

Zeal Education Society's

ZEAL COLLEGE OF ENGINEERING & RESEARCH, PUNE-41

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

NBA Accredited, NAAC Accredited with A+ Grade, ISO21001:2018



DEPARTMENT OF CIVIL ENGINEERING

Curriculum Structure and Syllabus of

T.Y. B. Tech. – Civil Engineering

(With effect from – Academic Year 2026-27)
(2024 Pattern)

VISION OF THE INSTITUTE

To be a premier institute in technical education by imparting academic excellence, research, social and entrepreneurial attitude.

MISSION OF THE INSTITUTE

- To achieve academic excellence through innovative teaching and learning process.
 - To imbibe the research culture for addressing industry and societal needs.
 - To inculcate social attitude through community engagement initiatives.
 - To provide conducive environment for building the entrepreneurial skills.

DEPARTMENT OF CIVIL ENGINEERING

VISION:

To contribute to the field of Civil Engineering by focusing state of the art technical knowledge, promoting research, nurturing social responsibility and imparting entrepreneurial attitude.

MISSION:

- M1:** To strengthen academics with holistic teaching learning practices.
- M2:** To inculcate a research approach pertaining to the civil engineering domain.
- M3:** To foster students for the development of entrepreneurial skills.
- M4:** To nurture the sense of ethics, morality and social responsibility.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

- PEO1:** Graduates will be proficient in critical thinking and problem solving based on a broad range of civil engineering technical areas.
- PEO2:** Graduates will be good decision makers with a blend of ethical, global, regional and local concerns, effective communication and leadership.
- PEO3:** Graduates will be able to contribute to society by civic engagement.
- PEO4:** Graduates will attain the pursuit of professional development and ever learning.

PROGRAM OUT COMES (POs):

- PO1: Engineering knowledge:** Apply the knowledge of mathematics, natural science, computing, and engineering fundamentals and an engineering specialisation to the solution of complex engineering problems.
- PO2: Problem analysis:** Identify, formulate, and analyze complex engineering problems, reaching substantiated conclusions with consideration for the holistic nature of the problem.
- PO3: Design /development of solutions:** Design creative solutions for complex engineering problems and design systems, components, or processes to meet identified needs — with consideration for public health and safety, and cultural, societal, and environmental factors. Sustainability is now intrinsic to design.
- PO4: Conduct investigations of complex problems:** Conduct investigations of complex engineering problems using research-based knowledge and research methods, including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
- PO5: Engineering tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling — recognising their limitations — to solve complex engineering problems.

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- PO6: The engineer and the world:** Analyse and evaluate societal and environmental aspects while solving complex engineering problems, considering their impact on sustainability with reference to economy, health, safety, legal frameworks, culture, and the environment.
- PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity, and inclusion; and adhere to relevant national and international laws
- PO8: Individual and team work:** Function effectively as an individual, and as a member or leader in diverse and multi-disciplinary teams.
- PO9: Communication:** Communicate effectively and inclusively within the engineering community and with society at large — comprehending and writing effective reports and design documentation, and making effective presentations — considering cultural, language, and learning differences.
- PO10: Project management and finance:** Apply knowledge and understanding of engineering management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects in multi-disciplinary environments.
- PO11: Life-long learning:** Recognise the need for, and have the preparation and ability for, independent and life-long learning, adaptability to new and emerging technologies, and critical thinking in the broadest context of technological change.

PROGRAM SPECIFIC OUT COMES (PSOs):

- PSO1:** Graduates will be able to develop the professional skills for analyzing and designing of structural, geotechnical, transportation, environmental, irrigation and hydraulic systems to cater societal and / or industrial needs.
- PSO2:** Graduates will be able to apply the knowledge pertaining to surveying, construction and / or management, town planning, estimation, valuation and soft computing tools to solve real time problems related to civil engineering.

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LIST OF ABBREVIATIONS

Abbreviation	Description
BSC	Basic Science Course
ESC	Engineering Science Course
PCC	Program Core Course
PEC	Program Elective Course
MDM	Multidisciplinary Minor
OE	Open Elective-Other than a particular program
VSEC	Vocational and Skill Enhancement Course
AEC	Ability Enhancement Course
ENTR	Entrepreneurship
EC	Economics
MC	Management Courses
IKS	Indian Knowledge System
VEC	Value Education Courses
RM	Research Methodology
CEP	Community Engagement Project
FP	Field Project
PROJ	Project
INT	Internship
OJT	On Job Training
CC	Co-curricular Courses
HSSM	Humanities Social Science and Management
ELC	Experiential Learning Course
B. Tech.	Bachelor of Technology
L	Lecture
P	Practical
T	Tutorial
H	Hours
CR	Credits
CIE	Continuous Internal Evaluation
ETE	End Term Evaluation
TW	Term Work
OR	Oral
PR	Project



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Third Year B. Tech. – Civil Engineering: Semester- V

Course Code	Course Type	Course Name	Teaching Scheme (hrs/Week)							Evaluation Scheme					
			L	P	T	H	CR			CIE	ETE	TW	PR	OR	Total
							TH	PR/Tut	Total						
CEPC507	PCC	Highway Engineering	3	-	-	3	3	-	3	40	60	-	-	-	100
CEPC507P	PCC	Highway Engineering Lab	-	2	-	2	-	1	1	-	-	-	-	50	50
CEPC508	PCC	Water Supply Technology	3	-	-	3	3	-	3	40	60	-	-	-	100
CEPC508P	PCC	Water Supply Technology Lab	-	2	-	2	-	1	1	-	-	-	-	50	50
CEPC509	PCC	Reinforced Concrete Structural Design	3	-	-	3	3	-	3	40	60	-	-	-	100
CEPC509P	PCC	Reinforced Concrete Structural Design Lab	-	2	-	2	-	1	1	-	-	-	-	50	50
CEPE501	PEC	Program Elective Course - I *	4	-	-	4	4	-	4	40	60	-	-	-	100
CEMD503	MDM	Introduction to Python Programming	-	4	-	4	-	2	2	-	-	25	-	-	25
ALOE503	OE	Open Elective – III#	2	-	-	2	2	-	2			50	-	50	100
CEIN504	ELC - INT	Internship - III*	4 Weeks				-	2	2	-	-	25	-	-	25
Total			15	10	-	25	15	7	22	160	240	100	-	200	700

BoS Chairman



Director

ZES's Zeal College of
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Narhe, Pune - 411041.



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DEPARTMENT OF CIVIL ENGINEERING

Third Year B. Tech. – Civil Engineering: Semester- V

*** - Select any one course from the given Program Elective Courses**

Course Code	Course Type	Program Elective-I
CEPE501A	PEC	Construction Economics and Financial Management
CEPE501B	PEC	Air and noise Pollution Control
CEPE501C	PEC	Airport, Railway and Metro Infrastructure

- Select any one course from the given Open Elective Courses

Course Code	Course Type	Open Elective - III
25ALOE503A	OEC	Introduction to Data Analytics
25ALOE503B		Green Building
25ALOE503C		Future of Transportation
25ALOE503D		Introduction to Stock Market
25ALOE503E		Patent Law for Engineers and Scientist

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DEPARTMENT OF CIVIL ENGINEERING

Third Year B. Tech. – Civil Engineering: Semester - VI

Course Code	Course Type	Course Name	Teaching Scheme (hrs/Week)							Evaluation Scheme					
			L	P	T	H	CR			CIE	ETE	TW	PR	OR	Total
							TH	PR/Tut	Total						
CEPC610	PCC	Structural Steel Design	3	-	-	3	3	-	3	40	60	-	-	-	100
CEPC610P	PCC	Structural Steel Design Lab	-	2	-	2	-	1	1	-	-	-	-	50	50
CEPC611	PCC	Quantity Surveying and Contract Management	3	-	-	3	3	-	3	40	60	-	-	-	100
CEPC611P	PCC	Quantity Surveying and Contract Management Lab	-	2	-	2	-	1	1	-	-	-	-	50	50
CEPE602	PEC	Program Elective Course - II *	3	-	-	3	3	-	3	40	60	-	-	-	100
CEPE603	PEC	Program Elective Course - III *	4	-	-	4	4	-	4	40	60	-	-	-	100
CEMD604	MDM	Smart Cities and Technologies	3	-	-	3	3	-	3	40	60	-	-	-	100
CEVS605	VSEC	Building Information modeling using Revit Architecture	-	4	-	4	-	2	2	-	-	25	50	-	75
CEIN605	ELC - INT	Internship - IV*	4 Weeks				-	2	2	-	-	25	-	-	25
Total			16	8	-	24	16	6	22	200	300	25	25	150	700



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Third Year B. Tech. – Civil Engineering: Semester - VI

*** - Select any one course from the given Program Elective Courses**

Course Code	Course Type	Program Elective-II
CEPE602A	PEC	Integrated Water Resource Management
CEPE602B	PEC	Off-Site Construction Technologies
CEPE602C	PEC	Bridge Engineering

Course Code	Course Type	Program Elective-III
CEPE603A	PEC	Structural Evaluation and Rehabilitation
CEPE603B	PEC	Geomatics Engineering
CEPE603C	PEC	Design of Prestressed Concrete Structures

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DEPARTMENT OF CIVIL ENGINEERING

INDEX

Sr. No.	Course Code	Course Name	Page No.
Third Year B. Tech.: Semester V			
1.	CEPC507	Highway Engineering	1
2.	CEPC507P	Highway Engineering Lab	4
3.	CEPC508	Water Supply Technology	6
4.	CEPC508P	Water Supply Technology Lab	8
5.	CEPC509	Reinforced Concrete Structural Design	10
6.	CEPC509P	Reinforced Concrete Structural Design Lab	12
7.	CEPE501	Program Elective Course - I *	14
8.	CEMD503	Introduction to Python Programming	21
9.	ALOE503	Open Elective - III #	23
10.	CEIN504	Internship - III*	38
Third Year B. Tech.: Semester VI			
11.	CEPC610	Structural Steel Design	41
12.	CEPC610P	Structural Steel Design Lab	44
13.	CEPC611	Quantity Surveying and Contract Management	47
14.	CEPC611	Quantity Surveying and Contract Management Lab	49
15.	CEPE602	Program Elective Course - II *	51
16.	CEPE603	Program Elective Course - III *	59
17.	CEMD604	Smart Cities and Technologies	65
18.	CEVS605	Building Information modeling using Revit Architecture	67
19.	CEIN605	Internship - IV*	69



