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 2025-26

Pimpri Chinchwad Education Trust's

Pimpri Chinchwad College of Engineering

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	12	
2	Hydrology & Water Resources Engineering Lab	BCI25PC13	14	
3	Transportation Engineering	BCI25PC14	15	
4	Transportation Engineering Lab	BCI25PC15	17	
5	Design of Steel Structures	BCI25PC16	19	
6	Design of Steel Structures Lab	BCI25PC17	21	
7	Integrated Water Resources Management	BCI25PE01	23	
8	Integrated Water Resources Management Lab	BCI25PE02	25	
9	Architecture & Town Planning	BCI25PE03	27	
10	Architecture & Town Planning Lab	BCI25PE04	29	
11	Advanced Mechanics of Structures	BCI25PE05	30	
12	Advanced Mechanics of Structures Lab	BCI25PE06	32	
13	Foundation Engineering	BCI25PE07	33	
14	Foundation Engineering Lab	BCI25PE08	35	
15	Remote sensing and GIS	BCI25OE04	56	
16	MOOC	BCI25OE05	58	
17	Water and Waste Water Engineering	BCI26PC18	61	
18	Environment Engineering Lab	BCI26PC19	63	
19	Design of Reinforced Concrete Structures	BCI26PC20	65	
20	Design of Reinforced Concrete Structures Lab	BCI26PC21	67	
21	Project Management and Economics	BCI26PC22	69	

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22	Dams and Hydraulic Structures	BCI26PE11	71	
23	Dams and Hydraulic Structures Lab	BCI26PE12	73	
24	Sustainable Engineering	BCI26PE13	74	
25	Sustainable Engineering Lab	BCI26PE14	76	
26	3D concrete Printing	BCI26PE15	78	
27	3D concrete Printing Lab	BCI26PE16	80	
28	Elements of Earthquake Engineering	BCI26PE17	82	
29	Elements of Earthquake Engineering Lab	BCI26PE18	84	
30	Advanced Transportation Engineering- I	BCI26PE19	86	
31	Advanced Transportation Engineering- I Lab	BCI26PE20	88	
32	Geospatial Techniques	BCI26PE31	90	
33	Geospatial Techniques Lab	BCI26PE32	92	
34	Waste Management for Smart Cities	BCI26PE33	93	
35	Waste Management for Smart Cities Lab	BCI26PE34	95	
36	Construction Equipment and Finance Management	BCI26PE35	96	
37	Construction Equipment and Finance Management Lab	BCI26PE36	98	
38	Pre-stressed Concrete Structures	BCI26PE37	100	
39	Pre-stressed Concrete Structures Lab	BCI26PE35	102	
40	Advanced Foundation Engineering	BCI26PE39	103	
41	Advanced Foundation Engineering Lab	BCI26PE40	105	
42	Skill Enhancement Course	BCI26VS04	107	

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B) Board of Studies - Department of Computer Engineering

Sr. No	Name of the course	Course code	Page number	Signature and stamp of BoS
1	Digital Marketing	BCE25OE01	37	

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C) Board of Studies - Department of CSE (AI&ML)

Sr. No	Name of the course	Course code	Page number	Signature and stamp of BoS
1	Business Intelligence	BCE25OE01	39	

D) Board of Studies - Department of E &TC

Sr. No	Name of the course	Course code	Page number	Signature and stamp of BoS
1	Introduction to Advanced Driver Assistance Systems	BET25OE01	41	
2	Engineering Psychology	BET25OE02	42	

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BoS, Electronics & Telecommunication Engineering
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E) Board of Studies - Department of Information Technology

Sr. No	Name of the course	Course code	Page number	Signature and stamp of BoS
1	Cloud Computing	BIT25OE01	44	

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BoS, Information Technology
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Sector No. 26, Pradhikaran, Nigdi, Pune-44

F) Board of Studies - Department of Mechanical Engineering

Sr. No	Name of the course	Course code	Page number	Signature and stamp of BoS
1	Unmanned Aerial Vehicle	BME25OE01	46	
2	Industrial Engineering	BME25OE02	48	
3	Lean Six Sigma	BME25OE03	50	
4	Safety, Health and Environment	BME25OE04	51	
5	Battery Technologies for Electric Vehicles	BME25OE05	52	
6	Professional Ethics and Sustainability in the Age of AI (All)	BME25OE06	54	

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Approved by Academic Council:

Chairman
Academic Council
PCET's, Pimpri Chinchwad College of Engineering
Sector No. 26, Pradhikaran, Nigdi, Pune-44

Chairman, Academic Council
Pimpri Chinchwad College of Engineering

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)."

INDEX

CURRICULUM FRAMEWORK
(Regulations2023)
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 ElectiveCourse
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 AND 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	44	27.5
4.	Programme Elective Course	11	20	12.5
5.	Multidisciplinary Minor	6	14	8.75
6.	Open ElectiveCourse	4	8	5
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		**78**	**160**	**100**

SEMESTER WISE CREDIT DISTRIBUTION

Sr. No.	TYPE OF COURSE	NO. OF COURSES/ 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	10	8	8	-	44
4.	Programme Elective Course	-	-	-	-	4	8	6	2	20
5.	Multidisciplinary Minor	-	-	2	2	4	2	4	-	14
6.	Open Elective	-	-	4	2	2	-	-	-	8
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	1	-	-	-	4
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**	**11**	**11**	**10**	**3**	**78**

Curriculum Structure

TY B Tech

Civil Engineering

CURRICULUM STRUCTURE

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

(With effect from Academic Year 2025-26)

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	2	-	-	2	2	-	-	1	3	10	10	30	-	-	-	**50**
BCI25PC13	PCC	Hydrology & Water Resources Engineering Lab	-	1	-	1	-	2	-	-	2	-	-	-	25	-	25	**50**
BCI25PC14	PCC	Transportation Engineering	2	-	-	2	2	-	-	1	3	10	10	30	-	-	-	**50**
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**
-	OEC	Open Elective	2	-	-	2	2	-	-	-	2	10	10	30	-	-	-	**50**
Total			**14**	**6**	**-**	**20**	**14**	**12**	**-**	**4**	**30**	**80**	**80**	**240**	**200**	**-**	**100**	**700**

L- Lecture, T- Tutorial, P- Practical, H-Hours, 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	

List of Open Elective courses (OEC 4)– offered to Civil

Course Code	Offered by	Course Name	
BCE25OE01	Computer	Digital Marketing	Select any one
BCS25OE03	CSE (AI&ML)	Business Intelligence	
BET25OE01	E&TC	Introduction to Advanced Driver Assistance Systems	
BET25OE02	E&TC	Engineering Psychology	
BIT25OE01	IT	Cloud Computing	
BME25OE01	Mechanical	Unmanned Aerial Vehicle	
BME25OE02	Mechanical	Industrial Engineering	
BME25OE03	Mechanical	Lean Six Sigma	
BME25OE04	Mechanical	Safety, Health and Environment	
BME25OE05	Mechanical	Battery Technologies for Electric Vehicles	
BME25OE06	Mechanical	Professional Ethics and Sustainability in the Age of AI (All)	

List of Open elective courses offered by Civil Department

Course Code	Offered by	Course Name	
BCI25OE04	Civil	Remote sensing and GIS (All other branches)	Select any one
BCI25OE05	Civil	MOOC (offered only for civil department student)	

CURRICULUM STRUCTURE

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

(With effect from Academic Year 2025-26)

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					
BCI26PC18	PCC	Water and Waste Water Engineering	2	-	-	2	2	-	-	1	3	10	10	30	-	-	-	**50**
BCI26PC19	PCC	Environment Engineering Lab	-	1	-	1	-	2	-	-	2	-	-	-	25	25	-	**50**
BCI26PC20	PCC	Design of Reinforced Concrete Structures	2	-	-	2	2	-	-	1	3	10	10	30	-	-	-	**50**
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	3	-	-	3	3		-	1	4	20	20	60	-	-	-	**100**
BCI26PE12/ 14/16/18/20	PEC	PEC 2 Lab	-	1		1	-	2	-	-	2	-	-	-	50	-	-	**50**
BCI26PE31/ 33/35/37/39	PEC	PEC 3	3	-	-	3	3		-	1	4	20	20	60	-	-	-	**100**
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, H-Hours, 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	
BCI26PE33 BCI26PE34	Waste Management for Smart Cities Waste Management for Smart Cities Lab	Choose any one
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

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		
2	2	-	-	1	10	10	30	50

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 runoff
2. Evaluate yield through Aquifer
3. Evaluate reservoir capacity and water requirement of crops
4. Gain the knowledge of hydraulic structures

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to Hydrology and Runoff** Hydrological cycle, precipitation, analysis of precipitation data, runoff hydrograph, unit hydrograph, S-curve, flood frequency analysis, Introduction to flood routing.	8
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.	7
3	**Reservoir Planning and Irrigation** Investigation for reservoir planning, applications of mass curve and demand curves, reservoir sedimentation, useful life of reservoir. Methods of irrigation, water requirements of crops, Piped distribution network for irrigation (PDN) : Introduction, advantages and disadvantages of PDN over conventional. Application of AI in Irrigation.	8
4	**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. Canal and canal structures, Introduction to cross drainage works.	7
	Total	**30**

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. 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, 3th Edition, John Wiley & Sons, 2011.
4. Irrigation Engineering, H.M.Raghunath,1st Edition, 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:	Hydrology and Water Resources Engineering Lab			Code:		BCI25PC13	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	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 8, 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.

