM, management of flood plains, flood risk mapping, flood forecasting and disaster relief, coordination between co-basins for flood management, use of QGIS for IWRM, effects of hydraulic structures on river surface profiles and sediment transport, hydro power generation, basic introduction of soft computing techniques for flood forecasting (only introductory).	**8**
	Total	**45**

Self Directed Learning: Urban water management, transboundary water agreements, water budget analysis by calculation of water inflow, outflow, and storage for a basin, use of GCMs/RCMs, introduction to downscaling techniques (statistical & dynamical), scenario planning under uncertainty (RCPs, SSPs).

Text Books:

1. Integrated Water Resources Management: Water in South Asia Volume I, Peter P Mollinga, Ajaya Dixit and Kusum Athukorala, Sage Publications
2. Ecosystem Principles and Sustainable Agriculture, Sithamparanathan, Rangasamy A. and Arunachalam, N, Scitech Publications (India) Pvt. Ltd, Chennai. .

Reference Books:

1. Water Resources System Planning & Management, M. C. Chaturvedi, Tata McGraw-Hill.
2. Water Resources Systems Engg, D. P. Loucks, Prentice Hall
3. Economics of Water Recourses Planning, L. D. James & R. R. Lee, McGraw Hills, New York
4. Integrated Water Resources Management: Global Theory, Emerging Practice and Local Needs, Peter P Mollinga, SAGE Publication
5. Principles of Water Resources: History, Development, Management and Policy, Thomas V., John Wiley and Sons Inc., New York. 2003.
6. Watershed Management in India, Murthy, J. V. S., Wiley Eastern Ltd., New York, 1995.
7. Soil Conservation and Land Management, Dalte, S.J . C., International Book Distribution

e-Resources:

1. https://www.unep.org/explore-topics/disasters-conflicts/where-we-work/sudan/what-integrated-water-resources-management
2. https://www.unep.org/explore-topics/disasters-conflicts/where-we-work/sudan/what-integrated-water-resources-management

Program:	B. Tech. (Civil Engineering)			Semester :		V	
Course:	Integrated Water Resources Management Lab (PEC-1 Lab)			Code:		BCI25PE02	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	2	-	50	-	-	50

Prior Knowledge: Water Resources Engineering, Public Health Engineering, Remote sensing and GIS

Course Objectives :

1. To impart knowledge of the key principles, policies, laws, and economic aspects of Integrated Water Resources Management (IWRM) for sustainable water governance.
2. To provide Knowledge of the role of technological tools, such as soft computing techniques and QGIS, in flood forecasting, irrigation planning, and water resource decision-making.
3. To impart knowledge of the impact of participatory water management, effluent quality standards, and global frameworks in addressing water security and environmental sustainability.

Course Outcomes: After learning the course, the students should be able to:

1. Evaluate integrated water management strategies, policies, and legal frameworks to address sustainable water governance challenges.
2. Formulate and apply participatory, economic, and institutional frameworks to enhance efficiency and equity in water resource management and distribution.
3. Apply computational tools such as soft computing techniques and QGIS for flood forecasting and resource management

Detailed Syllabus

Term work consists of (Solve any eight)

1. Report on components and approaches of IWRM
2. Report on national water policy
3. Report on participatory irrigation management and water distribution societies
4. Report on effluent quality standards as per CPCB
5. Report on economics in IWRM and decision making
6. Report on Dublin Principles (1992)
7. Report on water laws (National, State & Local)
8. Report on global water partnership (GWP)
9. Introduction to applications of QGIS for IWRM
10. Report on the expert session on IWRM

Text Books:

1. Integrated Water Resources Management: Water in South Asia Volume I, Peter P Mollinga, Ajaya Dixit and Kusum Athukorala, Sage Publications
2. Ecosystem Principles and Sustainable Agriculture, Sithamparanathan, Rangasamy A. and Arunachalam, N, Scitech Publications (India) Pvt. Ltd, Chennai.

Reference Books:

1. Water Resources System Planning & Management, M. C. Chaturvedi, Tata McGraw-Hill.
2. Water Resources Systems Engg, D. P. Loucks, Prentice Hall
3. Economics of Water Recourses Planning, L. D. James & R. R. Lee, McGraw Hills, New York
4. Integrated Water Resources Management: Global Theory, Emerging Practice and Local Needs, Peter P Mollinga, SAGE Publication

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

e-Resources:

1. https://www.unep.org/explore-topics/disasters-conflicts/where-we-work/sudan/what-integrated-water-resources-management

2. https://www.unep.org/explore-topics/disasters-conflicts/where-we-work/sudan/what-integrated-water-resources-management

Program:	B. Tech. (Civil Engineering)				Semester:		V	
Course:	Architecture & Town Planning (PEC-1)				Code:		BCI25PE03	
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Others	FA		SA	Total
					FA1	FA2		
3	3	--	-	1	20	20	60	100

Prior Knowledge:

1. Fundamentals of Building Technology and Architectural Planning.

Course Objectives: This course aims at enabling students,

1. To study the history of various architectural designs and their preservations.
2. To build the concepts of architectural and urban planning principles and understand the futuristic needs of users.
3. To impart the knowledge of landscaping and sustainable settlement planning.
4. To build the town planning concept and smart city requirements.
5. To impart the knowledge of various planning agencies and understand their organizational structures, functions, and contributions to urban and regional development.
6. To study major legal provisions and Acts that govern land acquisition, real estate regulation, and Development Plan preparation.

Course Outcomes: After learning the course, the students should be able to:

1. Illustrate the history of civilization, various forms of architectural designs, and its conservation.
2. Apply architectural and urban planning principles to improve quality of life.
3. Apply landscaping principles and sustainability in town planning to improve quality of life.
4. Identify the requirements for town planning and smart cities for future development.
5. Identify and compare the organizational structures and functions of major planning and interpret their roles in multi-level planning.
6. Interpret and summarize key provisions of the LARR Act 2013, RERA Act 2016, MAHA-RERA, URDPFI and AMRUT Guidelines and their implications on land acquisition, real estate regulation, and citizen rights.

Detailed Syllabus

Unit	Description	Duration (H)
1	**History of Architecture and Planning:** Evolution of Architecture, Western Architecture: Egyptian, Greek, Roman Architectures-Orders. Indian Architecture: Vedic age, Indus Valley civilization– Buddhist period: Stambas, Stupa, Toranas, Chaityas, Viharas – Hindu temples: Dravidian and Indo-Aryan (Nagara) Styles. Indo-Saracenic (Islamic) Architecture: Mosque – Palace – Fort – Tomb. Case study on any architectural style reflecting its significance and history. Case study on advanced technologies in conserving the history of architecture.	7
2	**Architecture and Urban Planning:** Elements of Designing –form, surface texture, mass, line, color, tone, Principles of Composition: –Unity, contrast, proportion, scale, balance, circulation, rhythm, character, expression, and relevant case studies. Qualities of Architecture: user-friendly, contextual, eco-friendly, useful for spaces, and future growth with the case study. Role of Architect in Planning and Designing spatial organization, utility, the demand of the area and supply, etc. considering situations like disasters conditions with case study, importance of sustainable architecture, Introduction to theories of Urban Planning, urban conservation, urban renewal with case study.	8
3	**Principles of Landscaping**: Objectives, principles, elements, material (soft and hard), landscaping styles, green roofs, and vertical gardens: need, means, outcome, impact on ecology and environment, quality of life and livability, case study on the impact of landscaping.	7

4	**Town Planning and Smart City requirement:** Scope, purpose, and benefits of town planning, components of town planning, planning levels: regional plan, development plan, town planning scheme, neighborhood planning, Horizontal and vertical expansion of towns- satellite towns- floating towns- Industrial Towns- sky scrapers-pyramidal cities, Special purpose plan -Smart cities. Special townships: SEZ, application of GIS, GPS, remote sensing in Town planning, integration of Internet of Things (IoT) technologies in town planning. Case study on any smart city.	**8**
5	**Civic Survey:** Civic surveys and their utility for DP proposal: demographic, housing, land use, water supply, sanitation, flora and fauna, natural elements, etc. Planning agencies for various levels of planning and organizational details with the purpose (CIDCO, MHADA, MIDC, MMRDA/PMRDA, SRA, and HUDCO), Traffic transportation systems: hierarchy of roads, traffic management, intelligent transport systems. Case study on various planning agencies.	**8**
6	**Legal provisions in Acts:** The administrative level of planning (neighborhood, local, district, state, and national) Land Acquisition Rehabilitation and Resettlement Act, 2013, Real Estate (Regulation and Development) Act 2016 and MAHA-RERA, URDPFI Guidelines (for land use, infrastructure, etc.), AMRUT Guidelines (water/sewerage, transport, etc.), a legislative mechanism for preparation of DP: MRTP Act 1966.	**7**
	Total	**45**

Self-directed learning:

1. Heritage Architecture and Digital Preservation.
2. Sustainable design to study how nature-integrated environments improve human well-being and ecological performance.
3. Virtual/augmented reality used in documenting and conserving heritage structures globally.
4. Investigate modern urban models focused on reducing automobile dependency and promoting high-density, mixed-use communities.

Textbooks:

1. Town Planning, G. K. Hiraskar, DhanpatRai Publications
2. Town Planning, S. C. Rangwala, Charotar Publishing House Pvt. Ltd.
3. Planning and Design of Buildings by Section of Architecture' by Y. S. Sane.
4. Indian Architecture – Vol. I & II' by Percy Brown, Taraporevala Publications, Bombay.
5. Fundamentals of Town Planning' by G.K. Haraskar

Reference Books:

1. MRTP Act 1966: The director, government printing, stationery and publications, Maharashtra state, Mumbai.
2. URDPFI & AMRUT Guidelines: Ministry of housing and urban affairs, Government of India.
3. LARR Act 2013: Ministry of law and justice, Government of India
4. An Introduction to Landscape Architecture, Michael Laurie, American Elsevier Publishing Company
5. Town and Country Planning By A.J.Brown and H.M.Sherrard
6. A History of Architecture by SIR BANISTER FLETCHER's Twentieth edition.

E-Resources:

1 https://onlinecourses.nptel.ac.in/noc22_ar18/preview (Introduction to Urban Planning by Prof. HarshitLakra, IIT Roorkee)

2. http://www.digimat.in/nptel/courses/video/124107001/L16html NPTEL Video Course: NOC: Housing Policy and Planning by Dr. Uttam K. Roy, IIT Roorkee

3.https://mohua.gov.in/upload/uploadfiles/files/URDPFI%20Guidelines%20Vol%20I

4.http://amrut.gov.in/upload/uploadfiles/files/designandStandards_AMRUT

5.https://mmrda.maharashtra.gov.in/home

6. https://www.pmrda.gov.in/index https://maharera.mahaonline.gov.in/

7. https://smartcities.gov.in/

8. https://blog.emb.global/urban-planning-through-iot/

Program:	B. Tech. (Civil Engineering)			Semester:		V	
Course:	Architecture & Town Planning Lab (PEC-1 Lab)			Code:		BCI25PE04	
	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
Credits	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	--	2	--	50	--	--	50

Prior Knowledge: Fundamentals of Building Technology and Architectural Planning

Course Objectives:

This course aims to enable students,

1. To study principles of architectural planning and understand the futuristic needs of users.
2. To study the concepts of urban renewal and sustainable architecture with a case study.
3. To distinguish different levels of planning, Acts and Govt. norms to develop neighborhood plans, SEZ, CRZ and special townships.

Course Outcomes:

After learning the course, the students should be able to:

1. Analyze urban planning principles, development plans, and policies through case studies of cities, town planning schemes, and national guidelines.
2. Apply neighborhood planning concepts, infrastructure design, and sustainable strategies in real-world urban and regional planning scenarios.
3. Evaluate the role of professionals and emerging approaches such as smart cities, urban renewal, and sustainable architecture in shaping planned and resilient communities.

Detailed Syllabus

Term work consists of following (any nine)

1	Study and analysis of development plan concerning land use, services, infrastructure, street furniture, and housing with case studies of cities like Pune, Nagpur, Navi Mumbai, Chandigarh, etc.
2	Neighborhood planning elements and planning calculation with case study.
3	Report on the contribution of engineers, planners, and architects in post-independence India with a case study on anyone.
4	Report on any satellite towns like new Mumbai, Gandhinagar, etc. (concerning TP aspects inclusive of infrastructure, disaster management, etc.)
5	Study of salient features of urban renewal schemes.
6	Study of any existing town planning scheme with a case study.
7	Study of URDPFI OR AMRUT guidelines with a case study
8	Study of special townships or SEZ or CRZ or rural planning strategies with some examples.
9	Study of urban conservation or sustainable architecture.
10	E-learning: referring to websites of various town planning authorities with their reports.
11	Case study of any Smart city planning and design.

Textbooks:

1. Town Planning, G. K. Hiraskar, Dhanpat Rai Publications
2. Town Planning, S. C. Rangwala, Charotar Publishing House Pvt. Ltd.
3. Fundamentals of Town Planning' by G.K. Haraskar

Reference Books:

1.MRTP Act 1966: The director, government printing, stationery and publications, Maharashtra state, Mumbai.
2. URDPFI & AMRUT Guidelines: Ministry of housing and urban affairs, Government of India.
3. LARR Act 2013: Ministry of law and justice, Government of India
4. Town and Country Planning By A.J.Brown and H.M.Sherrard

E-Resources:

1.https://mohua.gov.in/upload/uploadfiles/files/URDPFI%20Guidelines%20Vol%20I
2.http://amrut.gov.in/upload/uploadfiles/files/designandStandards_AMRUT
3.https://mmrda.maharashtra.gov.in/home
4. https://www.pmrda.gov.in/index https://maharera.mahaonline.gov.in/
5. https://smartcities.gov.in/
6. https://blog.emb.global/urban-planning-through-iot/

Program:	B. Tech. (Civil Engineering)				Semester :			V
Course:	Advanced Mechanics of Structures (PEC-1)				Code:			BCI25PE05
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
3	3	-	-	1	20	20	60	100

Prior Knowledge:

1. Engineering Mechanics: Equilibrium conditions, types of supports and analysis of beams.
2. Strength of Materials: Basics of slope and deflection of beams.
3. Mechanics of structures: Knowledge of static and kinematic indeterminacy of the structures, various methods of finding slopes and deflection of beams and frames, basics of influence line diagram.

Course Objectives: This course aims at enabling students,

1. To impart the knowledge about the basic concepts required for analysis of structures.
2. To develop the ability of analyzing structures.

Course Outcomes: After learning the course, the students should be able to:

1. Analyze indeterminate beams structures and frames by strain energy methods.
2. Analyze of multi-story multi-bay frames by approximate methods.
3. Analyze two and three hinged arches and its application.
4. Analyze beams and frames by rotation contribution method.
5. Analyze determinate beams and trusses using an influence line diagram (ILD).
6. Apply the concepts of plastic analysis in the analysis of steel structures.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Analysis of Indeterminate Beams and Frames** **a)** Propped cantilever and fixed beams by strain energy method, analysis of continuous beams by three moment theorem (Clapeyron theorem) up to three unknowns. **b)** Castigliano's second theorem, analysis of beams and rectangular portal frames with indeterminacy up to second degrees.	**8**
2	**Analysis Multi-storied multi-bay 2-D rigid jointed frames.** a) Approximate methods of analysis of multi-storied multi-bay 2-D rigid jointed frames by Cantilever method and Portal method. Automating frame analysis using AI-based approximation methods. b) Approximate methods of analysis of multi-storied multi-bay 2-D rigid jointed frames by Substitute frame method.	**7**
3	**Analysis of Arches** a) Three hinged arches: Concepts, types of arches, analysis of parabolic arch with supports at same and different levels, semicircular arches with supports at same level, determination of horizontal thrust, radial shear and normal thrust for parabolic and circular arch. b) Two hinged arches: Analysis of parabolic and semicircular arches with supports at same level, determination of horizontal thrust, radial, shear and normal thrust.	**8**
4	**Rotation Contribution Method** a) Basic concepts- The rotation contribution, rotation factor, applications to continuous beams. b) Applications to Portal frames and multistoried frames. Introduction to modified moment distribution method.	**7**

5	**Applications of Influence Line Method** a) Application of Influence line Diagram to moving loads on girders to calculate maximum and minimum shear force and bending moment. Application of ILD to the fixed beams. b) Influence line diagram for axial force in trusses, application of influence line diagram to determine the axial forces in the members of plane determinate trusses under dead load and live load.	**8**
6	**Plastic Analysis of Structure.** a) True and idealized stress-strain curve for mild steel in tension, stress distribution in elastic, elasto-plastic and plastic stage, concept of plastic hinge and collapse mechanism, static and kinematic methods of analysis, upper bound, lower bound and uniqueness theorem. b) Plastic modulus of section, Plastic moment, shape factor. Plastic analysis of determinate and indeterminate beams, single bay single storied portal frame.	**7**
	Total	**45**

Self –directed learning- Practice of solving the Numericals on Indeterminate frames, analysis of 2-D frame by portal frame method, Analysis of parabolic and semicircular arches, Analysis of beams by Rotation Contribution method, Application of ILD for Analysis of truss, collapse mechanism of frames.