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DEPARTMENT OF CIVIL ENGINEERING

SYLLABUS
SEMESTER- V

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Program: B. Tech (Civil Engineering)							Semester: V		
Course: Highway Engineering							Code: CEPC507		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-		100
Prerequisites:									
Construction materials relevant to transportation infrastructure, principles and practices of Surveying									
Course Objectives:									
1. To develop students' fundamental knowledge of highway planning, traffic engineering, and geometric design principles. 2. To impart students knowledge of highway materials, pavement design, and IRC standards used in road construction.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Assess highway development plans and determine appropriate road network planning approaches.								
CO2	Analyze traffic engineering studies for effective transportation planning and management.								
CO3	Apply IRC standards to design highway geometric elements.								
CO4	Recommend suitable highway materials and bituminous mix designs for durable pavement performance.								
CO5	Select suitable pavement design methods by evaluating subgrade conditions, material properties, and loading requirements.								
CO6	Evaluate pavement performance and recommend suitable maintenance and rehabilitation techniques.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Road Network Planning and Highway Development Evolution and development of road transportation systems, highway development plans in India, Vision 2030 & Rural Road Development Vision 2030; highway development plans in India; Highway alignment and highway project report preparation								07
2.	Traffic Engineering and Traffic Studies Traffic characteristics and road user characteristics ,Traffic volume studies, Speed studies ,Origin-Destination studies ,Parking studies, accident studies, Traffic control devices								06
3.	Highway Geometric Design Objectives and importance of geometric design, Cross-Sectiona Elements: Right of way, carriageway width, lane width, shoulders, camber, median, kerbs, road margins, side slopes and formation width, Sight Distance, Horizontal Alignment: Design of horizontal curves, radius of curve, super elevation, Vertical Alignment: Types of gradients, Highway Drainage								08
4.	Materials for Highway Engineering Properties and testing of highway construction materials including subgrade soil, aggregates, and bituminous binders. Viscosity grading of bitumen, modified bituminous materials, bituminous paving mixes, and Marshall Stability Mix								06

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	Design.	
5.	Pavement Design Properties and testing of soil, aggregates and bituminous materials, Subgrade characteristics and CBR concept, Types of pavements: flexible and rigid pavements, Design guidelines for flexible pavements as per IRC 37-2018 (steps only); Rigid pavements: components and functions, factors affecting design; Stresses in rigid pavements (ESWL); Design guidelines for concrete, pavements as per IRC 58-2015 (steps only).	06
6.	Highway Maintenance, Evaluation and Management Causes of pavement failures, Maintenance of flexible and rigid pavements, Pavement evaluation techniques, Overlay design and rehabilitation methods, Economic analysis of highway projects.	06
TOTAL		39
Text Books:		
1. Highway Engineering, S. K. Khanna, C. E. G. Justo & A. Veeraragavan, Nem Chand & Bros., 10th Edition (2018). 2. Principles and Practice of Highway Engineering, L. R. Kadiyali, Khanna Publishers, New Delhi. 3. Traffic Engineering, Roger P. Roess, Elena S. Prassas & William R. McShane, Pearson, 5 th Edition (2019). 4. Highway Engineering, Paul H. Wright & Karen Dixon, John Wiley & Sons. 5. Principles of Highway Engineering and Traffic Analysis, Fred L. Mannering & Scott S. Washburn, John Wiley & Sons.		
Reference Books:		
1. Highway Engineering, S. C. Rangwala, Charotar Publishing House. 2. Principles of Transportation Engineering, Partha Chakraborty & Animesh Das, PHI Learning Pvt. Ltd. 3. A Course in Highway Engineering, S. P. Bindra, Dhanpat Rai & Sons. 4. The Highway Engineering Handbook, T. F. Fwa, CRC Press. 5. Traffic Engineering, Louis J. Pignataro, Prentice Hall.		
Indian Standards and Handbooks:		
1. I.S. 1201 to 1220-1978: Methods for Testing Tar and Bitumen 2. I.S. 73 (2013): Paving Bitumen (Specification) 3. I.S. 2386 Part I to V: Methods of Tests for Aggregates 4. Specifications for Road and Bridge Works (MoRTH) 5th Revision, New Delhi 5. I.R.C. 58- 2015: Tentative Guidelines for the Design of Rigid Pavements 6. IRC 37-2018: Guidelines for the Design of Flexible Pavements		

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E-Resources:

1. CSIR–Central Road Research Institute (CRRI)
<https://crridom.gov.in/en/open-access-e-resources>
2. Ministry of Road Transport & Highways (MoRTH)
<https://morth.gov.in>
3. Indian Roads Congress (IRC)
<https://www.irc.nic.in>
4. NPTEL Videos - Geometric Design of Highways
<https://nptel.ac.in/courses/105107220/>
5. NPTEL Videos -Pavement Materials
<https://nptel.ac.in/courses/105107219>
6. NPTEL Videos - Transportation Engineering
<https://nptel.ac.in/courses/105105107>
7. NPTEL Videos - Traffic Engineering
<https://nptel.ac.in/courses/105105215>

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: V		
Course: Highway Engineering Lab							Code: CEPC507P		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
-	02	-	01	-	-	-	50	-	50
Prerequisites:									
Construction materials relevant to transportation infrastructure, principles and practices of Surveying									
Course Objectives:									
1. To develop students' ability to select and perform appropriate laboratory tests for determining the engineering properties and suitability of aggregates used in highway construction. 2. To equip students with the knowledge and skills required to evaluate the physical properties and performance characteristics of bitumen and bituminous mixes through standard laboratory tests.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Select appropriate laboratory tests and interpret test results to assess the strength, durability, shape, specific gravity, water absorption, and other engineering properties of aggregates used in highway construction.								
CO2	Evaluate the physical properties and performance of bituminous materials and mixes using appropriate tests, including penetration, ductility, softening point, flash and fire point, specific gravity, extraction, and Marshall Stability tests.								
CO3	Recommend suitable highway construction materials and assess road construction, RAP, or hot-mix plant practices through technical site visits and preparation of technical reports.								
List of Experiments:									
A. Lab Experiments:									
I. Tests on Aggregate (Any Five):									
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 (Any Five):									
1. 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. Marshall Stability Test(Aggregate bitumen combined)									
B. Technical site visits to (Any One)									
I. Road Construction and/or RAP Site									
II. Hot mix Plant with detailed report									

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Reference Books:

1. Highway Engineering, S. C. Rangwala, Charotar Publishing House.
2. Principles of Transportation Engineering, Partha Chakraborty & Animesh Das, PHI Learning Pvt. Ltd.
3. A Course in Highway Engineering, S. P. Bindra, Dhanpat Rai & Sons.
4. The Highway Engineering Handbook, T. F. Fwa, CRC Press.
5. Traffic Engineering, Louis J. Pignataro, Prentice Hall.

Indian Standards and Handbooks:

1. I.S. 1201 to 1220-1978: Methods for Testing Tar and Bitumen
2. I.S. 73 (2013): Paving Bitumen (Specification)
3. I.S. 2386 Part I to V: Methods of Tests for Aggregates
4. Specifications for Road and Bridge Works (MoRTH) 5th Revision, New Delhi
5. I.R.C. 58- 2015: Tentative Guidelines for the Design of Rigid Pavements
6. IRC 37-2018: Guidelines for the Design of Flexible Pavements

E-Resources:

1. CSIR–Central Road Research Institute (CRRRI)
<https://crridom.gov.in/en/open-access-e-resources>
2. Ministry of Road Transport & Highways (MoRTH)
<https://morth.gov.in>
3. Indian Roads Congress (IRC)
<https://www.irc.nic.in>
4. NPTEL Videos - Geometric Design of Highways
<https://nptel.ac.in/courses/105107220/>
5. NPTEL Videos -Pavement Materials
<https://nptel.ac.in/courses/105107219>
6. NPTEL Videos - Transportation Engineering
<https://nptel.ac.in/courses/105105107>
7. NPTEL Videos - Traffic Engineering
<https://nptel.ac.in/courses/105105215>

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Program: B. Tech (Civil Engineering)							Semester: V		
Course: Water Supply Technology							Code: CEPC508		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
Fundamentals of Environmental Studies, Engineering Chemistry									
Course Objectives:									
1. To equip students with the principles of urban water supply planning, demand forecasting, and design of water infrastructure systems.									
2. To develop competency in water treatment, distribution network management, and application of advanced technologies for water quality monitoring and loss reduction.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Recommend suitable design capacities and planning strategies for urban water infrastructure based on demand forecasting.								
CO2	Evaluate drinking water quality and treatment alternatives for effective water purification and public health protection.								
CO3	Recommend appropriate filtration and disinfection processes to produce potable water in accordance with quality standards.								
CO4	Assess the suitability of advanced water treatment methods, including membrane processes and desalination, for diverse water treatment applications.								
CO5	Optimize water distribution network configurations and storage facilities for sustainable water supply management.								
CO6	Propose appropriate leak detection, localization, and control techniques based on water distribution system conditions								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Urban Water Infrastructure and Demand Estimation Introduction to water supply scheme: importance of water infra-structure in India, Government of India initiatives - SMART city, AMRUT, Jal Jeevan Mission Quantity: demand and supply, population forecasting, design period, design capacities, demand forecasting								07
2.	Water Quality and treatment operations and processes Physical, chemical, biological analysis, Drinking water quality standards Treatment Operations and Processes Screening and Aeration Coagulation & Flocculation: Clari flocculator and tube settler Sedimentation								07
3.	Filtration and Disinfection Filtration- Mechanism, head loss, Slow sand, Rapid sand, Multimedia & Pressure filters. Disinfection- Mechanism, methods, chlorination, Forms and types of chlorination.								07