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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		
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: 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.

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
	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:

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. (2017). *Principles and practices of highway engineering* (9th ed.). Delhi: Khanna Publishers.

Books by International Authors:

1. Garber, N. J., &Hoel, L. A. (2014). *Traffic and highway engineering* (4th ed.). Cengage Learning.
2. Mannering, F. L., & Washburn, S. S. (2020). *Principles of highway engineering and traffic analysis* (7th ed.). John Wiley & Sons.

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.
6. Hancock, M. W., & Wright, B. (2018). A policy on geometric design of highways and streets 7th Edition. American Association of State Highway and Transportation Officials: Washington, DC, USA, 3, 20.

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 urbanhighways: IRC:86-1983: Geometric design standards for urban roads in plains.
9. AASHTO-The Green Book: A policy on geometric design of highways and streets (2018). American Association of State Highway and Transportation Officials: Washington, DC, USA, 3, 20.

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 Ten)

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.

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.
8. IS 3177 – 1999: Code of practice for Electric Overhead Travelling cranes & Gantry Cranes other than steel work cranes.

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 andindustrial 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 KusumAthukorala, 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)			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 8)

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 KusumAthukorala, 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 appraise the planning strategies concerning various laws, norms, policies, and guidelines.

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. Evaluate and defend planning strategies to develop the area under guidelines and government norms

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)			Code:		BCI25PE04	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	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 discuss and demonstrate the concepts of landscaping, urban renewal, and sustainable architecture.

3. To distinguish and relate planning levels understand the use of act and develop neighborhood plans.

4. To appraise multifaceted zones like SEZ, CRZ, and Special townships and understand applications of modern Tools like GIS / GPS / RS in town planning and the need for Rural Planning.

Course Outcomes:

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

1. Illustrate the concepts of the role and responsibility of engineers, planners, and architects for town planning.
2. Apply the principles of town planning, urban conservation, and urban renewal to improve quality of life with sustainability.
3. Explain the working principles of various town planning authorities under guidelines and Government norms.

Detailed Syllabus

Term work consists of following (any 9)

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:

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

Program:	B. Tech. (Civil Engineering)			Semester:		V	
Course:	Advanced Mechanics of structures Lab (PEC-1)			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 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 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)			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 8 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 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 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:
https://nptel.ac.in/courses/105105176

Course Syllabus

TY B Tech

Open Elective

Semester-V

Program:	B. Tech. (Civil Engineering)				Semester:			V
Course:	Digital Marketing (Offered by Computer Engineering)				Code:			BCE25OE01
Credits	Teaching Scheme (Hrs/Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-		-	10	10	30	50

Prior knowledge of Understanding of design thinking and planning is essential.

Course Objectives:

This course aims at enabling students:

1. To introduce the fundamental concepts and various types of digital marketing.
2. To familiarize students with different social media advertising platforms and their role in effective digital marketing campaigns.
3. To equip students with essential skills to implement Search Engine Optimization (SEO) technique.
4. To provide an understanding of E-commerce principles and business models, and to develop the ability to apply E-marketing techniques in digital environments.

Course Outcomes:

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

1. Understand the different types of Digital Marketing.
2. Learn social media advertising platforms for digital marketing campaigns.
3. Apply the fundamental principles and concepts of Search Engine Optimization (SEO).
4. Apply e-commerce and e-marketing concepts in Business Models.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Types of Digital Marketing** Digital Marketing – The concept, Digital Marketing Types : Mobile Marketing, Online Marketing, Email Marketing,	6
II	**Digital marketing using social media** Consumer Generated Contents (CGC), Impact of Social Media, Advantages and Disadvantages of Social Media, Types of Social Media, Social Media Marketing using Instagram, Snap Chat, Twitter and LinkedIn	8
III	**Search Engine Optimization (SEO)** Search Engine Optimization Basics, Keyword Research, SEO Tool- SEMrush: Overview and Features, Top Search Engine Ranking Factors. Case Study: Dominos India: Building Traffic through content propagation.	8
IV	**E-commerce Business Models & E-marketing** E-commerce: Meaning, Benefits and limitations, Business Models for E-commerce: Business-to-Consumer (B2C), Business-to-Business(B2B), Consumer-to-Consumer (C2C), Consumer To-Business (C2B). Case Study: Revenue sources at YouTube Traditional Marketing Vs. E-Marketing, Impact of E-commerce on markets, Issues in E-Marketing Case Study: Create an own business EC model example -Shopify	8
	Total	30

Text Books:

1. Damian Ryan& Calvin Jones . Understanding DIGITAL Marketing
2. Vandana Ahuja(2015), Digital Marketing. Oxford University Press, New Delhi
3. Neetu Kapoor, Concept Building Approach to Digital Marketing, Cengage, 2nd Edition.
4. The digital marketing Handbook, A step by step guide, Mohit Pawar,2015 Edition.
5. Joseph P. T., E - Commerce – An Indian Perspective, PHI publication, 6th Edition

Reference Books:

1. George Pain(2019). Marketing Automation and Online Marketing: Automate Your Business through Marketing Best Practices such as Email Marketing and Search Engine Optimization
2. Barker, M., Barker, D., & Bormann, N. (2016), Social Media Marketing: A Strategic Approach, Boston, MA : Cengage Learning.
3. Tuten, T., Solomon M., Social Media Marketing, SAGE, 2nd Edition.
4. Ian Dodson, The art of Digital Marketing, 2016, Wiley, 978-1-119-26570-2.

E-resources:

https://www.coursera.org/learn/foundations-of-digital-marketing-and-e-commerce
https://open.umn.edu/opentextbooks/textbooks/1602
https://www.coursera.org/learn/social-media-marketing-introduction
https://www.coursera.org/specializations/social-media-marketing
https://www.coursera.org/projects/create-your-ecommerce-store-with-shopify

Program:	B. Tech. (Civil Engineering)			Semester:			V
Course:	Business Intelligence (offered by CSE-AI&ML)			Code:			BCS25OE03
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of basic mathematics is essential.

Course Objectives:

1. To understand the fundamentals of Business Intelligence, Decision support system and BI Infrastructure.
2. To understand Data Preprocessing and Data Warehousing techniques to provide solutions to the real time BI problems.
3. Business and Data Analytics techniques for solving BI problems.
4. To learn Modern tools for BI applications.

Course Outcomes:

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

1. Demonstrate the role of Business Intelligence in Decision Support System.
2. Apply the data pre-processing techniques to solve BI problems.
3. Apply Data Analytics Life Cycle for Business Intelligence Application.
4. Use modern analytical tools to develop BI applications.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction:** Introduction, Defining BI Cycle, BI Environment and Architecture, Role of Mathematical model in BI, Factors Responsible for successful BI Project. **Decision Support System:** Structure and Development of Decision Support System (DSS), Role of Business Intelligence in DSS, Managing BI operations for business continuity	07
II	**Data Preprocessing and Data Warehousing :** Data preparation, Preprocessing requirements, data cleaning, data integration, data reduction, data transformation, Data discretization and concept hierarchy generation; Data warehouse Modeling, data warehouse design, Distributed data warehouse, and materialized view.	08
III	**Business Data Analytics:** Data analytics, business analytics, Data Analytics life cycle, Data Mining techniques for Business Analytics **BI Metrics & Pattern Visualization:** Metrics for performance evaluation: Accuracy, Error Rate, precision, Recall, F-measure, Sensitivity, Specificity, BI metrics on Dashboard, Need of Visualization, Pattern visualization tools and techniques (Tableau or PowerBI)	08
IV	**BI Tools and Applications:** Analytical Tools for Business Intelligence, Case studies: WEKA, KNIME, Rapid Miner, BI applications: ERP and Business Intelligence, BI Applications in CRM, BI Applications in Marketing, Finance, Banking, Fraud Detection.	07
	Total	30

Text Books:

1. R. Sharda, D. Delen, & E. Turban, Business Intelligence and Analytics. Systems for Decision Support,10th Edition. Pearson/Prentice Hall, 2015. ISBN-13: 978-0-13-305090-5, ISBN-10: 0-13-305090-4;
2. Business Process Automation, Sanjay Mohapatra, PHI.

Reference Books:

1. Introduction to business Intelligence and data warehousing, IBM, PHI.
2. Data mining concepts and techniques, Jawai Han, Michelline Kamber, Jiran Pie,Morgan Kaufmann Publishers 3rd edition.
3. Building the data Warehouse, William H Inmon, Wiley Publication 4th edition.