Text Books:

1. Theory of Structures by S. Ramamrutham and R. Narayan, DhanpatRai Publishing Company (P) Ltd, 10th Edition, (2014)
2. Structural Analysis-I & II by S. S. Bhavikatti, Vikas Publishing House Pvt. Ltd, 4th Edition, (2014)

Structural Analysis: A Matrix Approach by G.S. Pandit and S. P. Gupta, Tata McGraw Hill Education Pvt. Limited, 2nd Edition, (2016)

Reference Books:

1. Intermediate Structural Analysis by C. K. Wang, Tata McGraw Hill Education Pvt. Ltd. 7th Edition, (2013)
2. Mechanics of Structures Vol. II (Theory and Analysis of Structures) by Dr. H. J. Shah and S. B. Junnarkar, Charotar Publishing House Pvt. Ltd, 23rd Edition, (2013)
3. Basic Structural Analysis by C. S. Reddy, Tata McGraw Hill Education Pvt. Ltd, 3rd Edition, (2010).

Structural Analysis by R. C. Hibbler, Pearson Education. 3rd Edition, (2013).

e-Resources:

1. https://nptel.ac.in/courses/105/101/105101086/
2. https://nptel.ac.in/courses/105/106/105106050/.

Program:	B. Tech. (Civil Engineering)			Semester:		V	
Course:	Advanced Mechanics of Structures Lab (PEC-1 Lab)			Code:		BCI25PE06	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	--	2	--	50	--	--	50

Course Objectives:

1. To impart the knowledge about the basic concepts required for analysis of structures.
2. To develop the ability of analyzing structures.

Course Outcomes:

After learning the course, the students will be able to:

1. Analyze indeterminate beams structures and frames by strain energy methods and multi-story multi-bay frames by approximate methods.
2. Analyze two and three hinged arches and its application and beams, frames by rotation contribution method.
3. Analyze determinate beams and trusses using an influence line diagram (ILD) and apply the concepts of plastic analysis in the analysis of steel structures.

Detailed Syllabus

Lab Assignments

The term work shall consist of a journal giving following Assignments. (All Compulsory)

1. Analysis of Propped Cantilever Using Strain Energy Method: Solve numerically for reactions and internal moments using the strain energy method. Show detailed calculations with deflection compatibility.
2. Continuous Beam Analysis Using Three Moment Theorem: Analyze a two-span beam using Clapeyron's theorem. Apply boundary conditions, draw BMD and SFD.
3. Castigliano's Theorem: Portal Frame Analysis: Use Castigliano's second theorem to determine member forces and displacements in a statically indeterminate portal frame.
4. Approximate Analysis Using Cantilever and Portal Method: Apply both methods to a multistory multi-bay frame. Compare results and identify assumptions in each method.
5. AI-Based Approximate Analysis of 2D Frame: Use Python/Excel or a basic ML model to automate approximate analysis of a frame. Submit code and result comparison with manual analysis.
6. Substitute Frame Method for Multistory Structure: Analyze a floor frame using substitute frame method. Perform moment distribution and sketch BMD.
7. Analysis of Arches – Three Hinged Analyze a parabolic arch with supports at same level. Calculate horizontal thrust and internal forces. Plot thrust line.
8. Rotation Contribution Method for Beams/Frames: Apply rotation contribution method to a two-span continuous beam. Perform iterative calculations to determine support moments.
9. Influence Line Diagrams for Girders and Trusses: Construct ILDs manually for shear and moment in beams, and axial forces in truss members under a unit load. Comment on influence ordinates.
10. Plastic Analysis and Collapse Mechanism: Perform plastic analysis of a fixed beam and single-storey portal frame using kinematic and static methods. Identify plastic hinges and calculate collapse load.

Text Books:

1. Theory of Structures by S. Ramamrutham and R. Narayan, DhanpatRai Publishing Company (P) Ltd, 10th Edition, (2014)
2. Structural Analysis-I & II by S. S. Bhavikatti, Vikas Publishing House Pvt. Ltd, 4th Edition, (2014)
3. Structural Analysis: A Matrix Approach by G.S. Pandit and S. P. Gupta, Tata McGraw Hill Education Pvt. Limited, 2nd Edition, (2016)

Reference Books:

1. Intermediate Structural Analysis by C. K. Wang, Tata McGraw Hill Education Pvt. Ltd. 7th Edition, (2013)
2. Mechanics of Structures Vol. II (Theory and Analysis of Structures) by Dr. H. J. Shah and S. B. Junnarkar, Charotar Publishing House Pvt. Ltd, 23rd Edition, (2013)
3. Basic Structural Analysis by C. S. Reddy, Tata McGraw Hill Education Pvt. Ltd, 3rd Edition, (2010).
4. Structural Analysis by R. C. Hibbler, Pearson Education. 3rd Edition, (2013).

e-Resources:

1. https://nptel.ac.in/courses/105/101/105101086/
2. https://nptel.ac.in/courses/105/106/105106050/.

Program:	B. Tech. (Civil Engineering)				Semester :			V
Course:	Foundation Engineering (PEC-1)				Code:			BCI25PE07
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
3	3	-	-	1	20	20	60	100

Prior Knowledge:
1. Engineering Geology
2. Geotechnical Engineering

Course Objectives: This course aims at enabling students,
1. To learn about types and purposes of different foundations.
2. To learn how to utilize their knowledge in soil mechanics to perform various types of engineering calculations, this includes bearing capacity analysis, consolidation analysis for foundations, and settlement analysis and load carrying capacity in pile foundation.

Course Outcomes: After learning the course, the students should be able to:
1. Explain the methods of subsurface investigation and apply the knowledge of field tests on site.
2. Understand the steps in geotechnical design of shallow foundations.
3. Evaluate bearing capacity of different types of soil.
4. Determine the settlement below footing and consolidation settlement.
5. Determine the load carrying capacity of single pile and pile group.
6. Explain foundation solutions for black cotton soils and the selection of suitable cofferdams for construction.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Subsurface Investigations for Foundations** Purpose and planning of subsurface exploration, Methods of Investigation: Trial pits, borings, depth & number of exploration holes, core recovery, Rock Quality Designation (RQD), Geophysical methods – Seismic refraction, Electrical resistivity method, Disturbed and undisturbed sampling, types of samplers, degree of disturbance of a sampler, Field tests – Standard Penetration Test (SPT), N value correction and significance, Dynamic Cone Penetration Test (DCPT), Static Cone Penetration Test (SCPT).	7
2	**Shallow Foundations** Shallow Foundations: types and applications, location and depth of footing, principles of design of footing, steps involved in proportioning of footing, proportioning of combined footings – rectangular, trapezoidal and strap footing, raft foundation- types, bearing capacity, floating raft, design of raft foundation- conventional (rigid) method and elastic (flexible) method.	8
3	**Bearing capacity** Basic definitions, Modes of shear failure, Bearing capacity analysis - Terzaghi's, Meyerhof's, Skempton's, and IS code method -Rectangular and Circular footings, Bearing Capacity evaluation: -Plate Load Test and SPT, Housel's perimeter shear concept, Effect of water table on bearing capacity, Effect of eccentricity, Shallow foundation -Types and Applications.	7
4	**Settlement & consolidation** Settlement -Introduction, Causes of settlement, Pressure bulb, Contact pressure, Significant Depth of foundation, Allowable settlement, Differential settlement - I.S. criteria, Types - Elastic settlement, Consolidation settlement. Use of Plate Load test and SPT in settlement analysis. Consolidation - Introduction, spring analogy, Terzaghi's consolidation theory, Laboratory consolidation test, Determination of coefficient of consolidation - Square root of time fitting method and logarithm of time fitting method, Introduction of Normal consolidation, over consolidation and Preconsolidation pressure.	8

5	**Deep Foundations** Introduction, Pile classification, Pile installation - Cast in-situ, driven and bored pile, Load carrying capacity of pile by static method, Dynamic methods - Engineering news formula (ENR) and Modified ENR formula, Settlement of pile, Pile load test , Group action - Feld rule, Negative skin friction, Piers and Caissons - Definition, Types and uses, Well foundation: components, sand Island method.	**8**
6	**Cofferdams and Foundation on Black Cotton Soils** Cofferdams: types and applications, contiguous pile walls, RC Diaphragm wall method. Foundation on Black Cotton Soils: characteristics of black cotton soil, swelling potential and its evaluation methods, engineering problems, swelling pressure measurement, foundations on black cotton soil: design principles, construction techniques.	**7**
	Total	**45**

Self-directed learning- Pressure meter test,Ground Penetrating Radar (GPR), Magnetic and Gravity Surveys, Bearing Capacity Determination of Layered Soil.

Text Books:

1. Foundation Engineering by Dr. B. J. Kasmalkar, Pune Vidyarthi Griha Prakashan, Pune.
2. Foundation Design Manual by N V Nayak, Dhanpat Rai Publications, 7th Edition (2018)
3. Soil Mechanics and Foundation Engineering by B. C. Punmia, Laxmi Publications, 16th Edition (2017)
4. Soil Mechanics and Foundation Engineering by K. R. Arora, Standard Publisher, 7th Edition (2019)

Reference Books:

1. Basic and Applied Soil Mechanics by Gopal Ranjan and A. S. R. Rao, Newage International, 3rd Edition (2016)
2. Foundation Analysis and Design by J.E. Bowels, McGraw-Hill book company, 5th Edition (2001)
3. Soil Mechanics - T. William Lambe - Wiley
4. Foundation Engineering by P.C.Varghese - PHI Learning Pvt. Ltd (2013)
5. Principles of Soil Mechanics and Foundation Engineering by V.N.S. Murthy, UBS Publishers (2018)
6. Soil Mechanics & Foundation Engineering by M. Bandhu, Wiley Publications, 3rd Edition (2010)
7. Geotechnical Engineering by Principles & Practices by Donald. P. Coduto, Pearson Education, 2nd Edition (2017)

IS Codes:

1. IS 1892 1979 Code of practice for subsurface investigation for foundations.
2. IS 2131 1981 Method of standard penetration test for soils.
3. IS 1888 1982 Method of load test on soils.
4. IS 1080 1985 Code of Practice For Design And Construction Of Shallow Foundations in Soils.
5. IS 19235 2025 Geotechnical Engineering Services and Requirements.

e –Resources:

https://nptel.ac.in/courses/105105176

Program:	B. Tech. (Civil Engineering)			Semester:		V	
Course:	Foundation Engineering Lab (PEC-1 Lab)			Code:		BCI25PE08	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	--	2	--	50	--	--	50

Course Objectives:
To impart knowledge of methods of analysis and design of various foundations.

Course Outcomes:
After learning the course, the students will be able to:
1. Calculate the bearing capacity of soil using different methods.
2. Determine the load carrying capacity of pile.
3. Interpret existing soil investigation report.

Detailed Syllabus

Lab Assignments
The term work shall consist of a journal giving following Assignments. (Any eight from 1 to 10, 11 is compulsory)
1. Study of soil investigation report and preparation of detailed bore log analysis.
2. Investigation of Subsurface Using the Electrical Resistivity Method.
3. Calculate bearing capacity by Terzaghi's method
4. Calculate bearing capacity by Skempton's method
5. Detailed description and calculation of bearing capacity and settlement using plate load test data with critical comment on load settlement curve
6. Consolidation Test
7. Problems on design of shallow foundation – isolated, combined.
8. Problems on pile foundation – individual and group action
9. AI application for prediction of bearing capacity of soil.
10. Study of safe software for foundation design.
11. Visit to foundation construction sites and preparation of the report.

Text Books:
1. Foundation Engineering by Dr. B. J. Kasmalkar, Pune Vidyarthi Griha Prakashan, Pune.
2. Foundation Design Manual by N V Nayak, Dhanpat Rai Publications, 7th Edition (2018)
3. Soil Mechanics and Foundation Engineering by B. C. Punmia, Laxmi Publications, 16th Edition (2017)
4. Soil Mechanics and Foundation Engineering by K. R. Arora, Standard Publisher, 7th Edition (2019)

Reference Books:
1. Basic and Applied Soil Mechanics by Gopal Ranjan and A. S. R. Rao, Newage International, 3rd Edition (2016)
2. Foundation Analysis and Design by J.E. Bowels, McGraw-Hill book company, 5th Edition (2001)
3. Soil Mechanics- T. William Lambe - Wiley
4. Foundation Engineering by P.C.Varghese - PHI Learning Pvt. Ltd (2013)
5. Principles of Soil Mechanics and Foundation Engineering by V.N.S. Murthy, UBS Publishers (2018)
6. Soil Mechanics & Foundation Engineering by M. Bandhu, Wiley Publications, 3rd Edition (2010)
7. Geotechnical Engineering by Principles & Practices by Donald. P. Coduto, Pearson Education, 2nd Edition (2017)

IS Codes:
1. IS 1892 1979 Code of practice for subsurface investigation for foundations
2. IS 2131 1981 Method for standard penetration test for soils
3. IS 1888 1982 Method of load test on soils
4. IS 1080 1985 Code of Practice For Design And Construction Of Shallow Foundations in Soils
5. IS 19235 2025 Geotechnical Engineering Services and Requirements'

e –Resources:
1. https://nptel.ac.in/courses/105105176

Course Syllabus

TY B Tech

Semester-VI

Program:	B. Tech. (Civil Engineering)				Semester :			VI
Course:	Water and Wastewater Engineering				Code:			BCI26PC18
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
3	3	-	-	1	20	20	60	100

Prior Knowledge:

1. Fundamentals of Surveying, Building Planning and Fluid Mechanics
2. Basic Concepts of Engineering Sciences and Mathematics

Course Objectives: After completing this course, student will have adequate background to understand and solve the problem involving :

1. To make students understand importance of water infrastructure with respect to needs of various users.
2. To discuss and demonstrate the principles of water treatment plant and layout.
3. To inculcate and impart design principles and working of WTP components
4. To introduce students about the need of sanitation infrastructure, wastewater treatment, sludge management system and to identify potential of wastewater for recycle and reuse.
5. To inculcate an ability to learn the working principle, operation and design of various units of wastewater treatment plant

Course Outcomes: After learning the course, the students should be able to:

1. Define identify, describe reliability of water sources, estimate water requirement for various sectors and Understand the requirement of water treatment plant for infrastructure and Government scheme.
2. Design components of water treatment plant – aeration, sedimentation and estimating coagulant dose.
3. Design components of water treatment plant – flocculator, filtration, elevated service reservoir capacity.
4. Recall sanitation infrastructure, quantification and characterization of wastewater, natural purification of streams and explain the potential of recycle and reuse of wastewater treatment.
5. Design preliminary and primary unit operations in waste water treatment plant.
6. Design suspended and attached growth wastewater treatment systems.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Basics of Water Supply Engineering:** Introduction to water supply scheme: importance of water infra-structure in India, data collection required for implementing water supply schemes, components and layouts. Design periods, factors affecting design periods. Quantity: rate of water consumption for various purposes, fire demand, factors affecting rate of demand, population forecasting. Government of India initiatives - SMART city, AMRUT, Jal Jeevan Mission and its implication in rural India.	7
2	**Principles of Water Treatment: ite selection for WTP.** Aeration: principles of water treatment unit operations and processes, water treatment flow sheets, criteria for site selection for WTP. Aeration -principle and concept, necessity, methods, design of aeration fountain. Sedimentation: plain and chemical assisted, principle, efficiency of an ideal settling basin, types of sedimentation, settling velocity, types of sedimentation tanks, design of plain sedimentation tank, design of tube settlers. Coagulation and flocculation: principle of coagulation, common coagulants, natural coagulants.	8
3	**Design of Water Treatment Plant**: Concept of mean velocity gradient and power consumption, design of flocculation chamber, design of clari-flocculator. Filtration: theory of filtration, mechanism of filtration, filter materials, types of filter and design of rapid sand gravity filters. Disinfection: mechanism, factors affecting disinfection, types of disinfectants, types and methods of chlorination, bleaching powder estimation. Water distribution system: system of water supply: continuous and intermittent system, design of elevated storage reservoir capacity.	8

4	**Sanitation Infrastructure System**: wastewater sources and types, importance of sanitation infrastructure, collection and conveyance, quantitative estimation of wastewater, self-cleansing velocity, hydraulic design of circular sanitary sewer, necessity and location of pumping station. Self-purification of natural streams: oxygen sag curve, Streeter - Phelps equation- application and limitations. Wastewater recycle and reuse: driving factors for recycle and reuse, recycling of grey water, municipal sewage, storm water and industrial effluent, reuse opportunities in municipal, industrial, agricultural sector.	**7**
5	**Preliminary and Primary Wastewater Treatment**: Sewage/effluent treatment plant - flow diagram, unit operation and process, preliminary and primary treatment, emerging contaminants & its treatment issues, screens: types, hydraulics, velocity and head loss, design of screens, disposal of screenings. Grit chamber: sources of grit, types, proportional flow weir, Parshall flume, design of grit chamber, disposal of grit, skimming tanks: sources of oil and grease, methods of oil and grease removal. Equalization and neutralization tanks - application and benefits. Primary sedimentation tank: types of settling, types of sedimentation tanks, factors affecting efficiency, design of primary sedimentation tank.	**7**
6	**Secondary and tertiary Treatment**: Aerobic secondary treatment: unit operations and processes, principle of biological treatment, Activated sludge process (ASP): design of ASP, modifications in ASP, Integrated Fixed Film (IFF) ASP. Oxidation pond: bacteria – algae symbiosis, design of oxidation pond, Constructed wetlands, phytoremediation: principle, advantages, disadvantages, trickling filter: principle, different TF media & their characteristics, design TF using NRC formula, operational problems, and control measures. Sludge management system. Tertiary treatment – principle and methods, concept of Zero Liquid Discharge (ZLD).	**8**
	Total	**45**

Self-directed learning- Tertiary treatment for water and wastewater, Package sewage Treatment plant, operation and maintenance of water and wastewater treatment plant, energy estimation for water and wastewater treatment plant.