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4.	Advanced Water Treatment Methods Fluoridation, defluorination, desalination, softening, oxidation and membrane processes, applications of IoT, SCADA	06
5.	Water Distribution System System of water supply: continuous and intermittent system, distribution system, networks, storage and service reservoirs.	06
6.	Water Losses and Leak Analysis Water Losses: Sources, audit, audit components performance indicators Leak Analysis: detection, quantification, localization, control measures, rain water harvesting.	06
TOTAL		39
Text Books:		
1. Water Supply Engineering, S. K. Garg, Khanna Publishers, New Delhi. 2. Water Supply and Sanitary Engineering, G. S. Birdie and J. S. Birdie, Dhanpat Rai Publishing Company, New Delhi. 9 3. Water Supply Engineering, B. C. Punmia, Ashok Jain and Arun Jain. Laxmi Publications (P) Ltd.		
Reference Books:		
1. Environmental Engineering, Peavy and Rowe, McGraw Hill Publications. 2. Optimal Design of Water Distribution Networks, P. R. Bhawe, Narosa Publishing House. 3. Rain Water Harvesting: Making Water Every Body's business, Centre for Science and Environment. 4. Environmental Remote Sensing from Regional to Global Scales, Ed. Giles Foody, Wiley 5. Water Supply Engineering, Harold Eaton Babbitt & James Joseph Doland, Tata McGraw Hill. 6. Environmental Engineering Laboratory Manual, B. Kotain and Dr. N. Kumar Swamy, NEERI, Nagpur		
E-Resources:		
1. NPTEL Water Supply Engineering http://nptel.ac.in/courses/105105201 2. NPTEL Design Considerations of Roof Top Rain Water Harvesting https://youtu.be/QewEi2U1jLs?si=wjmaxTVgvevCuP8M 3. NPTEL Water Distribution Network https://youtu.be/5NzMt6PErYo?si=-wksG28wkXV6vsrD 4. CPHEEO Manual on Water Supply and Treatment http://cpheeo.gov.in/cms/manual-on-water-supply-and-treatment.php 5. 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		

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: V		
Course: Water Supply Technology Lab							Code: CEPC508P		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
-	02	-	01	-	-	-	50	-	50
Prerequisites:									
Fundamentals of Environmental Studies, Engineering Chemistry									
Course Objectives:									

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E-Resources:

1. NPTEL Water Supply Engineering
<http://nptel.ac.in/courses/105105201>
2. NPTEL Design Considerations of Roof Top Rain Water Harvesting
<https://youtu.be/QewEi2U1jLs?si=wjmaxTVgvevCuP8M>
3. NPTEL Water Distribution Network
<https://youtu.be/5NzMt6PErYo?si=-wksG28wkXV6vsrD>
4. CPHEEO Manual on Water Supply and Treatment
<http://cpheeo.gov.in/cms/manual-on-water-supply-and-treatment.php>
5. 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>

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Program: B. Tech (Civil Engineering)							Semester: V		
Course: Reinforced Concrete Structural Design							Code: CEPC509		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
Fundamentals of Concrete Technology, Engineering Mechanics, Mechanics of Materials and Structural Analysis									
Course Objectives:									
1. To impart knowledge of the principles and practices of reinforced concrete design, detailing, and construction in accordance with relevant Indian Standards.									
2. To develop students competency in designing and detailing reinforced concrete structural elements for safe and durable structures.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Apply limit state design principles and BIS codes for reinforced concrete structures.								
CO2	Design and detailing of reinforced concrete slab.								
CO3	Design reinforced concrete beams considering strength, serviceability, and detailing requirements.								
CO4	Design and detailing of reinforced concrete staircase.								
CO5	Design reinforced concrete columns with ductile detailing for earthquake resistance.								
CO6	Design reinforced concrete footing systems based on structural loading and soil conditions.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Fundamentals of RC Design and Professional Practice Limit State Design Philosophy, Material behavior of Concrete and Steel, Loading standards (IS 875), Design workflow in consultancy firms, Structural drawing interpretation, Introduction to BBS, Common site execution issues								06
2.	Design and Detailing of Slabs One-way slab, Two-way slab, Cantilever slab, Continuous slab, Reinforcement detailing, Development length requirements								07
3.	Design and Construction of Beams Singly reinforced beams, Doubly reinforced beams, T-beams, Continuous beams								06
4.	Design and Construction of Staircases Dog-legged staircase, Open-well staircase								06
5.	Design of Columns and Earthquake Resistant Detailing Short columns, Axially loaded columns, Columns with eccentric loading, Introduction to ductile detailing, IS 13920 provisions, Beam-column joint detailing								07
6.	Design of Foundations Isolated footing, Combined footing, Strap footing, Raft foundation (concept), Foundation layout preparation								07
TOTAL								39	

DEPARTMENT OF CIVIL ENGINEERING

IS Codes:

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

Text Books:

1. Illustrated Reinforced Concrete Design, V. L. Shah & S. R. Karve, Structures Publications, Pune
2. Design of Reinforced Concrete Structures, N. Subramanian, Oxford University Press
3. Reinforced Concrete Design, P. C. Varghese, PHI Learning Pvt. Ltd., New Delhi
4. Reinforced Concrete Design, S. U. Pillai & Devdas Menon, Tata McGraw-Hill Education, New Delhi

Reference Books:

1. Illustrated Design of Reinforced Concrete Buildings (G+3), V. L. Shah & S. R. Karve, Structures Publications, Pune
2. Comprehensive Design of R.C. Structures, B. C. Punmia, Ashok Kumar Jain & Arun Kumar Jain, Standard Book House, New Delhi
3. RCC Analysis and Design, S. Sinha, S. Chand & Company Ltd., New Delhi
4. Design of Prestressed Concrete Structures, T. Y. Lin, John Wiley & Sons
5. Design of Concrete Structures, J. N. Bandyopadhyay, PHI Learning Pvt. Ltd., New Delhi

E-Resources:

1. Design of Reinforced Concrete Structures (IIT Kharagpur) – Prof. Nirjhar Dhang
<https://nptel.ac.in/courses/105105105>
2. NPTEL Online Course (Preview) – Design of Reinforced Concrete Structures
https://onlinecourses.nptel.ac.in/noc25_ce123/preview
3. Reinforced Concrete Design (Advanced UG Course)
<https://nptel.ac.in/courses/105103824>
4. NPTEL YouTube Video Lectures – Design of Reinforced Concrete Structures
https://www.youtube.com/watch?v=pIdaC_I6H_M

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: V		
Course: Reinforced Concrete Structural Design Lab							Code: CEPC509P		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
-	02	-	01	-	-	-	50	-	50
Prerequisites:									
Fundamentals of Concrete Technology, Engineering Mechanics, Mechanics of Materials and Structural Analysis									
Course Objectives:									
1. To equip students with the principles and procedures for analysis, design, and detailing of reinforced concrete structural elements including slabs, beams, columns, footings, and staircases. 2. To develop competency in applying relevant IS codes and reinforcement detailing provisions for the safe and economical design of reinforced concrete buildings.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Analyze and design reinforced concrete slabs, beams, columns, footings, staircases, and other structural members of a G+2 building under appropriate loading conditions.								
CO2	Evaluate structural safety and detailing requirements by applying relevant IS codes, SP-34, and IS 13920, and justify suitable reinforcement arrangements.								
CO3	Develop complete structural drawings, schedules, design calculations, and project documentation using drafting software, spreadsheets, and suitable structural analysis and design tools.								
List of Experiments:									
1. 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. i. Minimum plan area of each floor shall be more than 150 m² ii. Design of plinth and ground beams: for each type two simply supported and two continuous. iii. Design of all slabs and beams of typical floor (first or second floor) iv. 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. v. Design of two footing: (a) axial load, (b) axial load plus uniaxial bending. vi. Design any one element by using spreadsheet or use of analysis and design by suitable software. vii. 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. viii. Detailing of reinforcement should be as per SP-34 & IS-13920. 2. Reports of site visit on Reinforced cement concrete building construction site.									

DEPARTMENT OF CIVIL ENGINEERING

IS Codes:

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

Reference Books:

1. Illustrated Design of Reinforced Concrete Buildings (G+3), V. L. Shah & S. R. Karve, Structures Publications, Pune
2. Comprehensive Design of R.C. Structures, B. C. Punmia, Ashok Kumar Jain & Arun Kumar Jain, Standard Book House, New Delhi
3. RCC Analysis and Design, S. Sinha, S. Chand & Company Ltd., New Delhi
4. Design of Prestressed Concrete Structures, T. Y. Lin, John Wiley & Sons
5. Design of Concrete Structures, J. N. Bandyopadhyay, PHI Learning Pvt. Ltd., New Delhi

E-Resources:

1. Design of Reinforced Concrete Structures (IIT Kharagpur) – Prof. Nirjhar Dhang
<https://nptel.ac.in/courses/105105105>
2. NPTEL Online Course (Preview) – Design of Reinforced Concrete Structures
https://onlinecourses.nptel.ac.in/noc25_ce123/preview
3. Reinforced Concrete Design (Advanced UG Course)
<https://nptel.ac.in/courses/105103824>
4. NPTEL YouTube Video Lectures – Design of Reinforced Concrete Structures
https://www.youtube.com/watch?v=pIdaC_I6H_M