4. Data Mining for Business Intelligence, WILEY
5. EMC Educational Services, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, Wiley ISBN-13 978 1118876138
6. Ken W. Collier, Agile Analytics: A value driven Approach to Business Intelligence and Data Warehousing, Pearson Education,2012, ISBN-13 978 8131786826

E-resources:

1. https://www.knime.com/sites/default/files/inline-images/KNIME_quickstart.pdf
2. www.cs.ccsu.edu/~markov/weka-tutorial.pdf

Program:	B. Tech. (Civil Engineering)			Semester:			V
Course:	**Introduction to Advanced Driver Assistance Systems** (Offered by E&TC to all)			Code:			BET25OE01
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of a. Electronics and electrical engineering b. Basic programming concepts **is essential.**

Course Objectives:

1. Equip students with a comprehensive understanding of ADAS technologies.
2. Enable students to evaluate and apply sensor technologies.
3. Foster proficiency in integrating embedded systems and real-time data processing.
4. Prepare students to design and implement testing strategies for ADAS

Course Outcomes:

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

1. Analyze the role of ADAS in vehicle safety and automation.
2. Evaluate sensor technologies and sensor fusion methods for ADAS functionality.
3. Apply embedded system concepts and real-time processing in ADAS.
4. Create testing strategies for ADAS using V2X communication.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Overview of ADAS and Core Functionalities:** Introduction to ADAS, importance of ADAS in vehicle safety, ADAS levels of automation, sensor technologies in ADAS, lane-keeping assist, adaptive cruise control, automatic emergency braking, collision avoidance, parking assist, and traffic sign recognition.	07
2	**Sensor Technologies and Sensor Fusion in ADAS:** Types of sensors used in ADAS, principles of sensor operation, sensor fusion for enhanced ADAS functionality, challenges of sensor calibration, sensor performance in various conditions, sensor integration with vehicle control systems.	08
3	**Embedded Systems and Real-Time Data Processing in ADAS:** Role of embedded systems in ADAS, microcontroller architectures for ADAS, real-time operating systems for data processing, system integration and communication between ECUs, decision-making algorithms, embedded software for ADAS, fault detection and self-diagnostics in ADAS systems.	07
4	**Vehicle-to-Everything (V2X) Communication and Testing ADAS:** Introduction to V2X communication (Vehicle-to-Vehicle, Vehicle-to-Infrastructure, Vehicle-to-Pedestrian), V2X communication protocols, integration of V2X with ADAS, testing methodologies for ADAS, validation of sensor fusion algorithms, ethical concerns, regulatory standards for ADAS.	08
	Total	**30**

Text Books:

1. Hussein T. Mouftah, Melike Erol-Kantarci, and Mubashir Husain Rehmani, "Connected and Autonomous Vehicles in Smart Cities", CRC Press, 1st Edition, 2020.
2. Claire Vishik, Simon Winberg, and Axel Sikora, "Cybersecurity for Connected and Automated Vehicles", Artech House, 1st Edition, 2021.
3. Andreas Herrmann, Walter Brenner, and Rupert Stadler, "Autonomous Driving: How the Driverless Revolution Will Change the World", Emerald Publishing, 1st Edition, 2018.

Reference Books:

1. Burkhard Huhnke, Markus Maurer, and Christoph Stiller, "Handbook of Driver Assistance Systems: Basic Information, Components and Systems for Active Safety and Comfort", Springer, 1st Edition, 2016.
2. Ramiro Liscano, Juan Carlos Garcia, and Miguel Angel Sotelo, "Advanced Driver Assistance Systems: Fundamentals, Applications, and Advances", CRC Press, 1st Edition, 2021.
3. Wolfgang Runge, "Autonomous Driving: Technical, Legal and Social Aspects", Springer, 1st Edition, 2016.

Program:	B. Tech. (Civil Engineering)			Semester:		V	
Course:	Engineering Psychology (offered by E&Tc)			Code:		BET25OE02	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of is not essential.

Course Objectives:

This course aims at enabling students,

1. Introduce engineers to key psychological principles relevant to personal and professional development.
2. Understand human behavior, cognition, and emotion to improve interpersonal effectiveness and teamwork.
3. Develop skills to integrate psychological insights into problem-solving and innovation.
4. Foster ethical decision-making and leadership through Emotional Intelligence.

Course Outcomes:

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

1. Understand fundamental psychological concepts and their engineering applications.
2. Understand the theories of cognitive works
3. Apply psychological principles to improve teamwork and leadership.
4. Integrate human-centered approaches in engineering design and problem-solving.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to Engineering Psychology** History of Engineering Psychology, Methods of Engineering Psychology Perspective on Engineering Psychology-Human-Centric Design, Balance in Cognitive Load, Ethical & Sustainable Technology, Holistic Decision-Making:	08
2	**Design of Cognitive Work-1** Attention Vigilance and Fatigue Information Processing Training and Automaticity Stress and Workload Displays, Monitors, and Screens Usability Teams and Performance	08
3	**Design of Cognitive Work-2** Situation Awareness Emotion, Motivation, and Boredom Decision-Making and Expertise Language and Artificial Intelligence	07
4	**Importance of EI for engineering professionals** Components of EI (as per Goleman's Model) Daniel Goleman's Model (Five components: Self-awareness, Self-regulation, Motivation, Empathy, Social skills) Role of EI in team collaboration, leadership, and conflict resolution Applications of EI in decision-making and problem-solving Examples of high-EI engineering leaders Developing Emotional Intelligence- Techniques for enhancing self-awareness and empathy, Managing emotions under stress	07
	Total	**30**

Text Books: :

1. Elliott, L. J. (2021). Engineering psychology. Penn State University Libraries. https://doi.org/10.26209/engin-psych
2. D. Goleman, Emotional Intelligence: Why It Can Matter More Than IQ. New York, NY, USA: Bantam Books, 1995..

Reference Books:

1. Baron, R. A., & Branscombe, N. R. Psychology (13th Edition). Pearson.
2. A. Nagraj, Vyavhar Darshan (The Conduct Perspective)
3. Schultz, D. P., & Schultz, S. E. Psychology and Work Today
4. A. Nagraj, Jeevan Vidya: Ek Parichay
5. R.R. Gaur, R. Sangal, G.P. Bagaria, A Foundation Course in Human Values and Professional Ethics

Program:	B. Tech. (Civil Engineering)			Semester:		V	
Course:	Cloud Computing (Offered by IT department)			Code:		BIT25OE01	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge Computer Network Fundamentals

Course Objectives:

This course aims at enabling students,

1. To learn the fundamentals of cloud computing.
2. To know the emergence of cloud as the next generation computing paradigm.

Course Outcomes:

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

1. Explore the basic terminologies in cloud computing
2. Categorize cloud service models and their utilities
3. Demonstrate cloud security mechanisms and policies
4. Examine common standard in cloud computing

Detailed Syllabus

Unit	Description	Duration (H)
1	**Fundamentals of Cloud Computing** Computer Network Fundamentals : OSI Reference Model, Computer Network architecture Origin and Influences of Cloud Computing - History, definitions, technology innovations; Cloud Computing terminologies, Applications, benefits and limitations, risk and challenges, roles and boundaries, cloud characteristics, Cloud Delivery Models, cloud Deployment Models.	07
2	**Cloud Service and Platforms** Software as a Service, Platform as a Service, Infrastructure as a Service, Database as a Service, Monitoring as a Service, Communication as services, Service providers: Google Cloud platform, Microsoft Azure Service Platform, Amazon EC2, Salesforce, IBM.	07
3	**Cloud Enabling Technology and Cloud Security** Broadband Networks and Internet Architecture, Data Centre Technology, Virtualization Technology, Web Technology, Multitenant technology, Service Technology, Cloud Security**:** Confidentiality, Integrity, Authenticity, availability, Vulnerability, Security Control, Security Mechanisms, Security Policies.Case study on Identity Access Management (IAM)	08
4	**Common Standards in Cloud Computing** Open Cloud Consortium- Open Virtualization Format, Working of Virtualization system, Types of Virtualization, Benefits of Virtualization, Standards for Application Developers- browsers, data and solution Stack; Standards for Messaging- SMTP, POP, IMAP, RSS, HTTP; Standards for Security- Security (SAML OAuth, OpenID, SSL/TLS).	08
	Total	**30**

Text Books:

1. Ricardo Puttini, Thomas Erl, and Zaigham Mahmood, "Cloud Computing: Concepts, Technology & Architecture", Pearson May 2013, ISBN: 9780133387568.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill.
3. Rittinghouse, John W., and James F. Ransome, Cloud Computing: Implementation, Management, And Security, CRC Press, 2017.

Reference Books:

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, ―Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
2. Tim Mather,Subra Kumaraswamy,Shahed Latif, "Cloud Security and Privacy:An Enterprise Perspective on Risks and Compliance", O'Reilly Media, Inc. 2009

Online Material :

1. NPTEL Course on Cloud Computing : https://nptel.ac.in/courses/106105167
2. Google Cloud Computing Foundation Course: https://nptel.ac.in/courses/106105223

Program:	B. Tech. (Civil Engineering)			Semester:			V
Course:	Unmanned Aerial Vehicle (offered by Mechanical department)			Code:			BME25OE01
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of: Basic knowledge of Engineering Physics, Mechanics and Materials Engineering

Course Objectives: This course aims at enabling the students to

1. To introduce students to the fundamental principles of UAV systems, including types, components, flight dynamics, materials and manufacturing.
2. To equip students with the fundamental knowledge for designing lightweight and smart UAV.