Text Books:

1. Water Supply Engineering, S. K. Garg, Khanna Publishers, New Delhi, 35th Edition (2015).
2. Water Supply and Sanitary Engineering, G. S. Birdie and J. S. Birdie, Dhanpat Rai Publishing Company, New Delhi, 9th Edition, (2010).
3. Environmental Engineering-1: Water Supply Engineering, B. C. Punmia, Ashok Jain and Arun Jain. Laxmi Publications (P) Ltd, 2nd Edition, Reprint (2016).
4. Sewage Disposal & Air Pollution Engineering, S. K. Garg, Khanna Publication, 41st Edition, (2018).
5.Manual on Sewerage & Sewage Treatment published by Ministry of Urban Development, New Delhi, Third Edition, (1993).

Reference Books:

1. Environmental Engineering, Peavy and Rowe, McGraw Hill Publications, (2017).
2. Waste Water Treatment & Disposal, Metcalf & Eddy, McGraw Hill Education (India) Private Limited, 4th Edition, (2017).
3. Wastewater Treatment for Pollution Control and Reuse, Arceivala and Asolekar, McGraw Hill Education (India) Private Limited, 3rd Edition, (2017).
4. Standard Methods for examination of water and wastewater, Mary Franson, American Public Health Association IS Codes 01
5. IS 3025: 2013, Methods of Sampling and Test (Physical, Chemical and Biological) for Water and Waste Water, Bureau of Indian Standards, New Delhi.

e-Resources

1. http://cpheeo.gov.in/cms/manual-on-water-supply-and-treatment.php
2. http://cpheeo.gov.in/cms/manual-on-sewerage-and-sewage-treatment.php
3. http://cpheeo.gov.in/cms/manual-on-storm-water-drainage-systems---2019.php
4. http://cpheeo.gov.in/cms/manual-on-operation--and-maintenance-of-water-supply-system-2005.php

Program:	B. Tech. (Civil Engineering)			Semester :		VI	
Course:	Environment Engineering Lab			Code:		BCI26PC19	
	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
Credits	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	2	-	25	-	25	50

Prior Knowledge:

Course Objectives :

1. To introduce students to performance based experiments related to water and wastewater quality.
2. To help students identify appropriate tests for specific environmental problems, statistically interpret laboratory results, write technical reports, and understand basic environmental design and technical solutions.

Course Outcomes: After learning the course, the students should be able to:

1. To characterize drinking water and wastewater for physical, chemical and microbiological treatment and Understand appropriateness of water source w.r.t qualities available via-a-vis qualities required.
2. To design water treatment plant and wastewater treatment plant

Detailed Syllabus

Term work consists of

A) List of Laboratory Experiments:

Part A: (Any four experiment from 1 to 6 and any four experiment from 6 to 11)

1. Total hardness and its components in raw water.
2. Determination of chlorides in water
3. Determination of chlorine demand and residual chlorine.
4. Determination of turbidity and optimum dose of alum.
5. Determination of Most Probable Number (MPN)
6. Determination of dissolved oxygen in a given water and wastewater sample
7. Determination of Bio-Chemical Oxygen Demand in a given wastewater sample
8. Determination of Chemical Oxygen Demand in a given wastewater sample
9. Determination of solids -Total solids, suspended solids, volatile solids, settleable solids and non-settleable solids in a given wastewater sample
10. Determination of Sludge Volume Index in a given wastewater sample
11. Determination of Phosphates by spectrophotometer in a given wastewater sample.
12. Determination of total nitrogen in a given wastewater sample.

Part B: (Any one)

1. Exercise on design of water distribution network using any suitable software such as EPANET / tools (total pipe length @ 10 km and minimum 10-12 nodes).
2. Design of Water Treatment Plant (WTP)/ Sewage Treatment Plant (STP) through software.

Part C: (Compulsory)

Visit to water treatment plant and domestic / Industrial wastewater treatment plant & its detailed report.

Text Books:

1. Water Supply Engineering, S. K. Garg, Khanna Publishers, New Delhi, 35th Edition (2015).
2. Water Supply and Sanitary Engineering, G. S. Birdie and J. S. Birdie, DhanpatRai Publishing Company, New Delhi, 9th Edition, (2010).
3. Sewage Disposal & Air Pollution Engineering, S. K. Garg, Khanna Publication, 41st Edition, (2018).

Reference Books:

1.Environmental Engineering, Peavy and Rowe, McGraw Hill Publications, (2017).
2.Waste Water Treatment & Disposal, Metcalf & Eddy, McGraw Hill Education (India) Private Limited, 4th Edition, (2017).

3. Wastewater Treatment for Pollution Control and Reuse, Arceivala and Asolekar, McGraw Hill Education (India) Private Limited, 3rd Edition, (2017).

Codes:

1. Standard Methods for examination of water and wastewater, Mary Franson, American Public Health Association.
2. IS 10500:2012 Drinking water specifications.
3. IS 3025: 2013, Methods of Sampling and Test (Physical, Chemical and Biological) for Water and Waste Water, Bureau of Indian Standards, New Delhi.

e-Resources

1.CPHEEO Manual on Water Supply and Treatment (https://jalshakti-ddws.gov.in/en/cpheeo-manual-water-supply-and-treatment

2. CPHEEO Manual onSewerage and Sewage Treatment) (http://cpheeo.gov.in/cms/manual-on-sewerage-and-sewage-treatment.php)

3. CPHEEO Manual on Storm Water Drainage System (https://mohua.gov.in/publication/manual-on-storm-water-drainage-systems--2019.php)

4. CPHEEO Manual on Operation and Maintenance of Water Supply System (http://cpheeo.gov.in/cms/manual-on-operation--and-maintenance-of-water-supply-system-2005.php)

Program:	B. Tech. (Civil Engineering)				Semester:			VI
Course:	Design of Reinforced Concrete Structures				Code:			BCI26PC20
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
3	3	-	-	1	20	20	60	100

Prior Knowledge:
1. Engineering Mechanics
2. Strength of Materials
3. Mechanics of Structures

Course Objectives: After Completing this course, student will have adequate background to understand and solve the problem involving:
1. Basic concepts of various design philosophies.
2. IS code-based design method of RCC structures.
3. Design of columns
4. Design of footing.
5. Concept of Ductile detailing as per IS: 13920:2016

Course Outcomes: After learning the course, the students should be able to:
1. Explain concepts of various design philosophies and determine moment capacity of beam elements using the Limit State Method.
2. Analyze & design beams for different support conditions
3. Analyze & design one-way slabs for different support conditions.
4. Analyze & design two-way slabs & staircase.
5. Analyze & design short column for different loading conditions using Interaction Curves
6. Design of Isolated footing for different loading conditions.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to Design Philosophies:** Design philosophies of RC structures: working stress method and limit state method, Limit state method: limit state of collapse, limit state of serviceability and limit state of durability, characteristic strength, characteristic load, partial safety factors. structural properties of concrete and reinforcing steel, assumptions of limit state method, strain variation diagram, stress variation diagram, design parameters for singly reinforced rectangular section, modes of failure, moment of resistance of singly and doubly reinforced rectangular section, singly reinforced flanged section.	07
2	**Design of Beam:** Design of simply supported, cantilever beams for flexure (singly reinforced, doubly reinforced, and flanged), shear, bond, and torsion.	08
3	**Design of one-way Slab:** Design of one-way slab: simply supported, cantilever and continuous slabs by using IS Code coefficients	07
4	**Design of two-way slab:** Simply supported, continuous and restrained. **Design of staircase:** dog legged.	08
5	**Design of Column:** Assumptions, minimum eccentricity, design of short column for Axial Load, Design of Short Column for combined Axial load and Uniaxial/Biaxial Bending using Interaction Curves.	07

6	**Ductile Detailing:** Design of isolated column footing for axial load, Design of column footing subjected to combined axial load and uniaxial. Introduction to ductile detailing using IS:13920 2016	**08**
	Total	**45**

Self-directed learning- Design of Footing for subjected to combined axial load and Biaxial Bending. Design of Open well Staircase. Concept of design of Combined Footing.

Text Books:

1. Illustrated Reinforced Concrete Design by Dr. V.L. Shah and Dr. S.R. Karve, Structures Publications, Pune 411009
2. Illustrated Design of Reinforced Concrete Buildings (G+3) by Dr. V.L. Shah and Dr. S.R. Karve, Structures Publications, Pune 411009.
3. RCC Analysis and Design by Sinha, S, Chand and Co. New Delhi.
4. Reinforced Concrete Design by Varghese, PHI, New Delhi.
5. Design of Concrete Structure by S. S. Bhavikatti, New Age International Private Limited.
6. Design of Reinforced Concrete Structures by N. Krishna Raju, CBS Publishers & Distributors.

Reference Books

1. Illustrated Reinforced Concrete Design by Dr. V.L. Shah and Dr. S.R. Karve, Structures Publications, Pune 411009
2. Illustrated Design of Reinforced Concrete Buildings (G+3) by Dr. V.L. Shah and Dr. S.R. Karve, Structures Publications, Pune 411009.
3. Design of Reinforced Concrete Structures by Subramanian, Oxford University Press.
4. Comprehensive Design of R.C. Structures by B.C. Punmia, Ashok Jain and Arun Jain, Standard Book House_, New Delhi.
5. RCC Analysis and Design by Sinha, S, Chand and Co. New Delhi.
6. Reinforced Concrete Design by Varghese, PHI, New Delhi.
7. Reinforced Concrete Design by Pillai Menon, Tata McGraw Hill_, New Delhi.
8. Design of Concrete Structure by J N Bandyopadhyay, PHI, New Delhi.
9. Design of Reinforced Concrete Structures by M. L. Gambhir, PHI, New Delhi

IS Codes

1. IS 456-2000: Plain and reinforced concrete-code of practice, Bureau of Indian Standards, New Delhi
2. IS 13920-2016: Ductile design and detailing of reinforced concrete structures subjected to seismic forces - code of practice, Bureau of Indian Standards, New Delhi
3. IS 875-Part 1-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (I) dead loads-unit weights of building materials and stored materials, Bureau of Indian Standards, New Delhi
4. IS 875-Part 2-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (II) imposed loads, Bureau of Indian Standards, New Delhi

e-Resources

1. https://www.classcentral.com/course/swayam-design-of-reinforced-concrete-structures-13995
2. https://www.udemy.com/course/reinforced-concrete-beam-design/
3. https://nptel.ac.in/courses/105105105
4. https://www.academia.edu/5041739/DESIGN_OF_REINFORCED_CONCRETE_STRUCTURES

Program:	B. Tech. (Civil Engineering)			Semester:		VI	
Course:	Design of Reinforced Concrete Structures Lab			Code:		BCI26PC21	
	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
Credits	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	2	-	25	25	-	50

Prior Knowledge:
1. Engineering Mechanics
2. Strength of Materials
3. Mechanics of Structures

Course Objectives: Student will have adequate background to understand and solve the problem involving:
1. Design the reinforced concrete residential building
2. Structural drawings
3. Ductile detailing as per IS:13920-2016

Course Outcomes: After learning the course, the students should be able to:
1. Design the different structural components of reinforced concrete residential buildings.
2. Prepare Structural drawings showing reinforcement details of different elements of the buildings.
3. Apply ductile detailing knowledge for structural reinforcement detailing as per IS:13920-2016.

Detailed Syllabus

01. Design Project: Design of G + 2 (residential/commercial/public) building covering all types of slabs, beams, columns, footings, and staircase (first and intermediate flight) with following details.

1. Minimum plan area of each floor shall be more than 150 m^2
2. Analysis of Building using suitable software and comparison with manual calculations.
3. Design of plinth and ground beams: for each type two simply supported and two continuous.
4. Design of all slabs and beams of typical floor (first or second floor)
5. Design of three types of columns: (a) axial load, (b) axial load with uniaxial bending, (c) axial load with biaxial bending, from terrace level to footing along with detailed load calculations.
6. Design of two footing: (a) axial load, (b) axial load plus uniaxial bending.
7. Design any one element by using spreadsheet or use of analysis and design by suitable software.
8. Four full imperial drawing sheets. Out of which only structural plan drawing sheets shall be drawn by using any drafting software. Schedule of slabs, beams, columns, and footing can be prepared by using any drafting software.
9. Detailing of reinforcement should be as per SP-34 & IS-13920.
10. Application of AI in RCC design.

02. Reports of two site visits on

Reinforced cement concrete building construction site.

Reference Books:

1. Varghese P.C.; Limit state design of Reinforced Concrete Structures Prentice Hall of India, 1999.
2. Ramchandra. Limit state Design Standard Book House 1990. Bureau of Indian Standards, I.S.456-2000: Plainand reinforced concrete, Code of Practice, Bureau of Indian Standards 2000.
3. Illustrated Reinforced Concrete Design by Dr. V.L. Shah and Dr. S.R. Karve, Structures Publications, Pune 411009.
4. Design of Reinforced Concrete Structures by M. L. Gambhir, PHI, New Delhi.
5. Illustrated Design of Reinforced Concrete Buildings (G+3) by Dr. V.L. Shah and Dr. S.R. Karve, Structures Publications, Pune 411009.
6. Design of Reinforced Concrete Structures by Subramanian, Oxford University Press.
7. Comprehensive Design of R.C. Structures by B.C. Punmia, Ashok Jain and Arun Jain, Standard Book House_, New Delhi.

8. RCC Analysis and Design by Sinha, S, Chand, and Co. New Delhi.
9. Reinforced Concrete Design by Varghese, PHI, New Delhi. Design of Prestressed concrete structures- T. Y. Lin.
10. Reinforced Concrete Design by PillaiMenon, Tata McGraw Hill, New Delhi.
11. Design of Concrete Structure by J N Bandyopadhyay, PHI, New Delhi.

IS Codes:

1. IS 456-2000: Plain and reinforced concrete-code of practice, Bureau of Indian Standards, New Delhi
2. IS 13920-2016: Ductile design and detailing of reinforced concrete structures subjected to seismic forces - code of practice, Bureau of Indian Standards, New Delhi
3. S.P. (16): Design Aids for Reinforced Concrete. (Interaction Charts Only) Bureau of Indian Standards 1980.
4. IS 875-Part 1-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (I) dead loads-unit weights of building materials and stored materials, Bureau of Indian Standards, New Delhi
5. IS 875-Part 2-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (II) imposed loads, Bureau of Indian Standards, New Delhi
6. S.P. (34): Design Aids for Reinforced Concrete. (Interaction Charts Only) Bureau of Indian Standards 1980.

e-Resources

1. https://www.classcentral.com/course/swayam-design-of-reinforced-concrete-structures-13995
2. https://www.udemy.com/course/reinforced-concrete-beam-design/
3. https://nptel.ac.in/courses/105105105
4. https://www.academia.edu/5041739/DESIGN_OF_REINFORCED_CONCRETE_STRUCTURES

Program:	B. Tech. (Civil Engineering)				Semester :		VI	
Course:	Project Management and Economics				Code:		BCI26PC22	
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	1	10	10	30	50

Prior Knowledge: Basic of management and economics

Course Objectives: After Completing this course, student will have

1. To understand the importance of construction project management and ability to do project scheduling
2. To understand the project resource monitoring and software's for project managements.
3. To impart knowledge of selection and recommend the project and understand project economics concepts.