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech. (Civil Engineering)						Semester: V			
Course: : Construction Economics & Financial Management						Code: CEPE501A			
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	PR	OR	Total
04	-	-	04	40	60	-	-	-	100
Prerequisites: Basic knowledge of management and economics.									
Course Objectives: 1. To equip students with the fundamentals of project economics, financial management, and economic evaluation techniques. 2. To prepare students to apply budgeting, taxation, and financial planning principles for effective construction project management.									
Course Outcomes: After the completion of course, students will be able to:									
CO1	Justify economic decisions by evaluating engineering and managerial economic principles.								
CO2	Analyze demand, supply, cost, and pricing relationships for engineering decision-making.								
CO3	Apply financial evaluation techniques to compare engineering investment alternatives.								
CO4	Analyze financial statements and sources of finance for project management decisions.								
CO5	Prepare project budgets and evaluate capital budgeting and depreciation for engineering projects.								
CO6	Apply taxation principles and financial regulations relevant to construction and infrastructure projects.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Project Economics: Definition, Principles, importance in construction industry, basic concepts of economics: Cost, efficiency and scarcity, Types of economics Difference between micro economics and macroeconomics. Application of Managerial economics								09
2.	Fundamentals of Economics and Market Analysis: Difference between Cost, Value, Price, Law of Diminishing Marginal Utility, Demand, Demand Schedule, Law of Demand, Demand Curve, Elasticity of Demand, Supply, Supply Schedule, Supply Curve, Elasticity of Supply.								09
3.	Cost Analysis and Financial Evaluation Techniques: Actual Cost & Opportunity Cost, Fixed & Variable Cost, Concept of Buy, Rent and Lease Options, Short Run & Long Run Cost, Price Fixation Pricing Method, Time Value of Money, Cash flow Diagram, Net Present Value, Present, Future & annual worth method of Comparing alternatives, Cost Benefit Ratio.								09
4.	Financial Management: Goal of financial management, Long- and short-term sources of finance, equity, debt, financial statement, profit and loss account, Balance sheet study of construction Company, Type of interest.								09
5.	Project Budgeting: Budget, types of budgets, master budgets, cost estimating and budgeting in civil engineering project, concept of capital budgeting, depreciation, impact of depreciation in economic decision making.								08

DEPARTMENT OF CIVIL ENGINEERING

6.	Taxation and Financial Regulatory Bodies: 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, financial regulatory bodies.	08
TOTAL		52
Text Books:		
1. Engineering Economics and Management, Dr. Vilas Kulkarni & Hardik Bavishi, S. Chand Publishing 2. Engineering Economy, Leland T. Blank & Anthony J. Tarquin, McGraw-Hill Education 3. Industrial Organization and Engineering Economics, T. R. Banga & S. C. Sharma, Khanna Publishers 4. Indian Economy, Gaurav Datt & Ashwani Mahajan, S. Chand Publishing 5. Engineering Economy, Degarmo, Sullivan, Bontadelli & Wicks, Pearson Education		
Reference Books:		
1. Fundamentals of Financial Management, D. C. Bose – PHI Learning 2. Financial Management, I. M. Pandey, Vikas Publishing House 3. Financial Management, M. Y. Khan & P. K. Jain, McGraw-Hill Education 4. Case Studies in Finance, Robert F. Bruner, McGraw-Hill Education 5. Principles of Managerial Economics, R. L. Varshney & K. L. Maheshwari, Sultan Chand & Sons		
E-Resources :		
1. NPTEL – Engineering Economic Analysis (IIT Roorkee) https://nptel.ac.in/courses/112107209 2. NPTEL – Construction Economics and Finance (Civil Engineering) https://www.digimat.in/nptel/courses/video/105106653/ 3. NPTEL – Managerial Economics (IIT Bombay) https://www.youtube.com/playlist?list=PLbMVogVj5nJRTAVF4-tueujAFiLKIV3Mo 4. NPTEL YouTube – Engineering Economic Analysis https://onlinecourses.nptel.ac.in/noc		

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: V		
Course: Air & Noise Pollution Control							Code: CEPE501B		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
04	-	-	04	40	60	-	-	-	100
Prerequisites:									
Fundamentals of Environmental Studies, Engineering Chemistry									
Course Objectives:									
1. To provide students with the fundamentals of air pollution, atmospheric processes, monitoring methods, and environmental quality standards.									
2. To equip students with the knowledge of pollution control technologies, environmental legislation, and sustainable strategies for managing air and noise pollution.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Justify air quality management decisions using pollutant characteristics, AQI, and ambient air quality standards.								
CO2	Evaluate Air & Noise Pollution using standard sampling & monitoring techniques.								
CO3	Analyze the influence of meteorological factors on pollutant dispersion.								
CO4	Select appropriate air and noise pollution control technologies for different applications.								
CO5	Interpret characteristics, measurement, sources, effects, and assessment of noise pollution using a sound level meter.								
CO6	Apply environmental legislation and sustainable pollution management practices for pollution control.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Air Pollution Atmosphere, air pollution, sources, episodes and accidents, Classification of air pollutants, criteria and hazardous air pollutants, scales, processes and fates, GHGs, NAAQS, Air quality indices (AQI).								09
2.	Meteorology Meteorological parameters and measurements, scales, lapse rates, Inversion and its types, atmospheric stability, mixing height, Stack height determination, Plume rise estimation, Gaussian dispersion								09
3.	Air Pollution Sampling & Monitoring Devices and methods used for sampling of particulates and gaseous air pollutants, Stack monitoring, isokinetic sampling, National Ambient Air Quality Standards (NAAQS) 2009 and Emission standards, Indoor air quality monitoring								09
4.	Air Pollution Control Technologies Natural self-cleansing properties, Control of particulates and gaseous pollutants, control equipments, carbon sequestration for CO ₂								09
5.	Noise Pollution Sound Vs noise, Sound- characteristics, Units of measurement, Sources, Effects, Sound level meter Waste management rule								08

DEPARTMENT OF CIVIL ENGINEERING

6.	Control of noise Noise control methods, Environmental standards for air and noise, Legal provisions for control of noise under Noise Pollution (Regulation and Control) Rules	08
TOTAL		52
Text Books:		
1. Air Pollution, M.N. Rao & H.V.N. Rao, Tata McGraw-Hill Education. 2. Environmental Pollution Control Engineering, C.S. Rao, New Age International Publishers. 3. Air Pollution and Control, K.V.S.G. Murali Krishna, Kaushal & Co. 4. Environmental Engineering, Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, McGraw-Hill Education		
Reference Books:		
1. Air Pollution Control Engineering, Noel de Nevers, Waveland Press. 2. Air Pollution Control Engineering Handbook, Lawrence K. Wang, Norman C. Pereira & Yung-Tse Hung, Humana Press. 3. Noise Pollution, S.P. Mahajan, APH Publishing Corporation. 4. Introduction to Environmental Engineering and Science, Gilbert M. Masters & Wendell P. Ela, Pearson Education. 5. Environmental Engineering, G. Kiely, Tata McGraw-Hill Education.		
Environmental Legislations & Standards :		
1. Air Pollution Laws (India) 2. Air (Prevention and Control of Pollution) Act, 1981 3. Environment (Protection) Act, 1986 4. Noise Pollution (Regulation and Control) Rules, 2000 Standards 5. National Ambient Air Quality Standards (NAAQS), 2009 6. Ambient Noise Standards (Industrial, Commercial, Residential, Silence zones) 7. World Health Organization - Air Quality Guidelines		
E-Resources:		
1. NPTEL Video on sources, effects , monitoring, modelling https://youtu.be/8BHXAb8kXDQ?si=ZISxatYqyREuCHEA 2. NPTEL Video on air pollution and control https://youtu.be/5dukz1UOtKA?si=wGoU2nCvE7zxBF_h 3. Video lecture on Air Pollution Sampling & Monitoring https://youtu.be/IFbhqBE4_jQ?si=RCSKdOX86QCtoSJO 4. NPTEL Video on Air Pollution Control Technologies https://youtu.be/5dukz1UOtKA?si=rBO6R5LodvEMufar 5. NPTEL Video on Noise Pollution https://youtu.be/s7DA_KjetSw?si=1QanMf4GdY7-KTWy 6. Video lecture on Noise Control & Environmental Management https://youtu.be/JLalzaOD6aY?si=Lt2yixspchYjOcC6		

**DEPARTMENT OF CIVIL ENGINEERING**

Program: B. Tech (Civil Engineering)							Semester: V		
Course: Airport, Railway and Metro Infrastructure							Code: CEPE501C		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
04	-	-	04	40	60	-	-	-	100
Prerequisites:									
Fundamentals of Transportation Engineering, Highway Engineering, and Surveying.									
Course Objectives:									
1. To equip students with the principles of airport planning and runway design, including airport classification, aircraft characteristics, runway orientation, wind analysis, runway length corrections, and essential airport components.									
2. To develop competency in railway and metro rail infrastructure planning, including permanent way, track components, geometric design, points and crossings, signalling, and planning of elevated, underground, and at-grade metro systems.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Analyze the characteristics, classification, and components of airports and aircraft for appropriate airport planning.								
CO2	Determine suitable airport layouts and runway orientation based on wind direction, crosswind components, wind coverage, and wind-rose diagrams.								
CO3	Calculate basic runway length and apply corrections for elevation, temperature, and longitudinal gradient.								
CO4	Evaluate railway permanent-way components, including rails, gauges, sleepers, ballast, fastenings, points, crossings, and signalling systems.								
CO5	Assess railway track geometry by considering train speed, superelevation, and widening requirements for safe and efficient railway operation.								
CO6	Formulate suitable planning solutions for metro rail corridors, stations, depots, and maintenance facilities considering elevated, underground, and at-grade systems.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Air Transportation and Airports Air transportation, airports, airport layout, characteristics, airport classification, aircraft components and characteristics, taxiway								09
2.	Airport Planning Airport site selection, airport obstruction, zoning laws, classification of obstruction.								09
3.	Runway Design Runway orientation, cross wind component and wind coverage, wind rose diagram, basic runway length, correction for elevation, temperature and gradient.								09
4.	Railway Engineering Permanent way, railway track cross section, rails and gauges, point and crossings, signal.								09
5.	Sleepers, Ballast and Fastening and Geometric Design Functions and requirements of sleepers, types of sleepers, sleeper density, ballast and its functions, track fastening, Speed of train, superelevation, widening of track.								08



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DEPARTMENT OF CIVIL ENGINEERING