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

1. **Describe** the classification, anatomy, and flight principles of various UAV systems used in different applications.
2. **Select** appropriate materials and explain relevant manufacturing techniques for UAV structural components.
3. **Investigate** UAV airframe design principles to develop structural configurations by analyzing aerodynamic loads and stress distribution
4. **Explain** the role of AI, ML, IoT, and cyber security in enhancing UAV intelligence, connectivity, and real-world applications.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Fundamentals of UAV Systems, Anatomy, and Flight Principles** Overview of UAVs: Types, Applications and DGCA Rules, Applications of UAVs: Military, commercial, agriculture, environmental monitoring, surveillance, logistics; Anatomy of UAV: Key Components, Airframe, Propulsion, Avionics, Payload; Basic Flight Principles: Lift, Thrust, Drag, Weight; Aerodynamics: Bernoulli's Principle, Airfoil Characteristics; Flight Dynamics: Stability, Control Surfaces (Ailerons, Elevators, Rudder)	7
2	**Materials & Manufacturing for UAV Design** Material Selection: Lightweight materials – composites, polymers, carbon fiber, aluminum alloys; Structural Materials for UAV Airframes; Manufacturing Techniques: Traditional: Machining, forming; Modern: 3D printing, additive manufacturing, CNC techniques, Assembly and Integration: Joining methods (gluing, bolting), modular UAV design, Maintenance & Repair: Field repair techniques, material durability, lifecycle assessment	8
3	**Design Approach of UAVs** UAV Airframe Design Principles, Wing, Fuselage, and Tail Design Concepts, Structural Design Aspects: Load paths, stress points, vibration and fatigue considerations, Load Analysis and Stress Calculations, Introduction to Structural Simulation Tools	8
4	**Smart Technologies in UAVs** IoT Integration in UAVs: Sensor networks, telemetry, data acquisition, cloud interfacing, AI/ML Applications, Swarm UAVs and Cooperative Missions: Communication protocols, decentralized control, Cyber security for UAVs: Threats, encryption techniques, safe data transmission, Use Cases: Precision agriculture, disaster monitoring, smart delivery drones	7
	Total	**30**

Text Books:

1. Garg, P. K. (2021). Unmanned aerial vehicles: An introduction.
2. Sebbane, Y. B. (2022). A first course in aerial robots and drones. CRC Press.
3. Gundlach, J. (2014). Designing unmanned aircraft systems. Reston: American Institute of Aeronautics & Astronautics.

Reference Books:

1. Yang, L. J., & Esakki, B. (2021). Flapping Wing Vehicles: Numerical and Experimental Approach. CRC Press.
2. Barnhart, R. K., Marshall, D. M., & Shappee, E. (Eds.). (2021). Introduction to unmanned aircraft systems. Crc Press.
3. Austin, R. (2011). Unmanned aircraft systems: UAVS design, development and deployment. John Wiley & Sons.

e-Resources

1. https://archive.nptel.ac.in/courses/101/104/101104073/
2. https://onlinecourses.swayam2.ac.in/ntr24_ed12/preview

Program:	B. Tech. (Civil Engineering)			Semester:			V
Course:	Industrial Engineering (offered by Mechanical department)			Code:			BME25OE02
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of: a. Basic manufacturing processes b. Basic mechanical components

Course Objectives: This course aims at enabling the students to

1. To introduce the concepts, principles and framework of contents of Industrial Engineering.
2. To acquaint the students with various productivity enhancement techniques.
3. To acquaint the students with different aspects of Production Planning and Control and Facility Design.
4. To introduce the concepts of various cost accounting and financial management practices as applied in industries.

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

1. Apply principles of management and evaluate productivity of an organization/Scenario.
2. Determine work content and standard time using different methods of work measurement.
3. Apply/use different techniques / concepts of production planning and control.
4. Analyze the strategic and operational aspects of plant location and layout, apply assembly line balancing techniques, and inventory control models

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to Industrial Engineering and Productivity** Definition and Role of Industrial Engineering, Functions of management, Types of production systems and organization structure. Measurement of productivity: Factors affecting the productivity, Productivity improvement techniques, Productivity Models and Index.	7
2	**Work Study** Definition, objective and scope of work-study, Human factors in work-study. Work Measurements: Definition, objectives and uses, Work measurement techniques. Method Study: Definition, objective and scope of method study, work content, activity recording and exam aids, micro motion study. Time Study: Definition, time study equipment, selection of job, steps in time study.	8
3	**Production Planning and Control** Introduction: Types of production systems, Need and functions of PPC, Aggregate production planning. Capacity Planning, ERP: Modules, Master Production Schedule, MRP and MRP-II. Forecasting Techniques: Causal and time series models, moving average, exponential smoothing, trend and seasonality (Numerical).	8
4	**Plant Location and Inventory Management** Plant Location: Need and factors influencing plant location, Plant Layout: Objectives, principles, types of plant layouts, Introduction to Assembly Line Balancing. Inventory control and Management: Types of inventories, Need of inventories, terminology, costs, Inventory Models: Basic production models, (with and without shortage and discount), ABC, VED Analysis.	7
	Total	**30**

Text Books:

1. Industrial Engineering and Production Management, M Mahajan, Dhanpat Rai and Co., 2015
2. Industrial Engineering and Production Management, M. Telsang, S. Chand Publication, 2018

Reference Books:

1. Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBH Publishing Company, New Delhi, Second Indian Adaptation, 2008.
2. Maynard's Industrial Engineering Hand Book, H. B. Maynard, K Jell, McGraw Hill Education, 2001
3. Design and Analysis of Lean Production System, R. Askin, Wiley, 2001
4. Most Work Measurement Systems, Zandin K.B., ISBN 0824709535, CRCPress, 2002
5. SAP ERP: Functionality and Technical Configuration, Martin Murry, SAP Press, 2010
6. Motion and time Study design and Measurement of Work, R. Barnes, Wiley, 2009
7. 'Process Simulation using WITNESS', R. Al-Aomar, A. Williams, O. M. Uigen, Wiley, 2015
8. Applied Ergonomics, Hand Book, Brien Shakel, Butterworth Scientific, 1988
9. Introduction to Human factor and Ergonomics, R. C. Bridger, McGraw Hill, 2017
10. Human Factor Engineering and Design, M. Sanders and E. McCormick, McGraw Hill, 1992
11. Ergonomics: How to Design for Ease and Efficiency, K. Elbert and H. Kroemer, Prentice Hall, 2018

e-Resources

https://onlinecourses.nptel.ac.in/noc21_me15/preview

Program:	B. Tech. (Civil Engineering)			Semester:			V
Course:	Lean Six Sigma (offered by Mechanical department)			Code:			BME25OE03
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of: Statistics

Course Objectives: This course aims at enabling the students to

1. To equip students with foundational knowledge of Lean and Six Sigma methodologies, including key tools such as DMAIC, 7QC tools.
2. To develop students' ability to apply continuous improvement techniques for effective decision-making and sustainable operational excellence.

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

1. Analyze quality-related issues using Cost of Quality and 7QC tools to improve product and process performance.
2. Analyze data using statistical tools like Pareto charts, histograms, and process capability indices to evaluate process performance.
3. Apply risk assessment and control tools such as FMEA, control charts to sustain process improvements.
4. Apply the continuous improvement techniques in the industry to improve the process performance.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to lean and quality** Lean and Six Sigma history, Eight wastes in lean, Lean tools, Quality values, Cost of Quality, Introduction to 7QC tools. Introduction to DMAIC.	7
2	**Six Sigma: Define and Measure** Define stage: Project Charters, VOC, CTQ, SIPOC, Gantt Charts, PERT-CPM. Measure stage: Process flowchart, Histogram, Pareto chart, Gage R&R study, Basic statistics, Probability theory, Process capability analysis, OEE.	8
3	**Six Sigma: Analyze, Improve and Control** Hypothesis testing, 5-Whys, Fishbone diagram, Regression analysis, Design of Experiments (DOE), Risk assessment (FMEA), Control chart (X and R chart).	8
4	**Continuous Improvement Methods** Case studies on implementation of continuous improvement methods like Kaizen, Poka-Yoke, Kanban, 5'S, Just in Time, 3M and 4M method.	7
	Total	**30**

Text Books:

1. Six Sigma: A Complete Step-by-Step Guide, Craig Joseph Setter and the Council for Six Sigma Certification, Harmony Living, LLC, ISBN: 1732592624, 2018.
2. The Six Sigma Handbook: A Complete Guide for Green Belts, Black Belts, and Managers at All Levels,Thomas Pyzdek, Paul A. Keller, Third Edition, McGraw-Hill, ISBN: 978-0-07-162337-7, 2010.

Reference Books:

1. The Six Sigma Way: How to Maximize the Impact of Your Change and Improvement Efforts, Peter S. Pande, Robert P. Neuman, and Roland Cavanagh, McGraw Hill Professional, ISBN:0071823018, 2014.

e-Resources

1. https://www.sixsigmacouncil.org/six-sigma-training-material/
2. https://onlinecourses.nptel.ac.in/noc20_mg19/preview

Program:	B. Tech. (Civil Engineering)			Semester:			V
Course:	Safety, Health and Environment (offered by Mechanical department)			Code:			BME25OE04
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of: None

Course Objectives: This course aims at enabling the students to

1. To provide exposure to the students about safety and health provisions, including the need for and methods of safety training.
2. To create awareness on safety standards in residential, commercial and agricultural applications.
3. To help students to learn about Factory act 1948, Environment act 1986 and rules framed under the act.
4. To describe the chemistry of fire & explosion and select & use appropriate fire-fighting and explosion proof equipment.