Course Outcomes: After learning the course, the students will be able to:

1. Explain the basic aspects of project management like PLC, PMBOK domain areas, WBS.
2. Analyze the project network using CPM and PERT.
3. Apply the knowledge to solve the problems on inventory and resource allocation , crashing and updating the network
4. Evaluate the project based on selection criteria's and explain the basics of project economics

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to Project Management:** Objectives & functions of Project Management, Project Life Cycle (PLC) Concept, Types of project organization structure, Project Management Book of Knowledge {PMBOK} and domain areas, Role of Project Management Consultants (PMC), Categories of Project, Causes of project failure, Work Breakdown Structure (WBS) for construction projects, Bar chart, Gantt and its Limitations.	07
2	**Project scheduling using CPM and PERT:** Types of precedence relationships, Activity on Arrow (AOA.), Activity on Node (AON), network analysis, time estimation, types and computation of float values, critical path method (CPM),Program Evaluation and Review Technique (PERT): three time estimates, slack, expected duration, calculation of probability of completion. Difference in CPM and PERT.	08
3	**Project resource management-monitoring and control:** Construction material management-objectives, procurement procedure, Inventory control-ABC analysis, Economic order quantity (EOQ) basis. Resource smoothening and Resource leveling, Time-cost optimization-crashing of networks, Network updating, Introduction to BIM (Building Information Modeling) in construction project management and BIM integration with AI.	07
4	**Project Economics and Appraisal of project :** Importance of economics in construction, Time value of money, Annuity, break even analysis, concept of project cash flow, sources of project finance. Project feasibility study, types of project appraisals, Detailed Project Report (DPR), Criteria for Project Selection – Net Present Value (NPV), Internal Rate of Return (IRR), Pay-Back Period, benefit cost (B/C) ratio.	08
	Total	30

Self-directed learning-Last planner system- A lean construction tool; Introduction to practical network methods as : Beeline method, DSM (Design Structure Matrix); Digital tools for project planning and control- MS Project, Primavera

Text Books:

1. Project planning and control with PERT and CPM by DR. B.C. Punmia and K. Khadelwal, Laxmi publication, New Delhi, 4th edition,2016.
2. Construction Engineering and Management by S. Seetharaman, 5th edition, 2015.
3. Project management Principles and Techniques by B.B. Goel, Deep and Deep publisher
4. Construction Engineering & Management of Projects by S.C. Sharma 3rd edition, Khanna publication,2008

Reference Books:

1. Construction project management by K. K. Chitkara, 4th edition, McGraw Hill Education, 2019
2. Construction Project management, Theory & Practice, by Jha, Kumar Neeraj., Pearson Education India, 2015.
3. construction management and planning by B. Sengupta and H. Guha Published by McGraw Hill India (2015)
4. Engineering Economics By R. Panneerselvam, PHI Learning pvt.ltd,13th print 2012.
5. Engineering Economy by William G. Sullivan, Elin M. Wicks and C. Patrick Koelling - Publisher: Prentice Hall, Inc.17th edition, 2019.

e-Resources

1. https://nptel.ac.in/courses/105104161
2. **https://onlinecourses.nptel.ac.in/noc23_ce62**
3. **https://archive.nptel.ac.in/courses/105/106/105106149/**
4. **https://nptel.ac.in/courses/110105167**

Program:	B. Tech. (Civil Engineering)				Semester :		VI	
Course:	Dams and Hydraulic Structures (PEC 2)				Code:		BCI26PE11	
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	1	10	10	30	50

Prior Knowledge: Fluid Mechanics, Hydrology and Water Resources Engineering, Engineering Geology (Geological investigations for suitable site selection)

Course Objectives: This course aims at enabling students,

1. To make students aware of various classification of dams and stability analysis of gravity dam
2. To make students aware of stability analysis of earthen dam and the concept of diversion head works
3. To impart knowledge of design of suitable hydraulic structures
4. To impart knowledge for appropriate cross drainage works and river training works

Course Outcomes: After learning the course, the students should be able to:

1. Classify dams and analyze stability of concrete gravity dam
2. Analyze Stability of earthen dam and the diversion head works
3. Design canal and related structures
4. Identify the applications of various cross drainage works and river training works

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to dams :**Introduction, historical development of dams, different terms related to dams, selection of site for dam, factors governing selection of type of dam, classification of dams, dams and social issues, large dams verses small dams **Gravity Dams :** Components of gravity dam, conditions favoring gravity dams, Forces acting on gravity dam, combinations of loading for design, seismic analysis of dam, middle third rule, modes of failure of gravity dam, elementary profile of gravity dam, economic height of dam, concept of low and high gravity dams, various design methods of gravity dam	7
2	**Earth Dam:** Introduction, Classification of earth dam, selection of type of earth dam, components of an earth dam, requirements for safe design of earth dam, hydraulic (seepage) analysis, plotting of seepage line, forces acting on earth dam, stability analysis of an earth dam, analysis by Swedish slip circle method, failure of earth dam, seepage control in earth dams, causes of seepage, seepage control measures, Real-time seepage monitoring in earth dams using AI and IoT. **Diversion head works:** Typical layout and components of diversion head works, site selection, criteria for safe deign of weir floor, brief introduction to Bligh and Lane's theory, Khosla's theory	8
3	**Spillway :** Concept, classification of spillway, design of ogee spillway, energy dissipation below spillway, classification of energy dissipation devices, spillway gates, classification of spillway crest gates, maintenance of gates, inspection of gates **Canal and canal structures :** Introduction, classification of canals, design of stable canal in alluvial beds, Kennedy's theory, design of canal by Kennedy's theory, Limitations of Kennedy's theory, Lacey's regime theory, canal Lining design of lined canal, canal falls introduction, necessity, types of falls, canal outlets- introduction of canal outlet or module, canal escapes.	8
4	**Cross drainage (C.D.) Works:** Necessity of cross drainage works, site selection classification drain over canal-siphon, super passage, canal over drain - aqueduct, siphon aqueduct, canal and drain water mixed in each other--level crossing, inlet and outlet, design considerations for cross drainage works **River training works :** Introduction, classification of rivers, classification based on topography, regime, alignment, source, behavior of rivers, river training, objectives classification, purpose, river training structures	7
	Total	30

Self Directed Learning: Emergency Action Plans for dam safety, Structural health monitoring (SHM) , Central Water Commission (CWC) Guidelines, spillway hydraulics, cavitations control, dam-break modeling, introduction to softwares viz. AutoCAD (for dam sections, spillway layouts),QGIS or ArcGIS for dam site selection, HEC-RAS (for reservoir routing, dam break simulations), GeoStudio (for seepage, slope stability)

Text Books:

1. Engineering hydrology, K. Subramanya,Tata McGraw- Hill, New Delhi, (4th Edition), 2013
2. Irrigation, water resources and water power Engineering, P. N. Modi, Standard book House 11th edition (2020)
3. Punmia, B.C. and Pande, B.B.L. "Irrigation and water power engineering", Laxmi Publications Pvt. Ltd, New Delhi 17th edition , 2016

Reference Books:

1. Design of Small Dams- United States Department of the Interior, Bureau of Reclamation revised Third edition 1987, Oxford and IBH Publishing Co.
2. Irrigation and Water Resources Engineering- Asawa G.L- New Age International (P) Ltd. Publishers, 2008.
3. Engineering for Dams- Creager W.P, Justin J.D, Hinds J -Wiley Eastern Pvt. Ltd., New Delhi, 1968
4. Irrigation Engineering and Hydraulic Structures- Garg S.K. - Khanna Publishers New Delhi, 34th revised 2017edition,

IS Codes:

1. I.S. 6512-1984 (Reaffirmed 1998), Criteria for design of solid gravity dams, first revision, first reprint, September, 1998, B.I.S. New Delhi.
2. I.S. 457 – 1957 (Reaffirmed, 2005), Code of practice for general construction of plain and reinforced concrete for dam and other massive structures, sixth reprint, January 1987, B.I.S. New Delhi.
3. I.S. 10135 – 1985(Reaffirmed 2002), Code of practice for drainage system for gravity dams, their foundations and abutments, first revision, B.I.S. New Delhi
4. I.S. 14591 – 1999 (R2015), Temperature control mass concrete for dams – guidelines, B.I.S. New Delhi
5. I.S. 11223 – 1985 (Reaffirmed 2004), Guidelines for fixing spillway capacity, edition 1.2 (1991-09), B.I.S.New Delhi
6. I.S. 6934 – 1998 (Reaffirmed 2003), Hydraulic design of high ogee overflow spillways – recommendations,first revision, B.I.S. New Delhi .
7. I.S. 11155- 2019 (Reaffirmed 2020), Second Revision, Construction of spillways and similar overflow structures – Code of practice, B.I.S. New Delhi

e-Resources

1. https://www.bis.gov.in/standards/technical-department/national-building-code/
2. https://mohua.gov.in/upload/uploadfiles/files/Chap-4.pdf
3. https:// www.worldcat.org/title/hydraulic-structures/edition
4. https://www./Hydrodynamic-Forces-Hydraulic-Structures-Manual ebook/dp/B077DRQVP8

Program:	B. Tech. (Civil Engineering)			Semester :		VI	
Course:	Dams and Hydraulic Structure Lab (PEC 2 Lab)			Code:		BCI26PE12	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	2	-	50	-	-	50

Prior Knowledge: Fluid Mechanics, Hydrology and Water Resources Engineering,

Course Objectives :

1. To impart knowledge of stability analysis of gravity and earthen dam
2. To provide Knowledge of Design of spillway with energy dissipater and lined canal
3. To impart knowledge of safety of weir on permeable foundation

Course Outcomes: After learning the course, the students should be able to:

1. Analyze the stability of gravity and earthen dam.
2. Design suitable hydraulic structures
3. Apply knowledge of causes of failure of hydraulic structure from the reference case study

Detailed Syllabus

Term work consists of

A) Analysis /Design Assignments

1) Stability analysis of gravity dam
2) Design of profile of Ogee spillway and suggest the suitable energy dissipater
3) Stability analysis of zoned earthen dam and learn AI-Based Approach to Predict the Center of the Critical Slip Circle in Slope Stability Analysis
4) Design of lined canal
5) Design of any one type of river training work

B) A report based on visit to any irrigation project during the academic term.

C) Presentation on review of any one case study of failure of hydraulic structure from published literature or patent related to hydraulic structures. (In a group of students)

Text Books:

1. Engineering hydrology, K. Subramanya,Tata McGraw-Hill, New Delhi, (4th Edition), 2013
2. Irrigation, water resources and water power Engineering, P. N. Modi, Standard book House 11th edition (2020)
3. Punmia, B.C. and Pande, B.B.L. “Irrigation and water power engineering”, Laxmi Publications Pvt. Ltd, New Delhi 17th edition , 2016

Reference Books:

1 Design of Small Dams - United States Department of the Interior, Bureau of Reclamation revised Third edition 1987, Oxford and IBH Publishing Co.
2. Irrigation and Water Resources Engineering- Asawa G.L- New Age International (P) Ltd. Publishers, 2008.
3. Engineering for Dams- Creager W.P, Justin J.D, Hinds J -Wiley Eastern Pvt. Ltd., New Delhi, 1968
4. Irrigation Engineering and Hydraulic Structures- Garg S.K- Khanna Publishers New Delhi, 34th revised 2017edition,

Codes:

1. I.S. 6512-1984 (Reaffirmed 1998), Criteria for design of solid gravity dams, first revision, first reprint, September, 1998, B.I.S. New Delhi.
2. I.S. 457 – 1957 (Reaffirmed, 2005), Code of practice for general construction of plain and reinforced concrete for dam and other massive structures, sixth reprint, January 1987, B.I.S. New Delhi.
3. I.S. 10135 – 1985(Reaffirmed 2002), Code of practice for drainage system for gravity dams, their foundations and abutments, first revision, B.I.S. New Delhi
4. I.S. 14591 – 1999 (R2015), Temperature control mass concrete for dams – guidelines, B.I.S. New Delhi.
5. I.S. 11223 – 1985 (Reaffirmed 2004), Guidelines for fixing spillway capacity, edition 1.2 (1991-09), B.I.S. New Delhi.
6. I.S. 6934 – 1998 (Reaffirmed 2003), Hydraulic design of high ogee overflow spillways – recommendations, first revision, B.I.S. New Delhi
7. I.S. 11155- 2019 (Reaffirmed 2020), Second Revision, Construction of spillways and similar overflow structures – Code of practice, B.I.S. New Delhi

e-Resources

1. https://www.worldcat.org/title/hydraulic-structures/ edition
2. https://www. Hydrodynamic-Forces-Hydraulic-Structures-Manual ebook/dp/B077DRQVP8

Program:	B. Tech. (Civil Engineering)				Semester :		VI	
Course:	Sustainable Engineering (PEC 2)				Code:		BCI26PE13	
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	1	10	10	30	50

Pre-requisite:
1. Fundamentals of Environmental Studies
2. Introduction to the basic concept of sustainability

Objectives:
1. To provide the fundamental concepts of sustainable engineering and the roles and responsibilities of engineers in developing a sustainable society.
2. To impart knowledge on energy conservation, green energy mechanisms, carbon footprints, and carbon credits.
3. To build conceptual knowledge of the circular economy and Life Cycle Assessment.
4. To provide conceptual knowledge on risk assessment, climate change mitigation, and environmental impact assessment.

Outcomes:
After learning the course, the students should be able to:
1. Apply sustainable engineering principles in real-world scenarios for developing a sustainable society.
2. Explain the methods and policies for energy conservation, clean energy production, and their mechanisms.
3. Identify sustainable engineering solutions for the circular economy and life cycle assessment for environmental impact assessment.
4. Identify the risk assessment and EIA tools and climate change mitigation.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Introduction to Sustainable Engineering:** Introduction to sustainability -definitions, principles, and sustainability indicators, social and economic aspects of sustainability, Links between industrial activities and sustainability issues, Sustainable handling of waste (case study), Sustainable Development Goals, roles and responsibilities of engineers in developing a sustainable society. Sustainable infrastructure (case study), sustainable buildings (case study), sustainable recovery of degraded areas (case study)	7
2	**Energy Conservation and Green Solutions:** The significance and the Global and Indian Energy scenarios of energy conservation and the environment, environmental impact of energy conversion for green solutions and its policies, Carbon footprint & carbon credits: introduction, carbon emission, carbon footprint and carbon trading (case study), 5R: waste to wealth concept with a case study. Sustainable materials for reduction of carbon emission (case study), case studies on sustainable energies, green buildings, sustainable infrastructure, waste recycling and material conservation, and sustainable environmental remediation.	8
3	**Circular Economy and Life Cycle Assessment:** Environmental design for sustainability, economics, ecological and social performance indicators, sustainable engineering design principles, sustainable material management, material flow analysis, Circular economy of construction material (case study), Impact of circular economy adoption of global sustainability (case study), Life cycle analysis, methodology, ISO 14040:2006 for Life Cycle Assessment**,** benefits and drawbacks**,** LCA tools (Open LCA and The LCA Calculator), Case study on to illustrate the LCA procedure and results.	8
4	**Risk Assessment and Environmental Impact Assessment:** Introduction to Environmental Risk Assessment, Environmental Impact Assessment (EIA) Process: concept and objectives, stages of EIA, EIA methodologies, Identifying potential environmental hazards from a project (case study), Exposure assessment techniques (monitoring, modeling, sampling), Environmental Impact Areas, Climate change mitigation and management plans (case study)	7
	Total	**30**

Self-directed learning:

1. Role of Strategic Environmental Assessment (SEA) in policy planning.
2. Case study on public participation in environmental decision-making.
3. Startup innovations in biodegradable packaging and reusable materials.
4. Life Cycle Assessment of a Common Household Product.
5. Design Thinking for Sustainable Product Development.

Text Books:

1.Sustainable Engineering: Principles and Practice, Bhavik R. Bakshi, Cambridge University Press (2019)

2. Sustainable Engineering, Dr. SrinivasVasam, Dr. K. JagannadhaRao, S.K. Kataria& Sons, S.K. Kataria& Sons, 1st Edition (2021)

3. Introduction To Sustainable Engineering, Rag R. L. RemeshLekshmiDinachandran, PHI, (2016)

4. Sustainable and Resilient Engineering: Drivers, Metrics, Tools, and Applications, Reddy, K. R., Cameselle, C., & Adams, J. A. (2025), 2nd Edition, ISBN: 978-1-394-26768-2

Reference Books:

1. Engineering for Sustainability, Jonker Gerald, Elsevier Science & Technology 1st Edition (2012)
2. Cradle to Cradle: Remaking the Way We Make Things, William McDonough, North Point Press, (2002)
3. Circular Economy and Sustainability, Volume 1: Management and Policy, AlexandrosStefanakis, Ioannis Nikolaou, Elsevier, (2021)

e-Resources:

1. https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview
2. https://www.rit.edu/sustainabilityinstitute/blog/what-life-cycle-assessment-lca
3. https://link.springer.com/book/10.1007/978-3-319-56475-3#toc
4. https://archive.nptel.ac.in/courses/105/105/105105157/
5. https://www.coursera.org/learn/global-sustainable-development

Program:	B. Tech. (Civil Engineering)			Semester :		VI	
Course:	Sustainable Engineering Lab (PEC 2 Lab)			Code:		BCI26PE14	
	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
Credits	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	2	-	50	-	-	50

Prior Knowledge: Nil

Course Objectives:

This course aims to enable students,

1.To study practical knowledge of sustainability concepts and their applications in engineering.
2. To understand and implement circular economy principles for resource management.
3. To gain hands-on experience in conducting Life Cycle Assessments (LCA) using appropriate tools.
4. To develop critical thinking and problem-solving skills through real-world case studies and practical applications.
5. To study practical cases of climate change mitigation and adaptation.