6.	Metro Rail Infrastructure characteristics and components of metro rail networks, principles of station layout planning and design, planning and design of elevated, underground, and at-grade metro corridors, planning and design considerations for metro depots and maintenance facilities	08
TOTAL		52
Text Books:		
1. Airport Engineering, S. C. Saxena, CBS Publishers & Distributors Pvt. Ltd., New Delhi. 2. Airport Planning and Design, S. K. Khanna, M. G. Arora & S. S. Jain, Nem Chand & Bros. Roorkee. 3. Airport Engineering, S. C. Rangwala, Charotar Publishing House Pvt. Ltd., Anand. 4. A Textbook of Railway Engineering, S. C. Saxena & S. P. Arora, Dhanpat Rai Publications, New Delhi. 5. Railway Engineering, Satish Chandra & M. M. Agrawal, Oxford University Press, New Delhi 6. Urban Transportation Planning: A Decision-Oriented Approach, Meyer, Michael D. and Miller, Eric J. (2013), McGraw-Hill Education, New York. 7. Urban Transit: Operations, Planning and Economics, Vuchic, Vukan R. (2005), John Wiley & Sons, Hoboken, New Jersey, USA. 8. Principles of Urban Transport Systems Planning, Hutchinson, B. G. (2010 Reprint), Hemisphere Publishing Corporation, Washington D.C		
Reference Books:		
1. Airport Engineering: Planning, Design and Development of 21st Century Airports, Norman J. Ashford, Saleh Mumayiz & Paul H. Wright, John Wiley & Sons, Inc., USA. 2. Planning and Design of Airports, Robert Horonjeff, Francis X. McKelvey, William J. Sproule & Seth B. Young, McGraw-Hill Education, New York. 3. Airport Systems: Planning, Design and Management, Richard de Neufville & Amedeo Odoni, McGraw Hill Education. 4. Railway Engineering, C. Venkataramaiah, Universities Press (India) Pvt. Ltd., Hyderabad. 5. Railway Engineering, J. S. Mundrey, McGraw Hill Education (India) Pvt. Ltd., New Delhi.		
Handbooks and Manuals:		
1. Airport Planning Manual, Part 2 Land Use and Environmental Control, Doc 9184 AN/902 2. Airport Planning and Development Handbook, Paul Stephen Dempsey, Paul Dempsey, McGraw Hill Professional, 2000.		



DEPARTMENT OF CIVIL ENGINEERING

E-Resources:

1. NPTEL – Air Transportation (Airport Planning, Design & Operations)
<https://nptel.ac.in/courses/101101805>
2. NPTEL – Railway Engineering (IIT Roorkee)
<https://nptel.ac.in/courses/105107463>
3. NPTEL – Transportation Engineering II (Includes Airport & Railway Engineering)
<https://nptel.ac.in/courses/105107123>
4. IIT Madras Pravartak – Airport Planning & Engineering
https://digitalskills.iitmpravartak.org.in/course_details.php?courseID=183
5. NPTEL Online Courses Portal
<https://nptel.ac.in/courses>
6. Research Designs and Standards Organisation (RDSO)
<https://rdso.indianrailways.gov.in/>
7. Airports Authority of India (AAI)
<https://www.aai.aero/>

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: V		
Course: Introduction to Python Programming							Code: CEMD503		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
-	04	-	02	-	-	25	-	-	25
Prerequisites:									
Basic computer literacy, familiarity with engineering mathematics and statistics, fundamental knowledge of Civil Engineering concepts, logical problem-solving ability.									
Course Objectives:									
1. To equip students with the fundamental concepts of Python programming, including operators, decision structures, loops, functions, built-in functions, data structures, strings, and file handling.									
2. To develop competency in applying Python programming constructs to develop logical, structured, and efficient solutions to computational problems.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Construct basic Python programs using variables, operators, expressions, and input-output statements for solving computational problems.								
CO2	Select appropriate decision-making and looping structures to implement logical solutions for different programming requirements.								
CO3	Develop reusable programs using user-defined functions and appropriate built-in functions.								
CO4	Analyze engineering data using NumPy and Pandas libraries.								
CO5	Create effective graphical visualizations using Matplotlib for Civil Engineering data.								
CO6	Develop Python-based applications to solve real-world Civil Engineering problems.								
List of Experiments: (Any 08 Experiments)									
1. Program to display Hello world in Python.									
2. Program to perform different Arithmetic Operations on numbers in Python.									
3. Program based on different types of operators.									
4. Program based on the decision structures and Boolean logic.									
5. Program to demonstrate use of different types of looping statements.									
6. Program to write and use different types of user defined function.									
7. Programs to demonstrate use of various built in functions in python.									
8. Program to construct the given pattern, using a nested for loop.									
9. Program to create, append, and remove lists in python.									
10. Program to demonstrate working with tuples and dictionaries in python.									
11. Program based on strings and its operations.									
12. Program based on files and its operations.									
Text Books:									
1. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, Latest Edition.									
2. Yashavant Kanetkar, Let Us Python, BPB Publications, Latest Edition.									
3. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, O'Reilly Media, 2nd Edition.									

DEPARTMENT OF CIVIL ENGINEERING

Reference Books:

1. Eric Matthes, Python Crash Course: A Hands-On, Project-Based Introduction to Programming, No Starch Press, 3rd Edition.
2. Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy and Jupyter, O'Reilly Media, 3rd Edition.
3. John V. Guttag, Introduction to Computation and Programming Using Python, MIT Press, 3rd Edition.
4. Jake VanderPlas, Python Data Science Handbook, O'Reilly Media.
5. Charles R. Severance, Python for Everybody: Exploring Data Using Python, CreateSpace Independent Publishing.

E-Resources:

1. The Joy of Computing Using Python
<https://nptel.ac.in/courses/106106182>
2. Programming, Data Structures and Algorithms Using Python
<https://nptel.ac.in/courses/106106145>
3. NPTEL YouTube Channel (Python Courses Playlist)
<https://www.youtube.com/@nptelhrd/playlists>
4. Official Python Documentation
<https://docs.python.org/3/>
5. Python Tutorial – W3Schools
<https://www.w3schools.com/python/>
6. Real Python Tutorials
<https://realpython.com/>
7. Free Code Camp – Python for Beginners (Full Course)
<https://www.youtube.com/watch?v=rfscVS0vtbw>

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Common to All)							Semester: V		
Course: Open Elective – III (Data Analytics)							Code: ALOE503A		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
02	-	-	02	-	-	50	50	-	100
Prerequisites:									
Basic knowledge of Mathematics and Statistics, Fundamentals of Computer Science									
Course Objectives:									
1. To introduce the types and applications of data analytics across domains.									
2. To apply descriptive statistics and visualization techniques to summarize data.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Explain the types of data analytics and their applications across domains.								
CO2	Apply descriptive statistics and visualization techniques to summarize data.								
CO3	Analyze data using inferential statistics and hypothesis testing methods.								
CO4	Apply correlation, regression, and ANOVA techniques for data-driven decisions.								
CO5	Design predictive models using classification and clustering approaches.								
CO6	Evaluate prescriptive analytics approaches and Big Data platforms for applications.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Data Analytics Types of analytics — descriptive, diagnostic, predictive, and prescriptive; Analytics vs. reporting; Key applications across domains: business, healthcare, finance, and marketing; Overview of analytics tools landscape: Excel, Python, R, and Power BI (comparative overview); KPIs and metrics for decision-making.								05
2.	Descriptive Analytics Frequency distributions, outliers; Measures of central tendency and dispersion; Interquartile range; Skewness and kurtosis; Normal distribution and z-scores; Data visualization principles: bar chart, histogram, box plot, scatter plot, and heat map.								05
3.	Inferential Statistics Population vs. sample, random sampling; Sampling distribution, standard error; Hypothesis testing: null and alternate hypothesis, z-test, t-test; One-tailed and two-tailed tests; Confidence intervals and level of confidence; Type I and Type II errors.								04
4.	Correlation, Regression & ANOVA Correlation and scatter plots; Simple linear regression, least squares method; Multiple regression; Coefficient of determination (R ²); One-way and two-way ANOVA; Chi-square test of independence.								04
5.	Predictive Analytics Introduction to predictive modeling; Classification techniques: logistic regression, decision trees; Clustering: k-means; Model evaluation: accuracy, confusion matrix; Time series analysis basics: moving averages, trend analysis.								04
6.	Prescriptive & Big Data Analytics: Prescriptive analytics: optimization and simulation for decision-making;								04

DEPARTMENT OF CIVIL ENGINEERING

	Introduction to Big Data: the 5 V's, sources of big data; Overview of the Big Data ecosystem: Hadoop, Spark (conceptual only); Applications: business analytics, web analytics, and social media analytics.			
TOTAL				26
Teamwork : (Any 10)				
	Sr. No.	Title	Proposed Tutorial Activities	
	1	Introduction to Data Analytics	Identify descriptive, diagnostic, predictive, and prescriptive analytics using real-world case studies. Compare Excel, Python, R, and Power BI for analytics tasks.	
	2	Descriptive Statistics – I	Calculate mean, median, mode, range, variance, and standard deviation using a given dataset in Excel/Python.	
	3	Descriptive Statistics – II	Detect outliers using IQR and visualize distributions using histograms and box plots.	
	4	Data Visualization	Create bar charts, scatter plots, heat maps, and box plots. Interpret insights from visualizations.	
	5	Sampling & Probability	Perform random sampling, calculate standard error, and differentiate between population and sample using datasets.	
	6	Hypothesis Testing	Perform z-test and t-test for given scenarios and interpret Type I and Type II errors.	
	7	Correlation & Regression	Calculate correlation coefficients, build simple linear regression models, and interpret R ² values.	
	8	ANOVA & Chi-Square	Perform one-way ANOVA and Chi-square tests using statistical software and interpret results.	
	9	Predictive Analytics	Build basic classification models (Logistic Regression/Decision Tree) and perform K-Means clustering using Python.	
	10	Model Evaluation	Evaluate predictive models using confusion matrix and accuracy metrics.	
	11	Time Series Analytics	Apply moving averages and identify trends in time-series datasets.	
	12	Big Data & Prescriptive Analytics	Explore Hadoop and Spark concepts through case studies and discuss optimization-based decision-making.	
Text Books:				
1. Anil Maheshwari, "Data Analytics", McGraw Hill Education				
2. Robert S. Witte and John S. Witte, "Statistics", Wiley Publications				
3. U. Dinesh Kumar, "Business Analytics: The Science of Data-Driven Decision Making", Wiley India				

DEPARTMENT OF CIVIL ENGINEERING

Reference Books:

1. Seema Acharya and SubhashiniChellappan, "Big Data and Analytics", Wiley India
2. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press