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

1. Demonstrate the safety, ethical issues, and importance of safety training that may arise from industrial processes.
2. Identify the safety standards in residential, commercial and agricultural applications
3. List out important legislations related to Health, Safety and Environment
4. Select a suitable method for prevention of fire and explosion

Detailed Syllabus

Unit	Description	Duration (H)
1	**Concepts and Techniques:** History of safety movement – Evolution of modern safety concept, safety survey, safety inspection, safety sampling. Safety Audits- Non-Conformity Reporting (NCR), audit checklist-identification of unsafe acts of workers and unsafe conditions in the industry, Safety training-needs and methods.	7
2	**Safety in residential, commercial, agricultural, installation & Protective equipment:** Electricity, its Usefulness and Hazards, statutory Provisions, Indian Standards, Effects of Electrical parameters on human body, Safety measures for electric shock, portable electrical apparatus, Electric work in hazardous atmosphere.	8
3	**Factories Act – 1948 & Environment Act – 1986:** **Factories Act – 1948:** Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Maharashtra Factories Rules 1963. **Environment Act – 1986:** General Powers of the central government, prevention, control and abatement of environmental pollution-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001. Air Act 1981 and Water Act 1974 -audit, penalties and procedures.	8
4	**Fires and Explosions and concepts to prevent fires and explosions:** Fire triangle, Distinction between fires and explosions, Flammability characteristics of liquids and vapors, limiting oxygen concentration and inerting, Controlling static electricity, Explosion-proof equipment and instruments, Ventilation.	7
	Total	**30**

Reference books:

1. Philip E. Hagan, John F. Montgomery, James T. O'reilly ―Accident Prevention Manual for Business and Industry: Administration and Programs‖, 14th Edition, National Safety Council, Illinois, Chicago, 2015.
2. Heinrich H.W. ―Industrial Accident Prevention‖ McGraw-Hill Company, New York, 1980.
3. Krishnan N.V. ―Safety Management in Industry‖ Jaico Publishing House, Bombay, 1997.

E-Sources: https://nptel.ac.in/courses/114106039

Program:	B. Tech. (Civil Engineering)			Semester:			V
Course:	Battery Technologies for Electric Vehicles (offered by Mechanical department)			Code:			BME25OE05
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior knowledge of: Fundamental concepts of physics and chemistry is essential.

Course Objectives: This course aims at enabling the students to

1. To make the learners conversant with various battery chemistries used for Electric Vehicles and impart a thorough understanding of Lithium-Ion Battery
2. To understand the various battery performance parameters and testing procedures
3. To understand the requirements and functioning of the battery management system
4. To make the learners conversant with battery pack design procedure and Equivalent Circuit Cell Modeling of Battery

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

1. Compare various battery chemistries and select a suitable battery for EV application
2. Analyze Li-ion Battery's performance based on various parameters
3. Select BMS for a given battery pack
4. Design a battery pack for a given EV application

Detailed Syllabus

Unit	Description	Duration (H)
1	**Overview of Battery Technology of Electric Vehicle (EV):** Electric vehicle (EV) requirements, Primary Battery, Secondary Battery, Past, current, and future EV battery technologies (Pb-acid, NiCd, NiMH, Li-ion, Na-air, Al-air, Li-S, Li-air, Na-ion etc) Lithium-Ion Battery Technology: Introduction, Components, Cathode, Anode, separators & Electrolytes Material comparison, Battery Working, Cylindrical, prismatic and Pouch cells, Battey cell Manufacturing	7
2	**Battery Performance and Testing:** Battery operating and performance parameters (Voltage, Capacity, Energy, Power, C-rate, SOC, DOD, Coloumbic & energy Efficiency, Calendar and Cycle life etc.), CC-CV charging, CC discharging tests. Effect of parameters on the charge-discharge characteristics of Li-ion battery, SOC Estimation: Coulomb Counting method, OCV-SOC method, Estimation of SoH, Capacity, efficiency.	7
3	**Battery Thermal Management:** Heat generation inside battery, Thermal issues of Li-Ion Battery, impact of temperature on capacity, cycle life, thermal Runaway, different Cooling strategies Battery Electric Management: Primary functions of BMS, BMS Architecture, voltage, current and temperature sensing, SOC estimation, BMS safety features, selection of BMS , battery pack balancing: Passive and active balancing. BMS topologies, A.I. based BMS	8
4	**Battery Pack Design:** Vehicle dynamics, Estimation of battery pack Energy, Voltage and Capacity using Drive-cycle simulation of EV, trade-off between parallel and series cell connections, parallel-cell-module (PCM), series-cell-module (SCM) **Equivalent Circuit Model (ECM) of Li-ion cell:** Modeling SOC & temperature dependence of OCV, polarization and diffusion voltage, Estimation of model parameter values, use of ECM to simulate constant voltage/ power charge/discharge characteristics	8
	Total	**30**

Text Books:

1. Gregory L. Plett, Battery Management Systems, Volume I: Battery Modeling, Artech House, London
2. Gregory L. Plett, Battery Management Systems Volume II, Equivalent-Circuit Methods, Artech House, London

3. Gianfranco Pistoia, Boryann Liaw (eds.), Behaviour of Lithium-Ion Batteries in Electric Vehicles_ Battery Health, Performance, Safety, and Cost, Springer International Publication
4. Jiuchun Jiang, Caiping Zhang - Fundamentals and Application of Lithium-ion Batteries in Electric Drive Vehicles,Wiley

e-Resources

1. https://www.coursera.org/learn/battery-management-systems
2. https://www.coursera.org/learn/equivalent-circuit-cell-model-simulation?specialization=algorithms-for-battery-management-systems

Program:	B. Tech. (Civil Engineering)			Semester:			V
Course:	Professional Ethics and Sustainability in the Age of AI (offered by Mechanical department)			Code:			BME25OE06
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

About the Course :
This course introduces the ethical dimensions of engineering and artificial intelligence (AI), helping students make responsible decisions in technology design and practice. It explores real-world dilemmas, sustainability challenges, and global regulatory perspectives to prepare future engineers for ethical leadership in an AI-driven world.
Prior knowledge of: none.

Course Objectives: This course aims to

1. Develop an understanding of ethical principles, professional conduct, and responsibilities in engineering and artificial intelligence (AI) practices.
2. Adapt the ability to identify and apply ethical frameworks for decision-making in research, AI system design, intellectual property, and sustainable engineering activities.
3. Create awareness of environmental ethics, sustainability principles, and the societal impacts of engineering and AI-based technological advancements.
4. Promote a global and culturally inclusive perspective on ethical issues, focusing on regulatory frameworks and the role of engineers in addressing contemporary challenges related to AI governance and sustainable development.

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

1. **Understand** fundamental ethical principles and professional responsibilities related to engineering, artificial intelligence (AI), and emerging technologies
2. **Apply** ethical frameworks and decision-making models to analyze dilemmas involving AI systems, research practices, intellectual property, and sustainable engineering solutions.
3. **Evaluate** the environmental and societal impacts of engineering and AI technologies, and promote sustainable and responsible innovations aligned with ethical standards.
4. **Demonstrate** awareness of global, cultural, and regulatory perspectives in professional practice, with an emphasis on ethics in AI governance, sustainability initiatives, and inclusive technological development.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Foundations of Professional Ethics and Emerging Technologies** Role of ethics in engineering and AI; moral autonomy; types of ethics; professional responsibilities in AI-driven world; ethical theories (utilitarianism, deontology, virtue ethics) with practical case studies.	8
2	**Ethical Decision-Making, AI Ethics, and Research Practices** Frameworks for ethical decision-making (with AI case examples); analyzing dilemmas; stakeholder responsibilities; ethical considerations in AI model development (bias, fairness, accountability); ethical issues in research, intellectual property, and emerging technologies.	8
3	**Sustainability, Environmental Ethics, and Social Responsibility** Introduction to sustainability in engineering; ethical resource management; circular economy; environmental impact of AI technologies; social justice, health, and safety responsibilities in sustainable design; role of engineers in building sustainable futures.	7
4	**Global, Cultural, and Regulatory Perspectives in AI and Sustainability** Ethical issues in global engineering projects; cultural perspectives on technology adoption; diversity, equity, and inclusion in AI; international regulations and governance of AI (GDPR, AI Act, IEEE standards); sustainability goals (SDGs) in a global context.	7
	Total	**30**

Text Books:

1. Harris, C. E., Pritchard, M. S., &Rabins, M. J. (2019). Engineering ethics: Concepts and cases. 6th Edition, Cengage Learning, Inc.
2. Coeckelbergh, M. (2020). AI Ethics (1st ed.). MIT Press.

Reference books:

1. Mike W. Martin and Roland Schinzinger, (2019). Ethics in Engineering, 3rdEdition,Tata McGraw Hill, New Delhi,
2. Caroline Whitbeck, Ethics in Engineering practice and Research. (2011) 2nd Edition, Cambridge.
3. Virginia Dignum (2019). Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way. Springer.
4. Wendell Wallach and Colin Allen (2008). Moral Machines: Teaching Robots Right From Wrong. Oxford University Press.

Open Elective course offered by Civil Department to other department							
Program:	**B. Tech. (Civil Engineering)**			**Semester:**		**V**	
Course:	**Remote Sensing and GIS (Open Elective)**			**Code:**		**BCI25OE04**	
Credits	**Teaching Scheme (Hrs/Week)**			**Evaluation Scheme and Marks**			
	Lecture	**Practical**	**Tutorial**	**FA**		**SA**	**Total**
				FA1	**FA2**		
2	**2**	**-**	**-**	**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 understand the fundamental principles and techniques of remote sensing and GIS.
2. To develop skills in processing, analyzing, and interpreting remote sensing data.
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, and disaster management.