Course Outcomes:

After learning the course, the students should be able to:

1. Demonstrate an understanding of sustainable waste management practices and the role of engineers in sustainability.
2. Apply circular economy principles to real-world engineering problems and material management.
3. Apply Life Cycle Assessment (LCA) using standard tools and assess the sustainability impact of products and processes.
4. Propose green engineering solutions, energy conservation strategies, carbon footprints, and carbon trading mechanisms.
5. Assess basic environmental impact assessments (EIA), risk assessments, and climate change mitigation and adaptation studies.

Detailed Syllabus:

Unit	Term work consist of the following (Any eight)
1.	Prepare a report on Sustainable Development Goals and their impact on engineering.
2.	Study a real-world example of sustainable waste management.
3.	Analyze a construction material recovery project following circular economy principles.
4.	Perform a basic LCA for a selected product using Open LCA or The LCA Calculator.
5.	Evaluate the life cycle of a construction material and suggest improvements.
6.	Study the impact of biofuels and waste-to-energy systems on sustainability.
7.	Prepare a report on India's energy conservation policies and green energy strategies.
8.	Measure the carbon footprint of a university/industry using available carbon calculators.
9.	Report on sustainable materials that reduce carbon emissions in the construction industry.
10.	Case study an industrial project that underwent EIA and analyze its mitigation plan.
11.	Case study on Climate Change Management Plans in India including mitigation and adaptation.

Text Books:

1.Sustainable Engineering: Principles and Practice, Bhavik R. Bakshi, Cambridge University press (2019)
2. Sustainable Engineering, Dr. SrinivasVasam, Dr. K. JagannadhaRao, S.K. Kataria& Sons, S.K. Kataria& Sons, 1st Edition (2021)
3. Introduction To Sustainable Engineering, Rag R. L. RemeshLekshmiDinachandran, PHI, (2016)
4. Sustainable and Resilient Engineering: Drivers, Metrics, Tools, and Applications, Reddy, K. R., Cameselle, C., & Adams, J. A. (2025), 2nd Edition, ISBN: 978-1-394-26768-2

Reference Books:

1. Engineering for Sustainability, Jonker Gerald, Elsevier Science & Technology 1st Edition (2012)
2. Cradle to Cradle: Remaking the Way We Make Things, William McDonough, North Point Press, (2002)
3. Circular Economy and Sustainability, Volume 1: Management and Policy, AlexandrosStefanakis, Ioannis Nikolaou, Elsevier, (2021)

e-Resources:

1. https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview
2. https://www.coursera.org/learn/global-sustainable-development
3. https://www.sciencedirect.com/journal/circular-economy-and-sustainability
4. https://www.openlca.org/
5. https://www.iso.org/standard/37456.html
6. https://www3.epa.gov/carbon-footprint-calculator/
7. https://www.india.gov.in/spotlight/waste-wealth
8. https://www.unep.org/resources/report/environmental-impact-assessment-guidelines
9. https://www.who.int/health-topics/environmental-risk-assessment

Program:	B. Tech. (Civil Engineering)				Semester :			VI
Course:	3D Concrete Printing (PEC 2)				Code:			BCI26PE15
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	--	--	1	10	10	30	50

Prior Knowledge:

1. Computer Aided Design & Drafting.
2. Engineering Materials, Strength of Material
3. Properties of Concrete

Course Objectives: This course aims at enabling students,

1. To gain knowledge and skills related to 3D printing technologies.
2. To understand the various software tools, process, material and techniques for construction technology.
3. To apply these techniques into civil Engineering applications like Building, Bridge, wall element, roof ceiling and decorative building elements.

Course Outcomes: After learning the course, the students should be able to:

1. Develop CAD models for 3D printing.
2. Process software files
3. Optimize concrete mix
4. Analyze behavior for strength and challenges in printing.

Detailed Syllabus

Unit	Description	Duration (H)
1	**3D Printing (Additive Manufacturing)** Introduction, Process, Classifications, Advantages, Additive v/s Conventional Manufacturing processes, Applications. **CAD for 3D Manufacturing** CAD Data formats, Data translation, Data loss, STL format.	07
2	**3D Techniques** Stereo- Lithography, Laminated Object Manufacturing (LOM), Fused deposition modeling (FDM), Selective laser sintering (SLS), Selective laser melting (SLM), Binder Jet technology. Processing of software file, Process parameter, Process Selection for various applications,	07
3	**Material Properties and Testings** Properties of concrete ingredient like cement, sand, fly ash, silica fume, fibers, Concrete Mix proportioning and optimization considering admixtures like super plasticizer, retarders, water reducing agents, quick setting agent etc, viscosity modifying agents, geo-polymers, fibers, alternative material used for printing, Testing on material like compressive strength, bonding strength, workability, setting time, build ability, flow ability, etc,	07
4	**Structural Behavior and Reinforcement methods** Structural behavior and its Integrity. Pre-installed, Post-installed, In-process, Bar penetrations, Steel cables, Carbon, glass, or basalt fibers, Continuous fibers are unwound as the machine prints. Design of 3D Printed Reinforcement Concrete elements, Pre-Post stressed 3D Printed concrete design	08
	Total	**30**

Self-directed learning-

3D files conversion from dwg to .stl to gcode hands on, 3D Printing hands on, Basic Concrete Properties, Post process information collection, Industry trends through literature.

Text Books:

1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing by Lan Gibson, David W. Rosen and Brent Stucker, Springer, 2010.
2. 3D Printing and Rapid Prototyping- Principles and Applications by CK Chua, Kah Fai Leong,World Scientific, 2017.
3. 3D Printing and Design by Hanser Publisher, Khanna Editorial, Khanna Publishing House, Delhi, 2011.
4. Concrete Technology: Theory and Practice by M. S. Shetty & A K Jain, S. Chand Publication, 2019.

Reference Books:

1. J.D. Majumdar and I. Manna, "Laser-Assisted Fabrication of Materials", Springer Series in Material Science, 2013.
2. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing".

E Resources:

1. 3D Printing and Additive Manufacturing Specialization
   https://www.coursera.org/specializations/3d-printing-additive-manufacturing
2. 3D Printing Software',Jeffrey Smith, Education Manager, Coursera Course by University of Illinois at Urbana-Champaign, USA.
   https://www.coursera.org/specializations/3d-printing-additive-manufacturing
3. 3D Printing Applications',VishalSachdev Clinical Assistant Professor , Director, Illinois MakerLab, Coursera Course ,University of Illinois at Urbana-Champaign, USA.
   https://www.coursera.org/learn/3d-printing-applications

Program:	B. Tech. (Civil Engineering)			Semester :		VI	
Course:	3D Concrete Printing Lab (PEC 2)			Code:		BCI26PE16	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
01	--	02	--	50	--	--	50

Prior Knowledge:

1. Computer Aided Design & Drafting.
2. Engineering Materials, Strength of Material
3. Properties of Concrete

Course Objectives :

1. To gain knowledge and skills related to 3D printing technologies.
2. To understand the various software tools, process, material and techniques for construction technology.
3. To apply these techniques into civil Engineering applications like Building, Bridge, wall element, roof ceiling and decorative building elements.

Course Outcomes: After learning the course, the students should be able to:

1. Develop CAD models for 3D printing.
2. Process software files
3. Optimize concrete mix
4. Analyze behavior for strength and challenges in printing

Detailed Syllabus

Term work consists of:-

1. **3D Modeling & STL File Generation**
   - Introduction to 3D modeling software for civil engineering applications.
   - Design and generation of STL files for additive manufacturing.
2. **CAD Data Exchange & G-Code Generation**
   - Understanding CAD file formats and interoperability in 3D printing.
   - Conversion of 3D models into machine-readable G-code for printing.
3. **3D Printing Using PLA Filament**
   - Basics of FDM (Fused Deposition Modeling) technology.
   - Hands-on experience in printing 3D models using PLA filament.
4. **Product Identification for Additive Manufacturing & Process Planning**
   - Selection of suitable civil engineering components for 3D printing.
   - Process planning, material selection, and feasibility analysis.
5. **Workability and Slump Test for 3D Printable Concrete**
   - Testing fresh concrete properties tailored for 3D printing applications.
   - Understanding rheology, pumpability, and extrudability of printable concrete.
6. **Optimization of Buildability, Workability, and Discharge Rate**
   - Enhancing material properties for better structural integrity.
   - Adjusting mix design for smooth extrusion and layering.
7. **Literature Review on Global 3D Concrete Printing**
   - Study of international research trends and innovations in 3D concrete printing.
   - Analysis of case studies from ongoing projects worldwide.
8. **Industry Report: Global 3D Concrete Printing Companies & Applications**
   - Overview of major companies pioneering 3D concrete printing.
   - Real-world applications in housing, infrastructure, and sustainability.

This refined structure ensures clarity and relevance for TY B.Tech Civil students, focusing on both theoretical knowledge and practical applications.

Text Books:

1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing by Lan Gibson, David W. Rosen and Brent Stucker, Springer, 2010.
2. 3D Printing and Rapid Prototyping- Principles and Applications by CK Chua, Kah Fai Leong,World Scientific, 2017.
3. 3D Printing and Design by Hanser Publisher, Khanna Editorial, Khanna Publishing House, Delhi, 2011.
4. Concrete Technology: Theory and Practice by M. S. Shetty& A K Jain, S. Chand Publication, 2019.

Reference Books:

1. J.D. Majumdar and I. Manna, "Laser-Assisted Fabrication of Materials", Springer Series in Material Science, 2013.
2. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing".

E Resources:

1. 3D Printing and Additive Manufacturing Specialization
   https://www.coursera.org/specializations/3d-printing-additive-manufacturing
2. 3D Printing Software',Jeffrey Smith, Education Manager, Coursera Course by University of Illinois at Urbana-Champaign, USA.
   https://www.coursera.org/specializations/3d-printing-additive-manufacturing
3. 3D Printing Applications',VishalSachdev Clinical Assistant Professor , Director, Illinois MakerLab, Coursera Course ,University of Illinois at Urbana-Champaign, USA.
   https://www.coursera.org/learn/3d-printing-applications

Program:	B. Tech. (Civil Engineering)				Semester :		VI	
Course:	Elements of Earthquake Engineering (PEC2)				Code:		BCI26PE17	
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	1	10	10	30	50

Prior Knowledge:

1. Engineering Geology,
2. Structural Analysis.

Course Objectives: This course aims at enabling students,

1. Interpretation of Seismic Analysis Results
2. Seismic forces and their distribution in structures.
3. Overview of response spectra and its interpretation.
4. Case studies of basic seismic analysis for simple structural systems.

Course Outcomes: After learning the course, the students should be able to:

1. Explain fundamental concepts of earthquakes, seismicity, and earthquake characterization relevant to civil engineering practice.
2. Identify, quantify, and interpret earthquake ground motion characteristics and response spectrum concepts.
3. Analyze simplified structural systems by determining essential dynamic properties under earthquake loading.
4. Apply Codal-based simplified seismic analysis methods and interpret seismic response of basic structural systems.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Earthquake Fundamentals & Seismic Characterization Plate:** tectonics, faulting, earthquake waves; Indian seismic zones and seismic map of India with reference to structural behaviour under earthquake loading; earthquake parameters: magnitude, intensity, and energy; seismic scales; basic Codal philosophy governing seismic zoning and seismic demand estimation; accelerographs and accelograms.	7
2	**Ground Motion & Response Spectrum Concepts:** Ground motion parameters: amplitude, frequency, duration; factors influencing ground motion such as soil type, fault mechanism, and epicentral distance; simplified numerical illustrations for ground motion parameters; response spectrum concept, construction, and interpretation through step-by-step conceptual examples.	8
3	**Dynamic properties of Structures:** mass, stiffness, and damping; natural frequency and resonance with simple numerical illustrations and practical interpretation; SDOF systems under free and forced vibrations; engineering relevance of SDOF idealization for real structures; introduction to MDOF systems with mode shapes and natural frequencies.	7
4	Introduction to IS 1893 with design philosophy and analytical basis of seismic force estimation; equivalent static method; response spectrum method (overview); seismic force distribution and interpretation of analysis results; case studies of simple structures; exposure to emerging applications such as AI in seismic design and risk mitigation.	8
	Total	**30**

Self-directed learning - USGS Earthquake Hazards Program—Plate tectonics & seismicity overview, IS 1893 Part 1 (2016)—Appendix A for intensity scales and magnitude; free & forced vibrations.

Text Books:

1. Earthquake resistant design of structures by Agrawal, P. and Shrikhande, M. Prentice Hall of India, Inc. (2011).
2. Dynamics of structures: Theory and application to earthquake engineering by Chopra, A.K, Prentice Hall of India, 5th edition (2017).
3. Dynamics of structure and foundation – A unified approach: 2 Applications by Chowdhary, I. and Dasgupta, S.P. CRC Press, Balkema. (2009).
4. Seismic analysis of structures by Datta, T. K. John Wiley & Sons (Asia) Pte Ltd. Singapore. (2010).
5. Geotechnical earthquake engineering Kramer, S. L. Prentice Hall, (2007).

Reference Books:

1. Earthquake Resistance Design for Engineers and Architects by Dowrick, D. L. John Willey & Sons, 2nd Edition, (1987).
2. Housner, G. W. &Jenning, P.C. "Earthquake Design Criteria", Earthquake Engineering Research Institute, Oakland, California, USA, (1982).
3. Earthquake Engineering Research Institute, Oakland, California, USA, (1982).
4. Design of Earthquake Resistance Buildings Wakabayashi, M. McGraw Hill Books Company, (1986).
5. Introduction to Earthquake Engineering by Okamoto, S. University of Tokyo press, 2nd Edition, (1984).

e-Resources

1. https://www.bis.gov.in/standards/technical-department/national-building-code/
2. https://mohua.gov.in/upload/uploadfiles/files/Chap-4.pdf3

Program:	B. Tech. (Civil Engineering)			Semester:			VI
Course:	Elements of Earthquake Engineering Lab (PEC 2 Lab)			Code:			BCI26PE18
	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
Credits	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	2	-	50	-	-	50

Prior Knowledge: Nil

Course Objectives:

1. Interpret seismic data and demonstrate the measurement of earthquakes through manual calculations and software tools.
2. Analyze seismic forces and their effects on structural models using computational and manual approaches.

Course Outcomes: After learning the course, the students should be able to:

1. Apply SAP2000 software to simulate and interpret seismic responses of simple structural systems.
2. Analyze dynamic properties such as mode shapes, center of mass, and center of rigidity for structural models.
3. Evaluate seismic parameters and their influence on structural behavior using both software-based tools and manual calculations.

Detailed Syllabus

Term work consists of:

A) List of Laboratory Experiments:

I. Mathematical Model of Structure: (All ***three***) **(06 hrs.)**

1. Study of earthquake ground motion of worldwide earthquakes.
2. Introduction to seismic analysis software.
3. Mathematical model of a two storied building.

II. Analysis of the Structure (Any ***three*** out of the following) _ **(12 hrs.):**

1. Determining Dynamic properties of Building.
2. Identifying mode shapes of the building model
3. Analysis of Centre of mass and Centre of rigidity of the given floor plan
4. Assigning rigid diaphragm in the given model.
5. Defining Response spectrum function in seismic analysis software.

B) Assignments: (Any ***three*** out of the following) _ **(12 hrs.):**

1. Estimation of epicenter of earthquake using circle method
2. Estimation of origin time and focal depth of an earthquake
3. Estimation of intensity of an earthquake.
4. Calculation of Design Seismic Force by Static Analysis Method
5. Calculation of Design Seismic Force by Dynamic Analysis Method.
6. Introduction to AI-based classification of seismic signals and damage detection using accelerogram datasets.

Text Books:

1. Earthquake resistant design of structures by Agrawal, P. and Shrikhande, M. Prentice Hall of India, Inc. (2011).
2. Dynamics of structures: Theory and application to earthquake engineering by Chopra, A.K, Prentice Hall of India, 5th edition (2017).
3. Dynamics of structure and foundation – A unified approach: 2 Applications by Chowdhary, I. and Dasgupta, S.P. CRC Press, Balkema. (2009).
4. Seismic analysis of structures by Datta, T. K. John Wiley & Sons (Asia) Pte Ltd. Singapore. (2010).

Geotechnical earthquake engineering Kramer, S. L. Prentice Hall, (2007).