Environmental Legislations & Standards:

Indian Regulations

1. Environment (Protection) Act, 1986
2. Energy Conservation Act, 2001
3. National Building Code (NBC) of India
4. Eco-Niwas Samhita (Energy Conservation Building Code – Residential)

Standards & Guidelines

1. Energy Conservation Building Code (ECBC)
2. GRIHA & IGBC rating guidelines
3. LEED certification standards
4. Bureau of Energy Efficiency (BEE) norms

E-Resources:

1. NPTEL Course on "Data Analytics with Python" (IIT Roorkee Track)
<https://nptel.ac.in/courses/106107220>
2. NPTEL Course on "Business Intelligence & Analytics" (IIT Madras Track)
https://onlinecourses.nptel.ac.in/noc25_cs09/preview
3. NPTEL Course on "Business Analytics for Management Decision" (IIT Kharagpur Track)
<https://nptel.ac.in/courses/110105089>
4. Coursera: "Google Data Analytics Professional Certificate"
<https://www.coursera.org/professional-certificates/google-data-analytics>
5. edX: "Data Science: Statistics and Machine Learning" by Harvard University
<https://www.edx.org/learn/machine-learning/harvard-university-data-science-machine-learning>

E-Books

1. Allen B. Downey – Think Stats: Exploratory Data Analysis in Python (Open Access)
<https://greenteapress.com/wp/>
2. EMC Education Services – Data Science and Big Data Analytics (Open Academic Archive)
<https://onlinelibrary.wiley.com/doi/book/10.1002/9781119183686>

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Common to All)							Semester: V		
Course: Open Elective – III (Green Building)							Code: ALOE503B		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
02	-	-	02	-	-	50	50	-	100
Prerequisites:									
Basic environmental engineering, building materials & construction, engineering chemistry/ environmental science, basic knowledge of energy and sustainability concepts									
Course Objectives:									
1. To equip students with the principles of sustainable building design, resource-efficient construction, and green building practices.									
2. To provide students with knowledge of energy-efficient technologies, water and waste management, sustainable materials, and green building rating systems.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Explain the concepts, principles, benefits, and environmental impacts associated with green buildings and sustainable development.								
CO2	Assess building orientation, climate-responsive planning, landscaping, green roofs, and green walls for improving environmental performance.								
CO3	Evaluate building energy consumption and recommend energy-efficient strategies, HVAC optimization, renewable energy systems, and conservation measures.								
CO4	Design suitable water conservation, rainwater harvesting, greywater recycling, waste management, and sustainable drainage solutions for buildings.								
CO5	Select appropriate sustainable building materials and assess indoor environmental quality based on thermal comfort, indoor air quality, lighting, and acoustics.								
CO6	Compare major green building rating systems such as IGBC, GRIHA, and LEED and apply their principles to assess building sustainability.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Green Buildings Definition, concept, and need of green buildings, Sustainable development principles, Environmental impacts of conventional buildings, Benefits of green buildings.								05
2.	Sustainable Planning & Architecture Sustainable planning, Orientation and climate-responsive design, Landscape planning, Green roofs and walls.								05
3.	Energy Efficiency in Buildings Energy consumption in buildings, Energy-efficient building design, HVAC optimization, Renewable energy systems (solar, wind), Energy audit and conservation techniques.								04
4.	Water & Waste Management Water conservation techniques, Rainwater harvesting systems, Greywater recycling, Waste management in buildings, Sustainable drainage systems.								04
5.	Sustainable Materials & Indoor Environmental Quality Eco-friendly building materials, Low embodied energy materials, Recycled and locally available materials, Indoor air quality (IAQ), Thermal comfort, lighting,								04

DEPARTMENT OF CIVIL ENGINEERING

	and acoustics.	
6.	Green Building Rating Systems & Regulations Overview of rating systems: Indian Green Building Council (IGBC) Green Rating for Integrated Habitat Assessment (GRIHA) Leadership in Energy and Environmental Design (LEED)	04
TOTAL		26

Teamwork : (Any 10)

1. Study any IGBC/GRIHA certified building and identify the sustainable features adopted.
2. Study how sustainable development principles have been implemented in any residential, commercial, or institutional building.
3. Study a construction project and identify its environmental impacts. Suggest green alternatives to reduce these impacts.
4. Analyze building designed using passive architectural principles.
5. Study the site planning of a green campus, township, or commercial complex.
6. Study an existing building incorporating green roofs or vertical gardens.
7. Study an energy-efficient building and identify passive design strategies adopted.
8. Study a building utilizing renewable energy systems and evaluate their benefits.
9. Analyze an energy audit report (or published case study) and summarize the recommended energy-saving measures.
10. Study water conservation measures implemented in any green building.
11. Study a residential or institutional building with rainwater harvesting and grey water reuse systems.
12. Study the waste management practices of a smart city, residential township, or institutional campus.
13. Study a building that has extensively used sustainable building materials.
14. Perform a literature review on the life cycle assessment of one construction material.
15. Study an office, hospital, educational building, or green building focusing on indoor environmental quality improvements.
16. Compare two certified buildings, each evaluated under different rating systems (e.g., IGBC vs LEED or GRIHA vs IGBC).
17. Study the certification journey of an IGBC or GRIHA certified building.

Text Books:

1. K.S. Jagadeesh – Alternative Building Materials and Technologies
2. C.J. Kibert – Sustainable Construction: Green Building Design and Delivery
3. Charles J. Kibert – Green Buildings: Principles and Practices

Reference Books:

1. O.H. Koenigsberger – Manual of Tropical Housing and Building
2. G.Z. Brown & Mark DeKay – Sun, Wind & Light
3. Laurie Baker – Building with Earth
4. IGBC Manuals and Guidelines

Environmental Legislations & Standards:

Indian Regulations

1. Environment (Protection) Act, 1986
2. Energy Conservation Act, 2001
3. National Building Code (NBC) of India
4. Eco-Niwas Samhita (Energy Conservation Building Code – Residential)

DEPARTMENT OF CIVIL ENGINEERING

Standards & Guidelines

1. Energy Conservation Building Code (ECBC)
2. GRIHA & IGBC rating guidelines
3. LEED certification standards
4. Bureau of Energy Efficiency (BEE) norms

E-Resources:

1. Indian Green Building Council
<https://igbc.in>
2. Green Rating for Integrated Habitat Assessment
<https://grihaIndia.org>
3. U.S. Green Building Council
<https://usgbc.org>
4. NPTEL Green Building courses
<https://nptel.ac.in>
5. Ministry of Environment, Forest and Climate Change
<https://moef.gov.in>

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Common to All)							Semester: V		
Course: Open Elective – III (Electrical Mobility)							Code: ALOE503C		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
02	-	-	02	-	-	50	50	-	100
Prerequisites:									
Basic Electrical and Electronics Engineering									
Course Objectives:									
1. To apply fundamental principles of electric mobility to interpret EV architectures, components and applications.									
2. To utilize energy storage and battery management concepts to evaluate battery performance, charging, and safety.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Explain the concepts, architecture, and applications of Electric and Hybrid Electric Vehicles.								
CO2	Identify the suitable energy storage systems used in electric vehicles.								
CO3	Illustrate battery charging methods, battery management systems, and SoC estimation techniques.								
CO4	Interpret hybrid power train configurations, operating modes, and regenerative braking								
CO5	Demonstrate the use of electric drives, charging levels, charging standards, and EV charging equipment.								
CO6	DescribeEV charging technologies and grid integration concepts such as G2V, V2G, V2H, V2B, and V2V.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Electric Mobility Need for electric mobility, evolution of EVs, advantages and challenges, environmental and economic aspects, EV vs conventional vehicles, types of EVs: BEV, HEV, PHEV and fuel-cell vehicles, basic EV architecture and major components.								05
2.	Energy Storage Systems Energy storage requirements, battery terminology and specifications, Li-ion batteries and their types, basic battery characteristics, battery alternatives: solid-state, Aluminium-air, fuel cell and supercapacitor, battery–supercapacitor hybrid system, selection of energy storage system.								05
3.	Battery Charging and Management EV charging basics, AC and DC charging, charging methods and levels, charging time and factors affecting charging, Battery Management System (BMS), functions of BMS, State of Charge (SoC), State of Health (SoH), State of Power (SoP), cell balancing, battery thermal management and safety.								04
4.	EV Powertrain and Electric Drives EV powertrain architecture, energy flow in EVs, vehicle performance and basic tractive effort, electric motors used in EVs: BLDC and PMSM, motor selection, basic drive control, regenerative braking and its benefits.								04

DEPARTMENT OF CIVIL ENGINEERING

5.	EV Charging Infrastructure EV charging infrastructure, charging levels, AC/DC chargers, EVSE, charging connectors and standards: CCS, CHAdeMO, SAE J1772, Bharat AC/DC, basic charging station components, installation and safety considerations.	04
6.	Smart and Emerging Electric Mobility Grid-to-Vehicle (G2V), Vehicle-to-Grid (V2G), Vehicle-to-Home (V2H), Vehicle-to-Building (V2B), Vehicle-to-Vehicle (V2V), smart charging, wireless charging, battery swapping, energy management, IoT and digital technologies in EVs, future trends and challenges.	04
TOTAL		26
Teamwork :		
1. Study the architecture of an Electric Vehicle (EV) and identify the functions of major components such as battery, BMS, motor, inverter, charger, controller and sensors. 2. Compare 3–5 EVs available in India based on battery capacity, motor power, driving range, charging time, efficiency, cost and other key specifications. 3. Study and compare different energy storage technologies such as Li-ion batteries, solid-state batteries, fuel cells and supercapacitors based on energy density, charging time, life, cost, safety and applications. 4. Visit an EV charging station and study the charger type, AC/DC charging, charging level, connector/standard, power rating, and charging time and safety provisions. 5. Prepare a basic layout of an EV charging station showing charging points, power supply, protection system, parking area, cable routing, safety provisions and user facilities. 6. Study smart EV charging and Vehicle-to-Grid (V2G) concepts, including G2V, V2G, V2H and V2B, and identify their applications in smart grids and buildings. 7. Collect and analyze EV performance or charging data using Excel/Python/MATLAB and study parameters such as battery capacity, range, charging time and energy consumption. 8. Design a conceptual IoT-based EV monitoring system showing sensors, communication network, cloud platform and user interface for monitoring SoC, temperature, charging status and energy consumption. 9. Study regenerative braking in EVs and prepare an energy-flow diagram. Analyze energy recovery under different braking conditions using numerical calculations or simulation. 10. Study an emerging EV technology such as battery swapping, wireless charging, solid-state batteries, autonomous EVs, solar charging or second-life batteries and evaluate its technical, economic and environmental benefits.		
Text Books:		
1. James Larminie and John Lowry, "Electric Vehicle", John Wiley & Sons, 2012. 2. Ronald K. Jurgen, "Electric and Hybrid-Electric Vehicles", SAE International. 3. K. T. Chau, "Energy Systems for Electric and Hybrid Vehicles", The Institution of Engineering and Technology. 4. D. A. J. Rand, R. Woods, and R. M. Dell, "Batteries for Electric Vehicles", Research Studies Press Ltd., New York, John Wiley & Sons. 5. "Electric & Hybrid Vehicles – Design Fundamentals", CRC Press.		
Reference Books:		
1. Mehrdad Ehsani, Yimin Gao, and Ali Emadi, "Modern Electrical Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2009. 2. Junwei Lu and Jahangir Hossain et al. (Eds.), "Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid", IET Digital Library.		