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

1. Demonstrate a clear understanding of remote sensing principles, systems, and sensor characteristics.
2. Apply remote sensing and GIS techniques to analyze data for various civil engineering and interdisciplinary applications.
3. Use GIS tools for spatial data processing, analysis, and visualization.
4. Integrate remote sensing data with GIS to solve real-world problems in urban planning, environmental monitoring, and disaster management.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Fundamentals of Remote Sensing:** Introduction to Remote Sensing: Definition, History, and Applications Electromagnetic Radiation (EMR): Spectrum, Energy Interactions with Atmosphere and Earth Surface, Remote Sensing Sensors and Platforms: Optical, Microwave, and Hyperspectral Sensors, Resolution in Remote Sensing: Spatial, Spectral, Temporal, and Radiometric Resolution, Recent Advances: UAV (Drone) Remote Sensing, AI-based Remote Sensing	8
2	**Satellite Image Processing and Interpretation:** Types of Remote Sensing Data, Satellite Image Acquisition and Preprocessing Techniques: Radiometric and Geometric Corrections, Image Enhancement and Filtering Techniques, Image Classification Methods: Supervised and Unsupervised Approaches, Cloud-based Remote Sensing: Google Earth Engine and Big Data GIS	8
3	**Geographic Information System (GIS) Fundamentals:** Introduction to GIS: Definitions, Components, and Functions, Spatial Data Models: Raster vs. Vector Data, Topology, GIS Data Sources: Digitization, GPS Data Collection, Open-Source Data, GIS Software and Tools: ArcGIS, QGIS, Python for GIS, Georeferencing, Map Projections, and Coordinate Systems, Thematic Mapping and Visualization Techniques	7
4	**GIS Data and Case Studies:** Role of AI & Machine Learning in GIS: Object Detection, Land Cover Classification Real-time GIS and Web-based GIS Technologies, Case Studies: GIS Applications in Urban Planning, Disaster Management, Environmental Monitoring, and Smart Cities	7
	Total	**30**

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://onlinecourses.nptel.ac.in/noc22 ce84/preview
2. https://onlinecourses.nptel.ac.in/noc23_ce52/preview
3. https://onlinecourses.nptel.ac.in/noc22_ce26/preview
4. https://elearn.nptel.ac.in/shop/nptel/remote-sensing-and-gis/

Open Elective offered by Civil Department to civil engineering students							
Program:	**B. Tech. (Civil Engineering)**			**Semester :**		**V**	
Course:	**Massive Open Online Courses (MOOC)**			**Code:**		**BCI25OE05**	
Credits	**Teaching Scheme (Hrs/Week)**			**Evaluation Scheme and Marks**			
	Lecture	**Practical**	**Tutorial**	**FA**		**SA**	**Total**
				FA1	**FA2**		
2	**2**	**-**	**-**	**20**	**10**	**20**	**50**

Course Objectives:

1. MOOC courses are introduced to imbibe self learning in students.
2. To prepare students for modern tools and techniques.

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

1. Build self-learning skills.
2. Discuss the application of modern tools and techniques in civil engineering.

Guidelines for Students:

1. The MOOC courses can be chosen from the **online platform** such as **NPTEL**
2. Individual student needs to take approval from MOOC coordinator for MOOC course listed by him and then proceed for registration. MOOC course should be exclusive to courses undertaken by students. **(Repetition of Course titles (and same course content) similar to regular curriculum are not allowed).**While selecting the course, student should be opted for the different courses based on the available latest courses apart from courses offered in the program curriculum.
3. **Total duration of course should be 8 to12 weeks. (minimum 30hrs)**
4. Regular assignments need to be completed as per requirement of course.
5. Submission of the regular assignments needed as per requirement of course.
6. At the end of course submission of MOOCs report of (3- 4 Pages) in hardcopy is mandatory along with course exam passing certificate.
7. 40% weightage given to internal evaluation based on assignment submitted and 20% weightage given to MOOC course report (notes). Remaining 40% weightage given to certification of the course as external evaluation by selected platform. Final examination for this course is mandatory irrespective of the platform.
8. If student is fail to complete assignments, report submission, final exam as per MOOC course criteria then he/she will be failed in the course, in such case the student can registered or opted for open elective courses floated by other department and earned 2 credits in stipulated time frame.

Evaluation Guidelines and Rubrics:

1. **Formative Assessment 1- completion of assignment of MOOC (20Marks)**
   Conversion of average assignment marks submitted into 20 marks
2. **Formative Assessment 2- MOOCs report Submission (10 Marks)**

	Excellent	**Good**	**Average**	**Poor**
MOOC report	10-9	8-7	6-5	Below 5

MOOCs report Submission

The student should summarize detail report along with learning outcomes in report of 3-4 pages or student may submit good quality paper with some application implemented using the knowledge gained through the course to comply these rubrics:

3. Final Examination Certificate (5+15= 20 Marks)

a. Appeared for Exam: 05 Marks

b. Performance of Exam: convert final exam marks gain in MOOC course into 15 Marks

Link of platforms:

https://nptel.ac.in/courses
https://www.coursera.org/search?query=construction%20management&
https://www.udemy.com/topic/construction/

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		
02	02	-	-	1	10	10	30	50

Prior Knowledge:

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

Course Objectives: This course aims at enabling students,

1. To discuss and demonstrate the principles of water treatment plant layout and working.
2. To inculcate and impart design principles and working of WTP components
3. To introduce students about the need of sanitation infrastructure, wastewater treatment, sludge management system and to identify wastewater as potential water source through recycle and resue.
4. 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. Design components of water treatment plant – aeration, sedimentation and estimating coagulant dose.
2. Design components of water treatment plant – flocculator, filtration, elevated service reservoir capacity.
3. Design preliminary and primary unit operations in waste water treatment plant.
4. Design suspended and attached growth wastewater treatment systems.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Principles of Water Treatment** Components and layouts. Design periods, Quantity: rate of water consumption for various purposes, Domestic water standards, fire demand, factors affecting rate of demand, population forecasting. Government of India initiatives. principles of water treatment unit operations and processes, Aeration: principle and concept, necessity, methods, design of aeration fountain. Sedimentation: plain and chemically 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. SDG6 Clean Water and Sanitation	07
2	**Design of Water Treatment Plant** Coagulation and flocculation: Principle of coagulation, design of flocculation chamber, design of clari-flocculator. Filtration: theory of filtration, mechanism of filtration, filter materials, types of filters and design of rapid sand gravity filters,membrane filtration . Disinfection: mechanism, 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. AI in water treatment plant	08
3	**Preliminary and Primary Wastewater Treatment** Collection and conveyance, quantitative estimation of wastewater, characteristics of wastewater, hydraulic design of circular sanitary sewer, Self-purification of natural streams, Wastewater recycle and reuse,sewage, emerging contaminants, screens: types, design of screens, disposal of screenings. Grit chamber: sources of grit, types, proportional flow weir, Parshall flume, design of grit chamber, skimming tanks, Equalization and neutralization tanks, types of settling, design of primary sedimentation tank.	07

4	**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. Concept of SBR & UASBR. 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). AI in a wastewater treatment plant	08
	Total	30

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, DhanpatRai 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).

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. Manual on Sewerage & Sewage Treatment published by Ministry of Urban Development, New Delhi, Third Edition, (1993).
4. Wastewater Treatment for Pollution Control and Reuse, Arceivala and Asolekar, McGraw Hill Education (India) Private Limited, 3rd Edition, (2017).
5. Standard Methods for examination of water and wastewater, Mary Franson, American Public Health Association IS Codes 01
6. 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:	Environmental Engineering Lab			Code:		BCI26PC19	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	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 wrt 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		
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. Basic concepts of various design philosophies.
2. IS code-based design method of RCC structures.
3. Design of columns & footing.
4. 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 slabs& staircase for different support conditions.
4. Analyze design column & Isolated footing for different loading condition

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.	8
2	**Design of Beam:** Design of simply supported, design of fixed beams, propped cantilever,cantilever beams for flexure (singly reinforced, doubly reinforced, and flanged), shear, bond, and torsion.	7
3	**Design of one-way Slab:** Design of one-way slab: simply supported, cantilever and continuous slabs by using IS Code coefficients. **Design of one-way Slab:** simply supported, continuous and restrained. **Design of staircase:** dog legged.	8
4	**Design of Column with footing:** Assumptions, minimum eccentricity, design of short column with footing for axial load, design of short column with footing subjected to combined axial load and uniaxial. Introduction to IS:13920 2016.	7
	Total	**30**

Self-directed learning-Design of Biaxial Column, Design of Biaxial Footing, Design of Continuous Beams.