Reference Books:

1. Earthquake Resistance Design for Engineers and Architects by Dowrick, D. L. John Willey & Sons, 2nd Edition, (1987).
2. Housner, G. W. &Jenning, P.C. "Earthquake Design Criteria", Earthquake Engineering Research Institute, Oakland, California, USA, (1982).
3. Earthquake Engineering Research Institute, Oakland, California, USA, (1982).
4. Design of Earthquake Resistance Buildings Wakabayashi, M. McGraw Hill Books Company, (1986).
5. Introduction to Earthquake Engineering by Okamoto, S. University of Tokyo press, 2nd Edition, (1984).

Codes:

1. IS 1893 (Part I), 2016: Indian Standard Criteria for Earthquake Resistant Design of Structures.
2. IS 13920, 2016 Indian Standard Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces.
3. IS 4326, 1993: Indian Standard Code of Practice for Earthquake Resistant Design & Construction of Buildings.
4. IS 13827, 1993: Indian Standard Guidelines for improving Earthquake Resistance of Earthen Buildings
5. IS 13828, 1993: Indian Standard Guidelines for Improving Earthquake Resistance of Low Strength Masonry Buildings
6. IS 13935, 2009: Seismic Evaluation, Repair and Strengthening of Masonry Buildings - Guidelines.

e-Resources:

1. https://www.csiamerica.com/products/sap2000
2. https://nptel.ac.in/courses/105101004
3. https://onlinecourses.nptel.ac.in/noc22_ce64/preview
4. https://library.iitd.ac.in/node/75670
5. https://www.eeri.org/
6. https://eq.iitr.ac.in/e-learning/index.html
7. https://www.nicee.org/EQTips.php

Program:	B. Tech. (Civil Engineering)				Semester :		VI	
Course:	Advanced Transportation Engineering – 1 (PEC 2)				Code:		BCI26PE19	
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	1	10	10	30	50

Prior Knowledge:
1. Basic Civil & Environmental Engineering
2. Geotechnical Engineering for characteristics of soil
3. Engineering Geology & Rock Mechanics for design of road geometry

Course Objectives: This course aims at enabling students,
1. Learn about modern trends in highway materials, construction, and maintenance.
2. Study traffic engineering components and their elements.
3. Explore traffic engineering facilities, regulations, and management measures.

Course Outcomes: After learning the course, the students should be able to:
1. Explain traffic stream characteristics and relationships between speed, flow, and density.
2. Demonstrate data collection methods for speed, volume, parking, and accident studies.
3. Illustrate different types of intersections.
4. Estimate the optimal signal timings using Webster‘s method for improved traffic flow.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Traffic Engineering & Study of its elements:** Introduction, Objectives and Scope of Traffic Engineering; Components of Road Traffic – Vehicle, Driver and Road; Road User and Vehicle Characteristics and their effect on Road Traffic; Traffic Manoeuvres. Traffic Stream Characteristics- Relationship between Speed,Flow and Density,	8
2	**Traffic Surveys** Traffic Surveys- Speed, journey time and delay surveys, Vehicles Volume Survey including non-motorized transports, Methods and interpretation, Origin Destination Survey, Methods and presentation, Parking Survey, Accident analyses-Methods, interpretation and presentation, Statistical applications in traffic studies and traffic forecasting, Level of service (LOS)-Concept, applications and significance.	7
3	**Intersection Design** Control of Traffic Movements at intersection through Time Sharing and Space Sharing Concepts; Design of Channelising Islands, T, Y, Skewed, Staggered, Roundabout, Mini-roundabout and other forms of AT-Grade Crossings including provision for safe crossing of Pedestrians and Cyclists; Grade Separated Intersections, their Types, Warrants and Design Methods.	8
4	**Modern Traffic Management** Traffic Signs, Markings and Signals; Principles of Signal Design, Webster's method of Signal Design, Redesign of Existing Signals including Case Studies; Signal System and Coordination. Traffic Management measures: Speed, vehicle, parking, enforcement regulations, mixed traffic regulation, various management techniques. Introduction to Traffic operation and management software (e.g **PTV VISSIM, SUMO**). Introduction to AI in Traffic Management.	7
	Total	30

Self-directed learning Smart Cities & Connected Vehicles – Exploring vehicle-to-infrastructure (V2I) communication, autonomous vehicle integration, and IoT applications can prepare students for the future of transportation. Behavioral Traffic Studies & Psychology – Examining how driver behavior, perception, and decision-making influence traffic flow and accident risks can improve road safety strategies.

Text Books:

Books by Indian Authors:

1. Khanna, S. K., Justo, C. E. G. &Veeraragavan, A. (2018). *Highway engineering* (10th ed.). New Delhi: Nem Chand & Bros.
2. Kadiyali, L. R. (2011). *Traffic engineering and transport planning*. Khanna Publishers.

Books by International Authors:

3. O'Flaherty, C. A. (2002). *Highways: Traffic planning & engineering*. Edward Arnold, UK.
4. McShane, W. R., &Roess, R. P. (2010). *Traffic engineering*. Prentice-Hall, NJ.

Reference Books:

1. The Institute of Transportation Engineers. (2016). Traffic engineering handbook (7th ed.). Institute of Transportation Engineers.
2. Indian Roads Congress. (2008). Guidelines for the design of at-grade intersections in rural & urban areas (RC-SP41). New Delhi: Indian Roads Congress.
3. Salter, R. J. (1996). Highway traffic analysis and design. ELBS.
4. Garber, N. J., & Hoel, L. A. (2009). Traffic and highway engineering. Cengage Learning.
5. Federal Highway Administration. (2009). Manual on uniform traffic control devices (MUTCD). U.S. Department of Transportation.
6. Matson, T. M., Smith, W. S., & Hurd, F. W. (1955). Traffic engineering. McGraw Hill Book Co.
7. **Indian Roads Congress.** (2018). *Guidelines for the design of flexible pavements (IRC: 37-2018).* Indian Roads Congress, New Delhi, India.
8. **Indian Roads Congress.** (2015). *Guidelines for the design of plain jointed rigid pavements for highways (IRC: 58-2015).* Indian Roads Congress, New Delhi, India.

Codes and Manuals:

1. IRC: SP:19-2001 - Manual for Traffic Surveys.
2. IRC: 93-1985 - Guidelines for Design of Traffic Signals.
3. IRC: 106-1990 - Guidelines for Capacity of Urban Roads.
4. Highway Capacity Manual 7th Edition, A Guide for Multimodal Mobility Analysis (2022)
5. Indo-HCM: Indian Highway Capacity Manual , CSIR, New Delhi (2017).

e-Resources

1. https://archive.nptel.ac.in/courses/105/104/105104098/ (By: Prof. A. Das & Prof. ParthaChakraborty)
2. https://ocw.mit.edu/collections/transportation (MIT- Open courseware)
3. https://www.icevirtuallibrary.com

Program:	B. Tech. (Civil Engineering)			Semester :		VI	
Course:	Advanced Transportation Engineering -1 Lab (PEC 2 Lab)			Code:		BCI26PE20	
	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
Credits	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	2	-	50	-	-	50

Prior Knowledge:

1. Basic Civil & Environmental Engineering
2. Geotechnical Engineering for characteristics of soil
3. Engineering Geology & Rock Mechanics for design of road geometry

Course Objectives :

1. Equip students with practical skills in traffic data collection, analysis, and interpretation using advanced techniques.
2. Develop an understanding of driver behavior, traffic flow characteristics, and congestion management strategies.
3. Provide hands-on exposure to transportation engineering software for simulation, geometric design, and pavement analysis.

Course Outcomes: After learning the course, the students should be able to:

1. Apply various traffic data collection methods to analyze speed, volume, time headway, and delays for traffic management.
2. Design and evaluate intersection performance using turning movement counts and signal design principles.
3. Apply transportation engineering software for simulating traffic operations, designing road geometry, and pavement analysis.
4. Understand transportation planning software (e.g., CUBE, VISUM) for network creation, zoning, and trip assignment.

Detailed Syllabus

A. Lab Experiments:

I. Experiments on Traffic: (Any Three)

1. Spot speed study using Radar Gun
2. Vehicle speed acceleration and deceleration profile study
3. Volume and speed study by video recording
4. Time headway distribution study
5. Volume and travel time study using moving observer method
6. Car-following study
7. Determination of queue length and delay estimation
8. Turning movement count and signal design

II. Exposure to Latest Software in the field of Transportation Engineering (Any one software)

1. **PTV Vissim (**Simulation Software**)**
2. **Bentley Open Road Designer (**Geometric Design Software**)**
3. **IIT Pave (**Pavement Design Software**)**

Text Books:

1. Khanna, S. K., & Justo, C. E. G. (2018). *Highway engineering* (10th ed.). New Delhi: Nem Chand & Bros.
2. Roess, R. P., Prassas, E. S., & McShane, W. R. (2019). *Traffic engineering* (5th ed.). Pearson.
3. Kadiyali, L. R. (2017). *Principles and practices of highway engineering* (9th ed.). Khanna Publishers, Delhi.
4. Papacostas, C. S., & Prevedouros, P. D. (2001). *Transportation Engineering and Planning*. Prentice Hall.
5. Khisty, C. J., &Lall, K. B. (2017). *Transportation Engineering: An Introduction*. Pearson.

Reference Books:

1. Bindra, S. P. (2003). *A course in highway engineering*. Dhanpat Rai & Sons.
2. Rao, G. V. (2007). *Principles of transportation engineering*. Tata McGraw-Hill.
3. Rangwala, S. C. (2017). *Highway engineering*. Charotar Publishing House.
4. Chakraborty, P., & Das, A. (2017). *Principles of transportation engineering*. Prentice Hall of India.
5. PTV Group (2023). *PTV Vissim User Manual* (available on PTV official website)

Codes:

1. **IRC: SP:19-2001** - Manual for Traffic Surveys.
2. **IRC: 93-1985** - Guidelines for Design of Traffic Signals.
3. **IRC: 106-1990** - Guidelines for Capacity of Urban Roads.

e-Resources

1. https://archive.nptel.ac.in/courses/105/101/105101087/ (NPTEL- By: Dr. Tom V Mathew)
2. https://ocw.mit.edu/collections/transportation (MIT- Open courseware)
3. https://www.icevirtuallibrary.com

Program:	B. Tech. (Civil Engineering)				Semester :			VI
Course:	Geospatial Techniques (PEC-3)					Code:		BCI26PE31
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	1	10	10	30	50

Prior Knowledge:

1. Fundamental related to Surveying
2. Types and Importance of various surveys
3. Global Positioning System (GPS)

Course Objectives: This course aims at enabling students,

1. To comprehend the fundamentals and principles of remote sensing and GIS techniques.
2. To develop skills in remote sensing data processing, analysis, and interpretation.
3. To gain proficiency in GIS concepts, spatial data models, and geospatial analysis.
4. To integrate remote sensing and GIS for applications in urban planning, environmental monitoring, disaster management, and hydrological studies.

Course Outcomes: After learning the course, the students should be able to:

1. Articulate the fundamentals and principles of remote sensing (RS) techniques.
2. Demonstrate knowledge of remote sensing systems, sensor characteristics, and their applications.
3. Explain the fundamentals and interdisciplinary applications of remote sensing and GIS.
4. Acquire skills in spatial data processing, analysis, and visualization using GIS tools.

Detailed Syllabus

Unit	Description	Duration(H)
1	**Fundamentals of Remote Sensing:** Definition, electromagnetic radiation (EMR) and electromagnetic spectrum, EMR interaction with atmosphere, and earth surface; atmospheric window, RS platforms, elements of remote sensing for visual, interpretation viz. tone, shape, size, pattern, texture, shadow and association, applications in civil, engineering/town planning	8
2	**Satellite Image Processing and Interpretation:** Types of Remote Sensing Data and Their Characteristics: Multispectral, Hyperspectral, Thermal, and Microwave Data, Types of Sensors: Passive vs. Active Sensors, Major Earth Observation Satellites: Landsat, Sentinel, MODIS, ASTER, and their Applications, Open-Source Data Portals, Sensor Classification and Applications: AI-based Object Detection, UAV (Drone) Remote Sensing, Resolution in Remote Sensing: Spatial, Spectral, Radiometric, and Temporal Resolution with Real-world Examples	7
3	**Fundamentals of GIS:** Geographic information system, definition, spatial and non-spatial data, data inputs, data storage and retrieval, data transformation, Introduction to cloud computing (types & applications), data reporting, advantages of GIS, essential elements of GIS hardware, software GIS data types, Software Tools: ArcGIS, QGIS, Python for GIS, Web GIS Platforms, applications of RS and GIS in civil engineering, hydrogeology, engineering geology, surveying and mapping.	8
4	**GIS Data GNSS and Case Studies:** GIS data types and data representation, data acquisition, geo-referencing of data, projection systems, raster and vector data, raster to vector conversion, attribute data models and its types, remote sensing data in GIS, GIS database and database management system. Case studies.	7
	Total	**30**

Self-directed learning-Explore GIS software for hands-on experience with GIS and satellite image processing. Download and visualize open-source remote sensing data (e.g., Sentinel, Landsat) from data portals. Watch online tutorials on GNSS and GPS fundamentals (YouTube, Coursera, ISRO IIRS lectures).Learn basic AI techniques for image classification. Study case studies and real-world GIS/remote sensing applications in civil engineering and urban planning.

Text Books:

1. Bhatta, B. – Remote Sensing and GIS (Oxford University Press, 2011)
2. Lillesand, T., Kiefer, R., &Chipman, J. – Remote Sensing and Image Interpretation (Wiley, 7th Ed., 2015)
3. Remote Sensing & Geographical Information System, M. Anji Reddy, BS Publications, Hyderabad, 4th Edition, 2022

Reference Books:

1. Textbook on Remote Sensing, C. S. Agarwal and P. K. Garg, Wheeler Publishing House, 2000.
2. Campbell, J. B., & Wynne, R. H. – Introduction to Remote Sensing (Guilford Press, 5th Ed., 2011)
3. Chang, K. – Introduction to Geographic Information Systems (McGraw Hill, 9th Ed., 2019)

e-Resources

1. https://www.bis.gov.in/standards/technical-department/national-building-code/
2. https://mohua.gov.in/upload/uploadfiles/files/Chap-4.pdf3

Program:	B. Tech. (Civil Engineering)			Semester :		VI	
Course:	Geospatial Techniques Lab (PEC 3 Lab)			Code:		BCI26PE32	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	2	-	50	-	-	50

Prior Knowledge:

1. Fundamental related to Surveying
2. Types and Importance of various surveys
3. Global Positioning System (GPS)

Course Objectives :

1. Develop skills in processing, analyzing, and interpreting remote sensing data.
2. Gain proficiency in GIS concepts, spatial data models, and geospatial analysis.

Course Outcomes: After learning the course, the students should be able to:

1. Apply remote sensing and GIS techniques to analyze data for various civil engineering and interdisciplinary applications.
2. Integrate remote sensing data with GIS to solve real-world problems in urban planning, environmental monitoring, and disaster management.

Detailed Syllabus

Term work consists of (any eight):

1. Creation of geo–database
2. Georeferencing and projection
3. Digitization of toposheet/map
4. Proximity Analysis (Buffer Analysis)
5. Preparation of thematic maps
6. Spatial Analysis Tools
7. Preparing Contour map
8. Geospatial Data Clipping and Extracting
9. Study of feature estimation
10. Watershed analysis
11. Road network analysis

Text Books:

1. Bhatta, B. – Remote Sensing and GIS (Oxford University Press, 2011)
2. Lillesand, T., Kiefer, R., &Chipman, J. – Remote Sensing and Image Interpretation (Wiley, 7th Ed., 2015)
3. Remote Sensing & Geographical Information System, M. Anji Reddy, BS Publications, Hyderabad, 4th Edition, 2022

Reference Books:

1. Textbook on Remote Sensing, C. S. Agarwal and P. K. Garg, Wheeler Publishing House, 2000.
2. Campbell, J. B., & Wynne, R. H. – Introduction to Remote Sensing (Guilford Press, 5th Ed., 2011)
3. Chang, K. – Introduction to Geographic Information Systems (McGraw Hill, 9th Ed., 2019)

e-Resources

1. https://www.bis.gov.in/standards/technical-department/national-building-code/
2. https://mohua.gov.in/upload/uploadfiles/files/Chap-4.pdf3

Program:	B. Tech. (Civil Engineering)				Semester :			VI
Course:	Waste Management for Smart Cities (PEC 3)				Code:			BCI26PE33
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	1	10	10	30	50

Prior Knowledge:
Fundamentals of Environmental Studies, Engineering Chemistry

Course Objectives: This course aims at enabling students,

1. To understand the solid waste management and apply the knowledge to provide the engineering solution.
2. To understand the processing of solid waste, material recovery facility, composting systems, waste to energy conversion.
3. To understand the various laws related to solid waste management and its application for proper solid waste management.