DEPARTMENT OF CIVIL ENGINEERING

3. Tom Denton, "Automobile Electrical and Electronic Systems", SAE International Publications.
4. C. Mi, M. A. Masrur, and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
5. Mark Warner, "The Electric Vehicle Conversion Handbook", HP Books, 2011.

E-Resources:

1. <https://www.theiet.org/resources/books/transport/vehicle2grid.cfm>
2. <https://www.sae.org/publications/books/content/pt-143.set/>
3. <http://nptel.ac.in/courses/108103009/>

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Common to All)							Semester: V		
Course: Open Elective – III (Introduction to Stock Market)							Code: ALOE503D		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
02	-	-	02	-	-	50	50	-	100
Prerequisites:									
Basic knowledge of economics and financial systems, Familiarity with percentage calculations and simple mathematics, Interest in investing and financial markets.									
Course Objectives:									
1. To understand the structure and functioning of financial and stock markets along with investor psychology.									
2. To apply candlestick patterns and indicators for identifying market trends.									
3. To understand the fundamentals of option trading and option pricing concepts.									
4. To develop short-term and long-term investment strategies using fundamental and technical analysis.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Explain the functioning of financial markets using fundamental analysis.								
CO2	Analyze stock price movements using candlestick patterns for trading decisions.								
CO3	Analyze stock price movements using technical indicators for trading decisions.								
CO4	Describe the concepts of derivatives and option trading.								
CO5	Apply the strategies for option trading.								
CO6	Apply investment strategies based on market analysis.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Fundamental Analysis and Investor Psychology Introduction to Financial Markets, Primary and Secondary Markets, Market Participants, Stock Exchanges, SEBI and Regulatory Framework, Investment vs Trading, Understanding Business Models, Reading Financial Statements (Balance Sheet, Profit & Loss Account, Cash Flow Statement), Fundamental Ratios (EPS, PE Ratio, PB Ratio, ROE, ROCE, Debt-Equity Ratio), Sector Analysis, Economic Indicators, Investor Psychology, Market Emotions (Fear & Greed), Behavioral Biases, Risk Management Principles.								06
2.	Technical Analysis using Candlestick Charts Introduction to Technical Analysis, Dow Theory, Support and Resistance, Trend Analysis, Price Action Concepts Candlestick Anatomy: Single Candlestick Patterns (Doji, Hammer, Shooting Star, Marubozu, Spinning Top), Double Candlestick Patterns (Bullish & Bearish Engulfing, Harami, Piercing Pattern, Dark Cloud Cover), Triple Candlestick Patterns (Morning Star, Evening Star, Three White Soldiers, Three Black Crows), Gap Analysis, Trend Reversal and Continuation Patterns.								04
3.	Technical Analysis using Indicators Technical Indicators : Moving Averages (SMA, EMA), MACD, RSI, Stochastic Oscillator, Bollinger Bands, VWAP, ADX, ATR, Volume Analysis, Fibonacci								04

DEPARTMENT OF CIVIL ENGINEERING

	Retracement, Pivot Points, Trend Confirmation, Indicator-Based Trading Strategies, Combining Multiple Indicators, Entry and Exit Rules, Backtesting Concepts.	
4.	Introduction to Derivatives and FNO Introduction to Derivatives, Futures and Options, Types of Options (Call and Put), Option Terminology (Strike Price, Expiry, Premium, Lot Size, Open Interest), Intrinsic and Time Value, ITM, ATM, OTM Options, Option Chain Analysis, Greeks (Delta, Gamma, Theta, Vega, Rho - Basic Concepts), Option Pricing Factors, Option Expiry and Settlement Process.	04
5.	Introduction to Option Trading Strategies Option Buying vs Option Selling, Risk and Reward Analysis, Long Call, Long Put, Covered Call, Cash Secured Put, Bull Call Spread, Bear Put Spread, Bull Put Spread, Bear Call Spread, Iron Condor (Basic Concept), Straddle and Strangle (Introduction), Position Sizing, Stop Loss Techniques, Capital Management, Risk Management in Options Trading.	04
6.	Short-Term and Long-Term Trading & Investment Strategies Swing Trading, Positional Trading, Intraday Trading (Overview), Momentum Trading, Breakout Trading, Trend Following Strategies, Portfolio Building, Value Investing, Growth Investing, Dividend Investing, SIP in Equity, Asset Allocation, Diversification, Trading Plan Development, Trading Journal, Performance Evaluation, Common Mistakes Made by Traders and Investors, Ethics in Financial Markets.	04
TOTAL		26

Teamwork : (Any 10)

Sr No	Title	Proposed Activities
1	Stock Market Basics & Trading Platform	Introduction to NSE & BSE, SEBI, Demat & Trading Accounts, Market Participants, Creating a Paper Trading Account.
2	Fundamental Analysis – I	Reading Financial Statements, EPS, PE Ratio, Book Value, Market Capitalization, Sector Analysis
3	Fundamental Analysis – II & Investor Psychology	Company Comparison, Economic Indicators, Market Cycles, Fear & Greed, Trading Discipline
4	Candlestick Analysis – I	Candlestick Anatomy, Doji, Hammer, Shooting Star, Marubozu, Trend Identification
5	Candlestick Analysis – II	Bullish/Bearish Engulfing, Morning Star, Evening Star, Support & Resistance using Charts
6	Technical Indicators – I	SMA, EMA, Volume Analysis, Trend Identification using TradingView
7	Technical Indicators – II	RSI, MACD, Bollinger Bands, VWAP, Indicator-based Entry & Exit
8	Option Trading Fundamentals	Call & Put Options, Strike Price, Premium, Expiry, Option Chain Analysis
9	Option Buying Strategies	Long Call, Long Put, Break-even Calculation, Risk & Reward Analysis
10	Option Selling Strategies	Covered Call, Cash Secured Put, Bull Call Spread, Bear Put Spread

DEPARTMENT OF CIVIL ENGINEERING

11	Short-term Trading Strategies	Intraday (Concept), Swing Trading, Breakout Trading, Risk Management
12	Long-term Investment Strategies	Value Investing, Growth Investing, Dividend Investing, Portfolio Diversification

Students should spend most of the session on:

- Live chart analysis using TradingView or similar platforms.
- Analyzing real companies using NSE/BSE financial data.
- Paper trading (no real money involved).
- Maintaining a trading journal.
- Presenting and reviewing trading decisions.

Text Books:

1. John J. Murphy, "Technical Analysis of the Financial Markets", Pearson.
2. Benjamin Graham, "The Intelligent Investor", Harper Business.
3. Martin J. Pring, "Technical Analysis Explained", McGraw-Hill.
4. Sheldon Natenberg, "Option Volatility and Pricing", McGraw-Hill.
5. AswathDamodaran, "Investment Valuation", Wiley.
6. Alexander Elder, "Trading for a Living", Wiley.

Reference Books:

1. O.H. Koenigsberger – Manual of Tropical Housing and Building
2. G.Z. Brown & Mark DeKay – Sun, Wind & Light
3. Laurie Baker – Building with Earth
4. IGBC Manuals and Guidelines

E-Resources:

1. National Stock Exchange (NSE) Learning Portal
<https://www.nseindia.com>
2. Bombay Stock Exchange (BSE) Investor Education
<https://www.bseindia.com>
3. SEBI Investor Education
<https://investor.sebi.gov.in>
4. NISM (National Institute of Securities Markets)
<https://www.nism.ac.in>
5. Zerodha Varsity
<https://zerodha.com/varsity>
6. Investopedia
<https://www.investopedia.com>

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Common to All)							Semester: V		
Course: Open Elective – III (Patent Law for Engineers and Scientists)							Code: ALOE503E		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
02	-	-	02	-	-	50	50	-	100
Prerequisites:									
Basic understanding of engineering/scientific concepts and technological innovation, Basic skills in technical reading, documentation, and report writing.									
Course Objectives:									
1. To understand the importance of Intellectual Property Rights (IPR) and patents. 2. To identify patentable and non-patentable inventions based on patentability criteria. 3. To conduct prior-art and patent searches using public patent databases. 4. To draft a basic patent specification, including claims and abstract. 5. To understand and apply the complete patent filing, examination, and granting process in India. 6. To analyze engineering case studies involving patents, innovation, and commercialization.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Apply the provisions of the Indian Patent Law to engineering inventions.								
CO2	Perform prior-art and patent searches using standard patent databases.								
CO3	Analyze the patentability, filing, examination, and grant process under the Indian Patent Act.								
CO4	Evaluate patent infringement, licensing, technology transfer, and commercialization issues.								
CO5	Draft a patent specification, including claims and abstract, in compliance with patent law.								
CO6	Develop a patent application for an innovative engineering solution following legal and procedural requirements.								
Course Contents:									
Unit	Description							Duration (Hrs.)	
1.	Introduction to Intellectual Property Rights and Patents Introduction to Intellectual Property Rights (IPR), significance of IPR in engineering, innovation and entrepreneurship, types of IPR, concept and objectives of patents, patentability criteria (novelty, inventive step and industrial applicability), patentable and non-patentable inventions under the Indian Patent Act, 1970, patents versus research publications and products, role of patents in technology commercialization and startup ecosystem. Case Study: Patentability analysis of a simple engineering innovation.							05	
2.	Indian Patent Law and Prior-Art Search Overview of the Indian Patent Act, 1970 and its amendments, objectives and scope of patent law, rights and duties of inventors, overview of WIPO, Patent Cooperation Treaty (PCT) and international patent systems, prior-art search techniques, patent classification systems, patent search using Google Patents, InPASS, Espacenet, and WIPO PATENTSCOPE novelty assessment and patent landscape analysis. Case Study: Prior-art search and novelty analysis of an engineering invention.							05	