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 Punmia, Jain and 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:	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 m2
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 Punmia, Jain and 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 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

https://nptel.ac.in/courses/105104161
https://onlinecourses.nptel.ac.in/noc23_ce62
https://archive.nptel.ac.in/courses/105/106/105106149/
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		
3	3	-	-	1	20	20	60	100

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 aware of various types of dams and objectives of dam instrumentation
2. To impart knowledge of stability analysis of various hydraulic structures
3. To make students aware of designing lined canal and related structures
4. To impart knowledge for learning characteristics of river training works

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

1. Classify dams and recognize to apply various instruments for Dam Safety
2. Analyze Stability of Concrete Gravity Dam
3. Classify Spillway, and Design the Ogee spillway with Energy Dissipaters
4. Analyze stability of Earthen Dam and Design the weir on permeable foundation
5. Design lined canals applying different theories
6. Identify the applications of appropriate Cross Drainage and River Training Works

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to dams and Dam Instrumentation :** 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, Displacement and rehabilitation, climate change impacts on dams, objectives of Dam instrumentation, Types of measurements, Instrumentation data system, Working principles of instruments, Selection of Equipments, Different Instruments.	7
2	**Gravity Dams :** Introduction, Components of gravity dam, Conditions favoring gravity dams, Forces acting on gravity dam, Combinations of loading for design, Seismic analysis of dam, Effect of horizontal earthquake acceleration, Effect of vertical earthquake acceleration, Stress analysis in gravity dam (Only concept, no derivations), Vertical or normal stress , Principal stresses, Shear stress (only Concept and equations), Middle third rule, Modes of failure of gravity dam, Elementary profile of gravity dam, Concept of low and high gravity dams, Various Design methods of gravity dam, Low-impact design to minimize environmental footprint and preserving natural habitats.	8
3	**Spillway:** Concept, classification of spillway, Components of spillway, design of ogee spillway, Shape of crest, Equations for spillway profile on upstream and downstream, energy dissipation below spillway, classification of energy dissipation devices, Correlation between jump height and tail water depth, spillway gates, classification of spillway crest gates, requirements of spillway gates maintenance of gates, inspection of gates.	7
4	**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, 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, structural stability analysis of homogeneous and zoned earthdam, Forces acting on earth dam, method of stability analysis of an earth dam, procedure of analysis by Swedish slip circle method, Fellenius method of locating centre of Critical Slip circle, Real-time seepage monitoring in earth dams using AI and IoT.	8

5	**Canal, Canal Structure:** Introduction, Classification of canals, components of canal , data required for canal design, Selection of canal alignment, canal Lining design of lined canal, canal falls: Introduction, necessity, selection of site for canal fall, types of falls, canal outlets- Introduction of canal outlet or module, canal escapes- Introduction of escapes, significance of canal escape, canal regulators.	7
6	**C.D. Works and River Training 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.	8
	Total	45

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,

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:	Dams and Hydraulic Structure Lab(PEC 2)			Code:		BCI26PE12	
	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
Credits	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		
3	3	-	-	1	20	20	60	100

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 build conceptual knowledge of the circular economy and sustainable material management.
3. To provide conceptual knowledge of the ISO framework of Life Cycle Assessment and LCA tools.
4. To impart knowledge on energy conservation, carbon footprints, and carbon credits.
5. To be aware of policies and clean development mechanisms for green energy.
6. 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. To design sustainable engineering solutions for waste management or circular economy.
3. Assess the life cycle assessment and associated tools for the sustainability approach.
4. Explain the methods and policies for energy conservation or resource recovery.
5. Identify the rules and regulations for clean energy production and its mechanism.
6. 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	**Circular Economy: Approaches /Technology Development:** Environmental design for sustainability, economics, environmental and social performance indicators, sustainable engineering design principles, sustainable material management, material flow analysis, circular Bio-Economy, biodegradable and reusable polymers, Circular economy of construction material (case study), Impact of circular economy adoption of global sustainability (case study)	8
3	**Life Cycle Assessment:** Life cycle analysis, methodology, ISO 14040:2006 for Life Cycle Assessment**,** benefits and drawbacks**,** life cycle inventory analysis (LCI) and impact assessment (LCIA), LCA tools (OpenLCA and The LCA Calculator), Case study on to illustrate the LCA procedure and results.	7
4	**Energy Conservation and Environment:** The significance of energy conservation and the environment, an overview of the global and Indian Energy scenarios, the environmental impact of energy conversion, its functions, policies, green energy, and sustainability, biofuels,and waste to energy systems (case study), **Carbon footprint & carbon credits**: introduction, carbon emission, carbon footprint and carbon trading (case study)	8
5	**Green solutions:** Importance, principles of cleaner production and its benefits, the role of industry, pollution prevention, and cleaner production awareness plan, waste audit, Government and institutes policies in cleaner production, clean development mechanisms, 5R: waste to wealth concept with a case study.	8

	Sustainable materials for reduction of carbon emission (case study), case studies on sustainable energies, green buildings, sustainable infrastructure, waste recycling and material conservation, sustainable environmental remediation).	
6	**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	**45**

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)			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.	Casestudy 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:

https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview
https://www.coursera.org/learn/global-sustainable-development
https://www.sciencedirect.com/journal/circular-economy-and-sustainability
https://www.openlca.org/
https://www.iso.org/standard/37456.html
https://www3.epa.gov/carbon-footprint-calculator/
https://www.india.gov.in/spotlight/waste-wealth
https://www.unep.org/resources/report/environmental-impact-assessment-guidelines
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		
3	3	--	--	1	20	20	60	100

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
5. Optimize printing mechanism and nozzle performance
6. Identify defects in pre-post process of 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
5	**Equipment Mechanism** Process Equipment- Introduction- robotic arm-based printing and gantry systems, process parameters, nozzle performance and optimization like shape, diameter, process Design and optimization for synchronization in flow through nozzle.	08
6	**Pre-Post and Processing:** Requirement and Techniques, Support Removal, Finishing treatment, polishing, Challenges like problems of aggregate jamming in the nozzle, compacting obstacles, and the spacing limitations due to rebar and formwork installation. Cleaning of equipements, On-Site Assembly & Transport **Product Quality:** Inspection and testing, Defects and their causes	08
	Total	45

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 Applicationsby 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 byM. 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 Applicationsby 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 byM. 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		
3	3	-	-	1	20	20	60	100

Prior Knowledge:

1. Engineering Geology,
2. Structural Analysis.

Course Objectives: This course aims at enabling students,

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

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

1. Explain the basic concepts of earthquakes and seismicity.
2. Identify and quantify earthquake characteristics, such as magnitude, intensity, and ground motion.
3. Simplify structural systems and determine their dynamic properties.
4. Perform basic earthquake analysis using standard methods and Codal guidelines.
5. Interpret seismic analysis results for understanding structural behavior during earthquakes.
6. Correlate theoretical earthquake concepts with real-world seismic activities.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to Earthquakes:** Basics of earthquakes: plate tectonics, faulting, and earthquake waves.Indian Seismic Zones: seismic map of India and major fault systems.Overview of global seismic activity and its relevance to civil engineering.	7
2	**Earthquake Quantification:** Parameters of earthquakes: magnitude, intensity, and energy.Measurement techniques: basic concepts of accelerographs and accelograms.Introduction to seismic scales (Richter scale, Mercalli intensity scale).	8
3	**Ground Motion and its Characteristics:** Ground motion parameters: amplitude, frequency, and duration.Factors influencing ground motion: soil type, fault mechanism, and epicentral distance.Basic concepts of ground motion prediction equations (simplified approach).	7
4	**Dynamics of Structures under Earthquake Loading:** Dynamic properties of structures: mass, stiffness, and damping.Natural frequency and resonance: simple numerical problems.Single-degree-of-freedom (SDOF) systems: free and forced vibrations (basic concepts only).	8
5	**Seismic Analysis Methods:** Introduction to IS:1893.Equivalent static analysis: basic Codal provisions and simplified approach.Modal response spectrum analysis: fundamental concepts	**7**
6	**Interpretation of Seismic Analysis Results:** Seismic forces and their distribution in structures.Overview of response spectra and its interpretation.Case studies of basic seismic analysis for simple structural systems.Applications of AI in Seismic Design and Risk Mitigation	**8**
	Total	**45**

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)			Code:		BCI26PE18	
Credits	Teaching Scheme (Hrs./Week)			Evaluation Scheme and Marks			
	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		
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: 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.
5. Explain urban transport planning steps and basic demand modeling techniques.
6. Explain the role of ITS and AI in improving transportation.

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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.	7
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**).	7

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**)	8
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	45

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)			Code:		BCI26PE20	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	2	-	25	25	-	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*. 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. 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		
3	3	-	-	1	20	20	60	100

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 understand electromagnetic radiation interactions, remote sensing platforms, and sensor characteristics.
3. To develop skills in remote sensing data processing, analysis, and interpretation.
4. To gain proficiency in GIS concepts, spatial data models, and geospatial analysis.
5. To study satellite image processing, interpretation, and thematic map generation in GIS.
6. 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. Distinguish the working principles of various space-based positioning systems.
4. Analyze remote sensing data and apply image processing techniques for civil engineering applications.
5. Explain the fundamentals and interdisciplinary applications of remote sensing and GIS.
6. 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, SAR, LiDAR 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	**Digital Image Processing and Analysis:** Fundamentals of Digital Image Processing: Image Representation, Pixel-based Analysis Visual Image Interpretation, Spectral Signature Curve: Concept, Spectral Reflectance Characteristics of Different Land Covers (Water, Vegetation, Built-up, Soil), Digital Image Preprocessing: Radiometric & Geometric Corrections, Atmospheric Corrections, Image Registration and Georeferencing,Histogram Equalization, Noise Removal	8
4	**GPS and GNSS:** Introduction to Global Navigation Satellite Systems (GNSS), Overview, Working Principles, and Evolution, Types of GNSS and Major Satellite Constellations, Global Systems, Indian Regional Navigation Satellite System (IRNSS/NavIC), Architecture, Features, and Applications, GPS Components, Differential GPS (DGPS) and Real-Time Kinematic (RTK) GPS, Types of GPS Tracking, Applications of GNSS in Engineering and Geospatial Sciences	7