Course Outcomes: After learning the course, the students should be able to:

1. To estimate the quantity of solid waste generated for a smart city.
2. To suggest the methods for the solid waste management with respect to collection, transportation, and segregation of MSW.
3. To select a suitable method for the disposal of MSW.
4. To suggest relevant methods for the management of e-waste, biomedical waste, hazardous waste and construction and demolition waste.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to Smart Cities and Solid Waste Management** Introduction to Smart Cities: Smart city concepts, components, and sources of solid waste generation. Solid Waste Management (SWM): Definition, objectives of SWM, impacts of improper SWM: sources and types of solid waste. Introduction to municipal solid waste (MSW): waste generation trends of MSW, factors affecting the generation rate, estimation of the quantity of solid waste, role of urban and local bodies in SWM, sustainable solid waste management perspective, Case Studies.	7
2	**Waste Collection, Transportation and Segregation of MSW** Decentralized and centralized system, three tier system, source reduction, segregation and salvage, material recovery facility centers, Resource recovery, recycling, reuse, value added products, carbon credits, circular economy in SWM, economics in MSW processing and recycling. Introduction and case studies related to Smart technologies in collection systems, IoT based real monitoring systems, Route Optimization through GPS & GIS, automated waste sorting and processing technologies	8
3	**Processing and Transformation of MSW, Disposal of MSW and Waste to Energy** Composting: Theory, types of composting, Methods: Indore method, Bangalore Method, Mechanical composting, governing factors in composting, design of composting system. Inclusion of smart technologies in composting. Landfill: Components, site selection, construction, leachate and landfill gas management, Sanitary landfill: Concept, design considerations. Bioreactor Landfill: Concept, applications. Inclusion of smart technologies in efficient O & M. Case studies of landfill. Waste to Energy: Bio-methanation, Energy content of MSW, Incineration, Pyrolysis, Refuse Derived Fuel(RDF), Plasma Gasification, Case Studies.	7

4	**E-waste, Biomedical Waste , Hazardous Waste Management and Construction and Demolition Waste** Sources, collection, transportation, treatment and disposal of E-Waste, Biomedical Waste and Hazardous Waste. E-Waste Management Rules (2016), Hazardous and Other Waste management Rule 2016, Plastic Waste Management Rules 2016, Reuse and recycling of plastic waste in road construction. Case studies of material recovery form E-Waste C & D Waste: Sources, collection, transportation, treatment and disposal of construction and demolition waste, Construction and Demolition Waste (C&D) Waste Management Rules-2016, Reuse of construction and demolition waste.	**8**
	Total	**30**

Self-Directed Learning: Role of NGOs in SWM, Life Cycle Assessment, Value-added product recovery, Climate change and solid waste management**.**

Text Books:

1.Integrated Solid Waste Management: Engineering Principles and Management Issues, George Tchobanoglous, Hilary Theisen, Samuel Vigil, Tchobanoglous George, Vigil Samuel, McGraw-Hill Companies, Incorporated.
2. Solid waste management, Dr. A.D. Bhide
3. Solid Waste Management, Sasikumar K and SanoopGopi Krishna, PHI.

Reference Books:

1. Solid waste Engineering, Vesilind P. A., Worrell W and Reinhart, Thomson Learning Inc., Singapore.
2. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.
3. Hazardous Waste Management, Charles A. Wentz, Second Edition, McGraw Hill International Edition, New York.

e-Resources

1. http://cpheeo.gov.in/cms/manual-on-solid-waste-management.php

Program:	B. Tech. (Civil Engineering)			Semester :		VI	
Course:	Waste Management for Smart Cities Lab (PEC 3 Lab)			Code:		BCI26PE34	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	2	-	50	-	-	50

Prior Knowledge:
Fundamentals of Environmental Studies, Engineering Chemistry

Course Objectives :
1. To understand the solid waste management and apply the knowledge to provide the engineering solution.
2. To understand the processing of solid waste, material recovery facility, composting systems, waste to energy conversion.
3. To understand the various laws related to solid waste management and its application for proper solid waste management.

Course Outcomes: After learning the course, the students should be able to:
1. To design composting system, anaerobic digestor system and sanitary landfill.
2. To determine the chemical characteristics of the MSW
3. Estimate the generation of quantity of leachate and landfill gas through software.

Detailed Syllabus

Term work consists of following (Any eight experiments)

1. Report of site visit to municipal solid waste management of a city
2. Practical/theoretical (from case study) identification of impacts and problems of improper management of municipal solid waste.
3. Practical/theoretical (from case study) sampling methods and characterization study of municipal solid waste: present and future trend, estimation of quantity of refuse.
4. Practical/theoretical (from case study) optimization of route network for municipal solid waste collection.
5. Determine moisture content and volatile solids for organic faction of municipal solid waste by using oven and muffle furnace.
6. Design a composting system for organic waste generated from housing society or city.
7. Design an anaerobic digester for organic waste generated from housing society or city.
8. Design of a sanitary landfill system for any city.
9. Identify any construction demolition waste problem and suggest appropriate solution.
10. Prepare a report for cost economics of MSW management for city.
11. Prepare a report for management of e-waste/ biomedical waste/ hazardous waste based on case study or field visit.
12. Estimation of quantity of leachate and landfill gas emission by using free software such as, bio-transform, HELP, GAISM etc.
13. Report on MSW management by NGO/ ULBs for zero waste management concepts.

Text Books:
1.Integrated Solid Waste Management: Engineering Principles and Management Issues, George Tchobanoglous, Hilary Theisen, Samuel Vigil, Tchobanoglous George, Vigil Samuel, McGraw-Hill Companies, Incorporated.
2. Solid waste management, Dr. A.D. Bhide
3. Solid Waste Management, Sasikumar K and SanoopGopi Krishna, PHI.

Reference Books:
1. Solid waste Engineering, Vesilind P. A., Worrell W and Reinhart, Thomson Learning Inc., Singapore.
2. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.
3. Hazardous Waste Management, Charles A. Wentz, Second Edition, McGraw Hill International Edition, New York.

e-Resources
1. http://cpheeo.gov.in/cms/manual-on-solid-waste-management.php

Program:	B. Tech. (Civil Engineering)				Semester :			VI
Course:	Construction Equipment and Finance Management (PEC 3)				Code:			BCI26PE35
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	1	10	10	30	50

Prior Knowledge:
Building planning and Construction

Course Objectives: This course aims at enabling students,

1. To equip students with knowledge of construction equipment management, including selection, costing, maintenance, and safety for optimal resource utilization.
2. To introduce financial management concepts, including sources of finance, working capital, taxation, and regulatory bodies in construction.

Course Outcomes: After learning the course, the students should be able to:

1. Select construction equipment based on project needs, costs, efficiency, safety, and maintenance.
2. Analyze project requirements and apply selection criteria to determine the most efficient and cost-effective construction equipment maintenance.
3. Analyze financial management concepts to evaluate funding sources, markets, and instruments for informed decisions.
4. Manage working capital, apply budgeting techniques, and assess taxation impacts on construction projects.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Selection Criteria, sources of Construction Equipment:** Introduction to equipment in construction projects, Selection criteria for construction equipment, Sources of construction equipment: purchase of old or new, rent and lease of equipment, economics of construction equipment, , Equipment's safety management, emerging technologies in construction industry.	7
2	**Equipment Management:** Equipment Management, Costing, Optimum utilization and Equipment selection, depreciation, Life Cycle Cost Analysis (LCCA) interest on capital, Manpower, Spare parts etc, Documentation, Log-Books, History Books, Periodical MIS Report. Depreciation analysis, work cycle time of any equipment with corrective factors. **Equipment maintenance –** Importance, merits and demerits of maintenance, Types of maintenance, Use of AI in equipment management, discuss case study	8
3	**Introduction to Financial Management:** goal of financial management ,Sources of finance, equity, debt, government grants & alternative sources, numerical on calculation of leverage ratio, Earnings Before Interest and Taxes (EBIT) & dividend pay-out, financial market & instruments, key activities in financial management, role of financing institutes in construction sector: banking institutions, Non-Banking Financial Company NBFC, housing finance institutions.	7
4	**Working capital:** Meaning, types of working capital, components of working capital, operating cycle, factors affecting working capital requirement, working capital management, estimation of working capital, components of working capital in Construction Company, and financing resources of working capital, Sensitivity Analysis	8
	Total	30

Self-directed learning : Occupational Safety and Health Administration **(OSHA),** IS 4137: 1993 – Safety Code for Earthmoving Machinery,IS 12552: 1989 – Code of Practice for Operation and Maintenance of Cranes, rules and regulations by Government of India related to Tax.

Text Books:

1.. Construction Planning, Equipment and methods – Peurifoy-Tata McGraw Hill Publication
2. Construction Technology: Analysis, and Choice, Bryan, Wiley India
3. Construction Planning, Equipment and methods – Peurifoy-Tata McGraw Hill Publication
4. Construction Equipment Planning and Applications – Dr. Mahesh Varma
5. Engineering Economics Management, Dr. Vilas Kulkarni and Hardik Bavishi, S. Chand Publication
6. Indian Economy, GauravDatt and Ashwani Mahajan, S. Chand Publication

Reference Books:

1. Journals/ periodical such as CE & CR. Construction world, International Construction.
2. Document Reports of actual major works executed.
3. Construction Technology by Roy Chudley and Roger Greeno, Prentice Hall, 2005
4. Engineering Economy, Theusen G. J. and Fabrycky W. J., 9th Edition, Prentice-Hall, Inc., New Delhi
5. Finance for Engineers: Evaluation and Funding of Capital Projects, Crundwell F. K., Springer, London.
6. Construction Project Management: Theory and practice, Jha K.N., 2nd Edition, Pearson India Education Services Pvt. Ltd.
7. Financial Management, Khan and Jain, Tata McGraw-Hill Education
8. Construction Management and Accounts, Singh H, Tata McGraw Hill, New Delhi.
9. Engineering Economy, Leland T. Blank and. Anthony Tarquin, McGraw Hill 07 Case studies in Finance, Burner, McGraw Hil

e-Resources

1. https://archive.nptel.ac.in/courses/105/103/105103206/
2. https://www.constructionworld.in/
3. https://onlinecourses.nptel.ac.in/noc20_mg31/preview

Program:	B. Tech. (Civil Engineering)			Semester :		VI	
Course:	Construction Equipment and Finance Management lab (PEC 3)			Code:		BCI26PE36	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	--	2	--	50	--	--	50

Prior Knowledge: Building planning and Construction

Course Objectives :

1. To understand selection, operation, and costing of construction equipment.
2. To develop knowledge of equipment maintenance, management information systems, and financial management in construction projects.
3. To understand financial planning, capital budgeting, and taxation concepts in construction projects.

Course Outcomes: After learning the course, the students should be able to:

1. Select suitable equipment and perform economic analysis for construction, drilling, and tunneling operations**.**
2. Apply equipment maintenance strategies, interpret MIS reports, and perform financial calculations for construction project management**.**
3. Estimate working capital, perform capital budgeting calculations, and analyze the impact of GST on the construction industry**.**

Detailed Syllabus

Term work consists of,

1. Assignment on importance and selection criteria of construction equipment with on purchase, rent, and lease options.
2. Perform a depreciation analysis for construction equipment & Calculate work cycle time of an excavator with corrective factors.
3. Discuss various tunneling methods and equipment required through case study.
4. Prepare assignment on various types of equipment maintenance considering case study.
5. Discuss the role of MIS reports in equipment management through case study.
6. Assignment on, Types, and Estimation of Working Capital Requirements for a Small Construction Company.
7. Assignment on sensitivity analysis based on case study related to construction industry.
8. Discuss the impact of GST on the construction industry through case study.
9. Discuss use of AI in the equipment maintenance and financial management of construction projects through case study.
10. Visit to construction Equipment company/Exhibition/ Site.

Text Books:

1. Construction Planning, Equipment and methods – Peurifoy-Tata McGraw Hill Publication
2. Construction Technology: Analysis, and Choice, Bryan, Wiley India
3. Construction Planning, Equipment and methods – Peurifoy-Tata McGraw Hill Publication
4. Construction Equipment Planning and Applications – Dr. Mahesh Varma
5. Engineering Economics Management, Dr. Vilas Kulkarni and HardikBavishi, S. Chand Publication
6. Laws for Engineers, Vandana Bhatt and Pinky Vyas, Pro Care Publisher
7.Indian Economy, GauravDatt and AshwaniMahajan, S. Chand Publication

Reference Books:

1. Journals such as CE & CR. Construction world, International Construction.
2. Document Reports of actual major works executed.

3. Journals such as CE & CR. Construction world, International Construction.
4. Document Reports of actual major works executed.
5. Construction Technology by Roy Chudley and Roger Greeno, Prentice Hall, 2005
6. Engineering Economy, Theusen G. J. and Fabrycky W. J., 9th Edition, Prentice-Hall, Inc., New Delhi
7. Finance for Engineers: Evaluation and Funding of Capital Projects, Crundwell F. K., Springer, London.
8. Construction Project Management: Theory and practice, Jha K.N., 2nd Edition, Pearson India Education Services Pvt. Ltd.
9. Financial Management, Khan and Jain, Tata McGraw-Hill Education
10. Construction Management and Accounts, Singh H, Tata McGraw Hill, New Delhi.
11. Engineering Economy, Leland T. Blank and. Anthony Tarquin, McGraw Hill 07 Case studies in Finance, Burner, McGraw Hil

e-Resources

1. https://archive.nptel.ac.in/courses/105/103/105103206/
2. https://www.constructionworld.in/
3. https://onlinecourses.nptel.ac.in/noc20_mg31/preview

Program:	B. Tech. (Civil Engineering)				Semester :			VI
Course:	Pre-stressed Concrete Structures (PEC 3)				Code:			BCI26PE37
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	1	10	10	30	50

Prior Knowledge:

1. Strength of Materials

Course Objectives:

After Completing this course, student will have adequate background to understand and solve the problem involving :

1. Concept of Pre-stressed concrete structures
2. Design of post tensioned flexural elements.
3. Design of post tensioned slab.
4. Design of post tensioned flat slab and maintenance and rehabilitation of Pre-stressed concrete structures

Course Outcomes: After learning the course, the students should be able to:

1. Apply theory of losses in pre-stressed concrete sections and analyze pre-stressed concrete beams.
2. Design Pre-stressed concrete beams with design of end block.
3. Design one way and two way post tensioned slab.
4. Design of post tensioned flat slab and carryout maintenance and rehabilitation of Pre-stressed concrete structures

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to pre-stressed concrete**: Pre-stressed concrete structures; theory of prestressing, methods and techniques of pre-stressing, pre-stressing systems, High-strength materials and requirements; properties and current uses, Basic concepts: stresses at transfer and service loads, critical sections under working load for pre-tensioned and post tensioned members, stress concept, strength concept and load balancing method of analysis of pre-stressed concrete beams. Pre-stressed losses: long-term and short-term, Introduction to IS 1343.	9
2	**Design of post tensioned beam**: Design of Pre-stressed concrete simply supported rectangular beam and Design of flanged sections for flexure, shear and torsion. Anchorage zone stresses for post-tensioned members. Design of end block for busting force. Concept of cable profile.	8
3	**Design of post tensioned slab**: Design of one way post tensioned slab and two way post tensioned slab (Single panel only).	6
4	**Design of post tensioned flat slab and Maintenance and rehabilitation of Pre-stressed concrete bridges:** Introduction to flat slab, IS 456 codal provisions for flat slab. Design of Pre-stressed two way flat slab by direct design method. Introduction to Maintenance and rehabilitation of Pre-stressed concrete bridges & use of AI in Maintenance and rehabilitation work.	7
	Total	30

Self-directed learning - Applications of pre-stressed concrete, Real-life failure case studies due to improper shear or anchorage, Deflection and Crack Control in Post-Tensioned beam, and types of sensors used (strain gauges, fiber optic sensors, accelerometers, and corrosion sensors) in structural health monitoring

Text Books:

1. Pre-stressed Concrete, N. Krishna Raju, Tata McGraw Hill Publishing Co. (2018)
2. Pre-stressed concrete, G.S.Pandit and S.P.Gupta, CBS Publishers and Distributers Pvt. Ltd, second edition (2014)

Reference Books:

1. Design of Pre-stressed Concrete Structures, T.Y. Lin, John Wiley and Sons Inc. (2010)
2. Modern Pre-stressed Concrete, J. Libby, Springer Science & Business Media (2012)
3. Pre-stressed Concrete Analysis and Design, A. E. Naaman, McGraw-Hill College (2014)
4. Prestressed Concrete - A Fundamental Approach, Edward G. Nawy Fifth Edition, Prentice Hall International. (2005)

IS Code:

1. IS 1343- 2012 Prestressed Concrete- Code of practice (Second Revision)
2. IS 456-2000 Plain and Reinforced Concrete - Code of Practice (Fourth Revision)

e-Resources

1. https://nptel.ac.in/courses/105106117

Program:	B. Tech. (Civil Engineering)			Semester :		VI	
Course:	Pre-stressed Concrete Structures Lab (PEC 3 Lab)			Code:		BCI26PE38	
	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
Credits	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	02	-	50	-	-	50

Prior Knowledge: Strength of Materials

Course Objectives :

1. Develop an insight into the behaviour of pre-stressed concrete structural members both at service loads and overloads
2. To embed fundamentals of pre-stressed concrete design and detailing.