5	**Fundamentals of GIS:** Geographic information system, definition, spatial and non-spatial data, data inputs, data storage andretrieval, 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 ofRS and GIS in civil engineering, hydrogeology, engineering geology, surveying and mapping.	8
6	**GIS Data 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 sensingdata in GIS, GIS database and database management system. Case studies:	7
	Total	45

Self-directed learning-Explore QGIS and SNAP 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 (Random Forest, SVM, Deep Learning) 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)			Code:		BCI26PE32	
	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
Credits	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	15	-	50	-	-	50

Prior Knowledge:

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 8):

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		
3	3	-	-	1	20	20	60	100

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 generation for a smart city.
2. To suggest the methods for the solid waste management with respect to collection, transportation, segregation of MSW.
3. To design the sanitary landfill for a smart city.
4. To compare and select the appropriate waste to energy technologies for a smart city.
5. To suggest relevant method for management of e-waste, biomedical waste and hazardous waste
6. To suggest relevant method for management of construction and demolition waste management in a smart city.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to Smart Cities and Solid Waste Management** Introduction to Smart Cities: smart city concepts, components of smart cities, sources of solid waste generation in smart city. Solid Waste Management (SWM): Definition, objectives of SWM, impacts of improper SWM: sources and types of solid waste in smart cities, Introduction to municipal solid waste (MSW): waste generation trends of MSW, factors affecting the generation rate, estimation of the quantity of solid waste, challenges in SWM in smart cities, role of urban and local bodies in SWM, sustainable solid waste management perspective	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 of MSW, 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** Composting: Theory, types of composting (home composting, vermicomposting, rotary drum, organic waste composter) Methods: Indore method, Bangalore Method, Mechanical composting, governing factors in composting, design of composting system. Inclusion of smart technologies in composting. Landfill: Introduction, components, site selection, construction, maintenance, precaution, leachate and landfill gas management, treatment and use. Sanitary landfill: Concept, design considerations, slope stability analysis. Bioreactor Landfill: Concept, applications. Role of Landfill in SWM of smart cities. Inclusion of smart technologies in efficient O & M. Case studies of landfill.	8

4	**Waste to Energy** Waste to Energy: Bio-methanation: Anaerobic digestion, factors affecting it and design of anerobicdigestor. Energy content of MSW, Estimation of LHV and HHV, incineration, types of incinerators, pyrolysis, Refuse derived fuel (RDF), plasma gasification, advantages and limitations of various W2E technologies. Role of W2E technologies in SWM of smart cities. Case Studies.	8
5	**E-waste, Biomedical Waste and Hazardous Waste Management** 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	7
6	**Construction and Demolition Waste and LCA Approach** 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. Introduction of Life Cycle Assessment (LCA)approach in solid waste management	7
	Total	**45**

Self-Directed Learning: Composition of Municipal Solid Waste and Its trends around the globe, Efficient ways of segregation at the source and its best examples, Computation of greenhouse gas emission from open landfill, Study of pelletization of waste for generation of energy, Nuclear waste management along with case study, Comparison of LCA of conventional aggregates and recycled aggregates

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)			Code:		BCI26PE34	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	TW	OR	PR	Total
1	-	2	-	50			

Prior Knowledge:

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.

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		
3	3	-	-	1	20	20	60	100

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 provide students with an understanding of construction equipment types, applications, economics, and maintenance strategies.
3. To introduce financial management concepts, including sources of finance, working capital, taxation, and regulatory bodies in construction.
4. To teach students working capital management, capital budgeting, and taxation in construction projects for effective financial decision-making.

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
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	**Construction Equipments :**Earthmoving equipment, compaction equipment, Drilling and Blasting equipment, tunneling equipment‘s, equipment for dewatering and Grouting, Pile Driving Equipment, Material handling equipment.	8
3	**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	7
4	**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.	8
5	**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	7

6	**Capital Budgeting:**Types of budgets, Rule of 72, process of capital budgeting, techniques of capital budgeting, economic decision making in construction project, impact of depreciation in economic decision making. **Taxation :**Introduction to direct and indirect tax, GST, impact of GST on construction industry, tax exemption for contractors, property tax: types, methods of calculation & numerical on computation of property tax, tax deductions against income from property, corporate tax planning, discuss case study	8
	Total	45

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 HardikBavishi, S. Chand Publication
6. Indian Economy, GauravDatt and AshwaniMahajan, 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:	Prestressed Concrete Structures (PEC 3)				Code:			BCI26PE37
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. Strength of Materials

Course Objectives:

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

1. Concept of Prestressed concrete structures
2. Design of post tensioned flexural elements.
3. Design of post tensioned flat slab.
4. Maintenance and rehabilitation of Prestressed concrete structures

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

1. Apply theory of losses in pre-stressed concrete sections.
2. Apply the principles of pre-stressed concrete for analysis of pre-stressed concrete sections.
3. Design Prestressed concrete sections with design of end block.
4. Design one way and two way post tensioned slab.
5. Design of post tensioned flat slab
6. Describe methodology of carrying out maintenance and rehabilitation of Prestressed concrete structures.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to pre-stressed concrete**: Prestressed concrete structures; theory of prestressing, methods and techniques of pre-stressing, pre-stressing systems, High-strength materials and requirements; properties and current uses, Prestresse losses: long-term and short-term, Introduction to IS 1343.	7
2	**Analysis of Flexural Members**: 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.	8
3	**Design of post tensioned beam**: Design of Prestressed 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.	9
4	**Design of post tensioned slab**: Design one way post tensioned slab and two way post tensioned slab (Single panel only).	7
5	**Design of post tensioned flat slab**: Introduction to flat slab, IS 456 codal provisions for flat slab. Design of Prestressed two way flat slab by direct design method.	8
6	**Maintenance and rehabilitation of pre-stressed concrete structures:** Maintenance methodology, Inspection of Structures, Cracks in Prestressed concrete members remedy and repairs, Repairs of girders damaged by collision. Case studies of repair and rehabilitation of structures. Use of AI in Maintenance and rehabilitation of Prestressed concrete bridges.	6
	Total	45

Self-directed learning - Applications of prestressed concrete, Real-life failure case studies due to improper shear or anchorage, Deflection and Crack Control in Post-Tensioned beam, Comparison of post-tensioned slabs with conventional reinforced concrete slabs, case studies and software tools for flat slab design, 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. Prestressed 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)			Code:		BCI26PE38	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	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 prestressed concrete structural members both at service loads and overloads
2. To embed fundamentals of prestressed concrete design and detailing.

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

1 Determine stresses and losses in Prestressed concrete beams.
2. Design and carryout detailing of prestressed concrete elements.

Detailed Syllabus

Term work consists of

A. Compulsory assignment /design

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

Codes:

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:	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		
3	3	-	-	1	20	20	60	100

Prior Knowledge:

1. Engineering Geology (Subsurface Investigation)
2. Geotechnical Engineering (Index and Engineering Properties of soil)
3. Foundation Engineering (Basic Concepts)
4. Advanced Geotechnical Engineering (Index and Engineering Properties of soil)

Course Objectives: This course aims at enabling students,

1. To impart the knowledge of design of different foundations.
2. To get acquainted with different types of foundations.
3. To make aware of ground improvement techniques, geosynthetic materials.

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

1. Apply design principles for raft foundations considering bearing capacity.
2. Explain the design and construction of piers, caissons, well, and offshore foundations.
3. **Classify** machine foundation types, dynamic response, and design criteria.
4. Understand Soil-Structure Interaction and its influence on foundation behavior.
5. Explain various ground improvement techniques and their applications
6. Apply 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.	7
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.	8
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.	7
4	**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, Interface behavior between soil and foundation, SSI effects in isolated, strip, and raft foundations, Effect of dynamic loads (earthquake, machine vibrations) on SSI**.**	8
5	**Ground Improvement:** In-situ ground improvement by compaction piles, soil nailing, sand drains, grouting, deep mixing, inserting reinforcement elements, freezing soil, and vibroflotation, stone columns, prefabricated vertical drains, Preloading techniques.	8
6	**Geosynthetics:** Introduction to Geosynthetics, Types Properties and Testing, Functions and Applications, Geosynthetics in Reinforced Soil Structures, Geosynthetics in Ground Improvement, Geosynthetics in Environmental and Hydraulic Applications, Case studies on successful geosynthetic applications.	7
	Total	45

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. 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 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)			Code:		BCI26PE40	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	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	
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	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.**
   Autodesk Revit Architecture 2024 Basics: From the Ground Up**, Elise Moss, Sybex, 2023.**
4. Limit State Design of Steel Structures by Dr. Ramchandra&VirendraGehlot, Standard Publishers; Delhi.
5. Limit State Design of Steel Structures by S. K. Duggal
6. Design of Steel Structures‖, Tata McGraw Hill India by B.S.Negi
7. Wastewater Engineering by Metcalf & Eddy
8. Hydraulics of Sewer Systems by L. W. Mays
9. Water Supply Engineering by B.C. Punmia / S.K. Garg / Duggal
10. Analysis of water distribution networks by P. R. Bhave and R. Gupta
11. Optimal design of water distribution networks by P. R. Bhave

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https://revittutorials.info/
https://www.autodesk.com/learn
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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.