Course Outcomes: After learning the course, the students should be able to:

1 Determine stresses and losses in Pre-stressed concrete beams.
2. Design and carryout detailing of Pre-stressed concrete elements.

Detailed Syllabus

Term work consists of

A. Compulsory assignment /design

1. Assignment on difference between reinforced concrete structures and pre-stressed concrete structures.
2. Assignment on introduction, prestressing systems and material properties, composite sections
3. Assignment on calculation of losses in pre-stress.
4. Assignment on stress calculation
5. Design and detailing of design of pre-stressed concrete determinate beam
6. Design and detailing of pre-stressed concrete slab
7. Design and detailing of pre-stressed concrete flat slab.
8. One site visit reports, on pre-stressed concrete structure.

B. Minimum Two full imperial sheets based on two projects on design of prestressed concrete structural elements.

Note: There should be a separate design problem statement for a group of students not exceeding five in number.

Text Books:

1. Pre-stressed Concrete, N. Krishna Raju, Tata McGraw Hill Publishing Co. (2018)
2. Pre-stressed concrete, G.S.Pandit and S.P.Gupta, CBS Publishers and Distributers Pvt. Ltd, second edition (2014)

Reference Books:

1. Design of Pre-stressed Concrete Structures, T.Y. Lin, John Wiley and Sons Inc. (2010)
2. Modern Pre-stressed Concrete, J. Libby, Springer Science & Business Media (2012)
3. Pre-stressed Concrete Analysis and Design, A. E. Naaman, McGraw-Hill College (2014)
4. Pre-stressed Concrete - A Fundamental Approach, Edward G. Nawy Fifth Edition, Prentice Hall International. (2005)

Codes:

1. IS 1343- 2012 Pre-stressed Concrete- Code of practice (Second Revision)
2. IS 456-2000 Plain and Reinforced Concrete - Code of Practice (Fourth Revision)

e-Resources

1. https://nptel.ac.in/courses/105106117

Program:	B. Tech. (Civil Engineering)				Semester :		VI	
Course:	Advanced Foundation Engineering (PEC 3)				Code:		BCI26PE39	
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	1	10	10	30	50

Prior Knowledge:
1. Engineering Geology (Subsurface Investigation)
2. Geotechnical Engineering (Index and Engineering Properties of soil)
3. Foundation Engineering (Basic Concepts)

Course Objectives: This course aims at enabling students,
1. To get acquainted with different types of foundations and soil structure interaction.
2. To make aware of ground improvement techniques, geosynthetic materials.

Course Outcomes: After learning the course, the students should be able to:
1. Design raft foundations considering bearing capacity.
2. Explain the design and construction of piers, caissons, well, and offshore foundations.
3. Apply concepts of machine foundations, their dynamic behavior, and soil–structure interaction on foundations.
4. Apply ground improvement techniques and geosynthetics for soil stabilization and reinforcement.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Raft foundations:** Types of rafts, Bearing capacity and settlements of raft, Design considerations and I.S. Code method of analysis, Design of Raft foundation on different types of soil. Design of combined and isolated footing based on field test including calculation of settlement.	07
2	**Special Foundations:** Introduction to Piers, Caissons, and Well Foundations, Types of piers, Caisson Foundations- Types, Construction methods and sinking techniques, Advantages, limitations, and case studies, Well Foundations- Components and types, Construction methods: Sinking process, tilting, and remedial measures, Underwater and Offshore Foundations, Under-reamed piles.	07
3	**Machine Foundations:** Types of machine foundations, mathematical models, response of foundation – soil system to machine excitation, cyclic plate load test, block resonance test, criteria for design. **Soil-Structure Interaction (SSI):** Introduction to Soil-Structure Interaction, Differences between conventional foundation design and SSI analysis, Factors affecting SSI behavior, Contact pressure distribution and foundation response, Elastic and plastic behavior of soil under structural loads. Case studies.	08
4	**Ground Improvement:** In-situ ground improvement by compaction piles, soil nailing, sand drains, grouting, deep mixing, vibroflotation, stone columns, prefabricated vertical drains, preloading techniques. **Geosynthetics:** Introduction to Geosynthetics, Types Properties and Testing, Functions and Applications, Geosynthetics in Reinforced Soil Structures, Geosynthetics in Ground Improvement. Case studies.	08
	Total	30

Self –directed learning- Foundations for towers, chimneys, FEM for foundation analysis, Reinforced soil foundations, Bearing capacity of footings on slopes, layered soils.

Text Books:
1. Foundation Engineering by Dr. B. J. Kasmalkar, Pune VidyarthiGrihaPrakashan, Pune.
2. Foundation Design Manual by N V Nayak, DhanpatRai Publications, 7th Edition (2018)
3. Soil Mechanics and Foundation Engineering by B. C. Punmia, Laxmi Publications, 16th Edition (2017)
4. Soil Mechanics and Foundation Engineering by K. R. Arora, Standard Publisher, 7th Edition (2019)

Reference Books:

1. Foundation Analysis and Design by J.E. Bowels, McGraw-Hill book company, 5th Edition (2001)
2. Foundation Engineering by P.C.Varghese - PHI Learning Pvt. Ltd (2013)
3. Principles of Soil Mechanics and Foundation Engineering by V.N.S. Murthy, UBS Publishers (2018)
4. Soil Mechanics & Foundation Engineering by M. Bandhu, Wiley Publications, 3rd Edition (2010)
5. Geotechnical Engineering by Principles & Practices by Donald. P. Coduto, Pearson Education, 2nd Edition (2017)

IS Codes:

1. IS: 1892-1979 “Code of Practice for Subsurface Investigation for Foundation”.
2. IS: 2950 (Part 1) – 1981“Code of Practice for design and construction of raft foundations”.
3. IS 2974 (Part 1) – 1982 “Code of Practice for design and construction of machine foundations”.
4. IS 19235 2025 Geotechnical Engineering Services and Requirements.

e –Resources:

1. https://archive.nptel.ac.in/courses/105/105/105105207/
2. https://onlinecourses.nptel.ac.in/noc22_ce32/preview

Program:	B. Tech. (Civil Engineering)			Semester :			VI
Course:	Advanced Foundation Engineering Lab (PEC 3 Lab)			Code:			BCI26PE40
	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
Credits	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	02	-	50	-	-	50

Course Objectives:
To impart knowledge of methods of analysis and design of various foundations.

Course Outcomes:
After learning the course, the students will be able to:
1. Interpret soil investigation reports for infrastructural projects.
2. Assess foundation systems by applying principles of soil-structure interaction.
3. Assess the effectiveness of ground improvement and geosynthetic applications through case studies.

Lab Assignments

The term work shall consist of a journal giving following Assignments. (All Compulsory)
1. Study of soil investigation reports on infrastructural projects (for special foundations).
2. Problems on design of raft foundations.
3. Problems on under-reamed piles.
4. Problems on Machine foundations.
5. Case study report on application of soil structure interaction (Minimum 2 Case Study).
6. Problems on soil structure interaction.
7. Case study report on application of ground improvement techniques (Minimum 3 Case Study).
8. Case Study report on Application of Geosynthetic Materials (Minimum 2 Case Study).
9. Visit to foundation construction sites and preparation of the report.
10. AI application in ground improvement techniques

Text Books:
1. Foundation Engineering by Dr. B. J. Kasmalkar, Pune VidyarthiGrihaPrakashan, Pune.
2. Foundation Design Manual by N V Nayak, DhanpatRai Publications, 7th Edition (2018)
3. Soil Mechanics and Foundation Engineering by B. C. Punmia, Laxmi Publications, 16th Edition (2017)
4. Soil Mechanics and Foundation Engineering by K. R. Arora, Standard Publisher, 7th Edition (2019)

Reference Books:
1. Basic and Applied Soil Mechanics by GopalRanjan and A. S. R. Rao, Newage International, 3rd Edition (2016)
2. Foundation Analysis and Design by J.E. Bowels, McGraw-Hill book company, 5th Edition (2001)
3. Soil Mechanics- T. William Lambe - Wiley
4. Foundation Engineering by P.C.Varghese - PHI Learning Pvt. Ltd (2013)
5. Principles of Soil Mechanics and Foundation Engineering by V.N.S. Murthy, UBS Publishers (2018)
6. Soil Mechanics & Foundation Engineering by M. Bandhu, Wiley Publications, 3rd Edition (2010)
7. Geotechnical Engineering by Principles & Practices by Donald. P. Coduto, Pearson Education, 2nd Edition (2017)

IS Codes:
1. IS 1892 1979 Code of practice for subsurface investigation for foundations
2. IS 2950 (Part 1): 1981 – Code of Practice for Design and Construction of Raft Foundations.
3. IS 2911 (Part 3): 2017 - Design and Construction of Pile Foundations – Code of Practice, Part 3: Under-reamed Piles
4. IS 2974 (Part 1 to 5) – Code of Practice for Design and Construction of Machine Foundations
5. IS 19235 2025 Geotechnical Engineering Services and Requirements.

Skill Enhancement Course (VSEC)

TY B Tech

Semester-VI

Program:	B. Tech. (Civil Engineering)			Semester:			VI
Course:	Skill Enhancement Course(VSEC 4)			Code:			BCI26VS04
	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
Credits	Lecture	Practical	Tutorial	TW	OR	PR	Total
2	-	4	-	50	50	-	100

Course Objectives:

This course aims to enable students,

1. To gain hands-on experience with advanced surveying instruments and their application in field survey work.
2. To develop skills in building 2D and 3D modeling or structural analysis and design of building or flow through channels or flow through water distribution system

Course Outcomes:

After successful completion of the course, the student will be able to:

1. Operate advanced surveying instruments such as Total Station and DGPS, and analyze collected data for field survey applications.
2. Apply appropriate civil engineering software to model, analyze, and design buildings or sewer systems, or water distribution networks based on the selected domain.

Detailed Syllabus:

PART A: (Mandatory to all) (30 Hrs)

Introduction to advance surveying: Concepts, Importance & Necessity of Advance Surveying. **Introduction to Total Station**: Principle and Function, REM, RDM, Use of Total station for data processing and analysis, **Field work**: Point data collection (Easting, Northing and Height), Electronic Distance Measurement Survey, Area Measurement, Survey Data Post Processing, Survey Data Applications. Introduction to Differential GPS (DGPS): Principle, Concepts and Function, Duel and Single Frequency DGPS, RTK and Static Surveys in DGPS.

PART B: (Select any one option from 1 to 4) (30Hrs)

1) 2D and 3D design of building using software

Introduction Autodesk Revit: Introduction to Revit interface; Starting a new project; Units setup, snap settings, viewing commands. Levels, Grids, and CAD Integration: Setting up Levels and Structural Grids;Linking/importing CAD files; Coordination settings for linked files; Modeling Walls and Custom Elements: Creating and modifying basic walls; Using wall types and editing profiles; Creating and placing decals; Creating, Inserting and customizing doors/windows; Loading and creating family types; Creating curtain walls, adding grids, mullions; Modeling Structural & Architectural Elements: Creating floors and shaft openings; Modeling ceilings and adding fixtures; Modeling roofs by footprint and extrusion; Components, Stairs, and Railings: Inserting and modifying components; Model-in-place tools (extrusion, sweep, revolve);Creating stairs, ramps, and railings; Views, Dimensions, and Detailing: Working with 2D/3D views and section boxes; Adding dimensions, text, detail lines, and symbols; Creating legends and annotation elements; Views, Dimensions, and Detailing: Working with 2D/3D views and section boxes; Adding dimensions, text, detail lines, and symbols; Creating legends and annotation elements; Setting up sheets, placing/modifying views; Printing and sheet composition;

2) Structural Analysis & Design of Building using software

A) Analysis& Design of industrial building including roof truss, purlins, bracings, column, column base and connections. Analysis of truss by using software and cross check manually. Full imperial size hand drawn drawing sheet presenting the design details.

B)Design Project: Analysis of G + 2 (residential/commercial/public) building covering all types of slabs, beams, columns, footings, and staircase (first and intermediate flight) with following details.

Analysis of Building using suitable software and comparison with manual calculations.

Design any one element by using spreadsheet or use of analysis and design by suitable software and compare with Manual Calculations.

3) Analysis and Design of Sewer Using Softwar

Introduction: Type of sewer systems; Hydraulics of partially filled sewers. Hydraulic formulas: Manning's, Chezy's, Hazen-Williams, Sewer material selection and alignment, Self-cleansing velocity and Scour.

Design Principles of Storm Sewers: Flow estimation using the Rational method, Design of surface drains and underground pipes.

Hydraulic Modeling Using Software: Input parameters: node elevations, pipe diameters, slope, and inflow; Hydraulic and hydrologic analysis; Interpretation of results: flow profile, velocity, and surcharge analysis.

Mini-project: design a sewer system for a locality

Sustainability and Future Trends: Integration with smart city concepts, digital twins, and IoT in sewer systems.

4) Design and Analysis of Water Distribution Networks with Software

Introduction to Water Distribution Systems: Water demand forecasting and population estimation, network components: Reservoirs, pumps, pipes, tanks, valves, and junctions.

Hydraulic Fundamentals: Major and Minor Head loss, Head loss formulae (Darcy-Weisbach, Hazen-William's equations); Types of networks (Classification based on layout/purpose/energy source); Types of analysis (Flow-dependent and Pressure dependent analysis)

Modeling with software: Creating network layouts, assigning demand, pipe data, pump curves, running simulations (steady and extended period), Analyzing results: flow, head, pressure, velocity

Calibration and Validation: Understanding flow and pressure measurement.

Mini project – Real/local network design with maps

Input demand and pipe properties, run simulation and analyze pressure, head loss, Model a pump + tank system, Leak detection and network calibration, Optimization, and reporting.

References:

1. Surveying and Levelling by KanetkarKulkarni
2. Surveying and Levelling by N NBasak, TATA McGraw-Hill
3. .Mastering Autodesk Revit 2024 and BIM Fundamentals**, Daniel John Stine, CADCIM Technologies, 2023.**
4. Autodesk Revit Architecture 2024 Basics: From the Ground Up**, Elise Moss, Sybex, 2023.**
5. Limit State Design of Steel Structures by Dr. Ramchandra&VirendraGehlot, Standard Publishers; Delhi.
6. Limit State Design of Steel Structures by S. K. Duggal
7. Design of Steel Structures‖, Tata McGraw Hill India by B.S.Negi
8. Wastewater Engineering by Metcalf & Eddy
9. Hydraulics of Sewer Systems by L. W. Mays
10. Water Supply Engineering by B.C. Punmia / S.K. Garg / Duggal
11. Analysis of water distribution networks by P. R. Bhave and R. Gupta
12. Optimal design of water distribution networks by P. R. Bhave

e-Resources:

1. **https://revittutorials.info/**
2. **https://www.autodesk.com/learn**
3. **https://alison.com/tag/revit**
4. **https://learn.bentley.com**
5. **https://communities.bentley.com**
6. **https://www.bentley.com/software-downloads/**
7. **https://education.bentley.com/**
8. **https://www.epa.gov/water-research/epanet**
9. **https://www.bentley.com/software/watergems/**
10. **https://www.cse.iitb.ac.in/jaltantra/**
11. **https://cpheeo.gov.in//cms/manual-on-operation--and-maintenance-of-water-supply-system-2005.php**
12. **https://doi.org/10.3389/frwa.2021.696630**
13. **https://doi.org/10.2166/aqua.2019.158**
14. **https://doi.org/10.2166/wp.2023.267**

Vision and Mission of the Civil Engineering Department

Vision of the Civil Engineering Department

To establish as a premier civil engineering department in Maharashtra in the coming five years by providing quality education, fostering innovation with ethical values to serve the society.

Mission of the Civil Engineering Department

1. Fostering value-based education to achieve academic excellence with the rightattitude and professional ethics.

2. Inculcating a culture of research and innovation, with an aim of serving society in a sustainable manner.

3. Developing skilled civil engineers with an ability to provide solutions to meet national and global challenges in accordance with the needs of the society.

Program Specific Outcomes (PSO) of Civil Engineering Department

1. Graduates in civil Engineering will demonstrate proficiency in practical applications for quality construction work in the domain of Structural Engineering, Water Resources-Environmental Engineering, Geotechnical-Transport and Construction Management.

2. A graduate in Civil Engineering, equipped with the necessary skills and technical knowledge, can become an entrepreneur in the field, capable of identifying business opportunities, developing business plans, managing resources, designing and executing sustainable construction projects for infrastructural development.