DEPARTMENT OF CIVIL ENGINEERING

3.	Patent Drafting Structure and components of a patent specification including title, field of invention, background, prior art, problem statement, objectives, summary of invention, brief description of drawings, detailed description, claims, abstract, and drawings. Principles of claim drafting, dependent and independent claims, patent drafting guidelines, common drafting errors, and patent documentation for engineering innovations. Case Study: Drafting of a patent specification for a smart engineering product.	04
4.	Patent Filing, Examination and Grant: Patent filing procedure in India, provisional and complete specification, online filing process, statutory forms, publication of patent application, request for examination, First Examination Report (FER), response to objections, hearing process, patent grant, renewal, restoration, opposition, and maintenance of patents under the Indian Patent Act. Case Study: Patent filing and grant timeline of an Indian engineering patent.	04
5.	Patent Commercialization and Legal Issues Patent ownership, licensing, assignment, technology transfer, patent valuation, startup and university patents, patent infringement, remedies and dispute resolution, freedom-to-operate (FTO), patent analytics, commercialization strategies, and ethical issues in patent protection. Case Study: Commercialization of a patented engineering innovation.	04
6.	Emerging Technologies and Patent Case Studies Patents in Artificial Intelligence, Machine Learning, Internet of Things (IoT), Robotics, Semiconductor Technology, Biotechnology, Software, Green Technologies, and Industry 4.0, AI-generated inventions, recent developments in patent law, international patent trends, patent portfolio management, and innovation-driven entrepreneurship. Case Study: Analysis of landmark patent disputes such as Apple vs Samsung or an Indian engineering innovation, along with preparation of a basic patent draft for an engineering solution.	04
TOTAL		26

Teamwork :

Students shall complete the following practical, activity-oriented assignments based on a selected engineering innovation/project:

1. Identify suitable IP protection for an engineering innovation and assess basic patentability criteria.
2. Conduct patent searches using Google Patents, IP India, WIPO PATENTSCOPE and Espacenet and analyze the novelty of the selected innovation.
3. Identify a copyrightable work such as software, technical content or digital work and prepare/undertake the copyright registration process.
4. Develop a product/start-up brand, conduct trademark search, identify the appropriate class and prepare a basic trademark application.
5. Identify protectable visual features of an engineering product, conduct design search and prepare a basic design registration application.
6. Prepare a basic patent specification including title, background, objectives, description, drawings, abstract and claims for an engineering innovation.
7. Prepare a mock provisional/complete patent application and study the filing, publication, examination, FER, response and grant process in India.
8. Study the PCT route and prepare a mock PCT application based on the selected engineering

DEPARTMENT OF CIVIL ENGINEERING

invention.

9. Analyze patents in a selected emerging technology area and identify major patent holders, technology trends and basic FTO considerations.
10. Develop an IP portfolio for the selected innovation covering patent, copyright, trademark/design and propose a basic commercialization strategy. Study a building that has extensively used sustainable building materials.

Text Books:

1. P. Narayanan, "Patent Law", Eastern Law House.
2. PrabuddhaGanguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw-Hill.
3. N. S. Gopalakrishnan and T. G. Agitha, "Principles of Intellectual Property", Eastern Book Company.
4. Government of India, "The Patents Act, 1970 (as amended) and The Patents Rules, 2003 (as amended)", Government of India.

Reference Books:

1. David Pressman, "Patent It Yourself", NOLO Publications.
2. WIPO, "WIPO Intellectual Property Handbook: Policy, Law and Use", World Intellectual Property Organization.
3. Indian Patent Office, "Manual of Patent Office Practice and Procedure", Office of the Controller General of Patents, Designs & Trade Marks (CGPDTM), Government of India.
4. Alexander I. Poltorak and Paul J. Lerner, "Essentials of Intellectual Property", John Wiley & Sons.

E-Resources:

1. Patent Law for Engineers and Scientists – NPTEL (IIT Madras)
<https://nptel.ac.in/courses/110106081>
2. Intellectual Property – NPTEL (IIT Madras)
<https://nptel.ac.in/courses/109106137>

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: V		
Course: Internship – III							Code: CEIN504		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
4 Weeks			02	-	-	25	-	-	25
Preamble:									
Internships serve as vital educational and career development experiences, offering practical exposure in a specific field. Employers seek individuals who possess the necessary skills and an understanding of industry environments, practices, and cultures. This internship is designed as a structured, short-term, supervised training program, often centered on specific tasks or projects with clear timelines. The primary goal is to immerse technical students in an industrial setting, providing experiences that cannot be replicated in the classroom. This exposure aims to develop competent professionals who understand the social, economic, and administrative factors influencing the operations of industrial organizations.									
Course Objectives:									
1. Exposure to students to the industrial environment, which cannot be provided in the classroom and hence creating deployable professionals for the industry. 2. Learn to implement the technical knowledge in real industrial situations									
Course Outcomes: After completion of this course students will be able to -									
CO1	Gain exposure to industry practices and understand how academic concepts are applied in professional settings.								
CO2	Develop and demonstrate effective communication and teamwork skills within a work environment.								
CO3	Improve your problem-solving and time management skills by working in real-world industry settings.								
Internship Requirements:									
1. Internship Duration: It is mandatory for all students to undergo an internship after every semester during vacations for the duration of 4 weeks. Internships completed during this period will be considered for the assessment of Term Work (TW). 2. Internship Opportunities: Students can explore various opportunities for internships at: a. Industries b. Research labs or organizations c. Collegiate clubs d. In-house research projects e. Online internships 3. Support and Assistance: Students can seek assistance for securing internships from: a. The Training and Placement cell, along with departmental coordinators b. Department or institute faculty members c. Personal contacts d. Directly connecting with industries or organizations 4. Request Letter: Once an industry, research organization, or collegiate club is identified, students must obtain a request letter from the concerned department or placement office. This letter, in the standard format must be duly signed by the authority, should be addressed to the HR manager or relevant authority.									

DEPARTMENT OF CIVIL ENGINEERING

5. **Confirmation Letter:** Students must submit the confirmation letter from the industry, research organization, or collegiate club to the Internship Coordinator and the Head of Department (HOD) office.
6. **Joining Report:** Upon commencing the internship, students must submit the joining report, joining letter, or a copy of the confirmation email to the Internship Coordinator and the HOD office.
7. **Faculty Mentor:** A faculty member will be assigned as a mentor to a group of students. The mentor will be responsible for monitoring, evaluating, and assessing student internship activities. The faculty mentor is also required to visit the internship location and submit formal feedback to the Internship Coordinator.
8. **Faculty Visits:** Faculty members are advised to visit the internship site once or twice during the internship period to monitor progress.
9. **Progress Report:** Students must submit progress report fortnightly to their faculty guide and the final internship report to the Internship Coordinator and department office.
10. **Evaluation Report:** After the completion of the internship, the mentor, along with the assessment panel members, should submit the evaluation report of the students to the department office and the Internship Coordinator.
11. **Internship Certificate:** Students must receive the Internship Certificate from the industry and submit it to the Internship Coordinator and department office.
12. **Presentation and Assessment:** Students are required to give a presentation on their internship work as part of the term work. The internship diary and report will also be verified and assessed.



Zeal Education Society's

ZEAL COLLEGE OF ENGINEERING & RESEARCH, PUNE-41

(An Autonomous Institute Affiliated to Savitribai Phule Pune
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21001:2018

DEPARTMENT OF CIVIL ENGINEERING

SYLLABUS

SEMESTER- VI

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: VI		
Course: Structural Steel Design							Code: CEPC610		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
Fundamentals of Engineering Mechanics, Mechanics of Materials and Structural Analysis									
Course Objectives:									
1. To provide students with the fundamentals of steel structural design, connection detailing, and fabrication practices. 2. To prepare students to apply codal provisions for the design, detailing, and fabrication of steel structures.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Justify the selection of tension members and bolted/welded connections using limit state design principles.								
CO2	Design compression members and axially loaded steel columns.								
CO3	Design column bases and eccentrically loaded steel columns.								
CO4	Compare and select the appropriate waste to energy technologies for a smart city.								
CO5	Advise relevant method for management of e-waste, biomedical waste and hazardous waste.								
CO6	Propose relevant method for management of construction and demolition waste management in a smart city.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Steel Structures and Tension Members Types and applications of steel structures, Structural steel grades and rolled steel sections, Introduction to IS 800:2007 and relevant IS codes, Limit State Design philosophy, Loads and load combinations, Design of tension members, Design of bolted and welded connections for tension members								07
2.	Compression Members and Steel Columns Behavior of compression members, Buckling and effective length concept, Design compressive strength, Design of compression members using angle sections, Design of axially loaded steel columns, Introduction to built-up column								07
3.	Eccentrically Loaded Columns and Column Bases Eccentrically loaded columns, Uniaxial bending in columns, Section strength checks, Design of slab base, Design of gusseted base, Introduction to moment resisting bases								07
4.	Design of Steel Beams Design bending strength, Shear strength of beams, Laterally restrained beams, Laterally unrestrained beams, Web buckling and web crippling, Deflection checks, Beam detailing and flange plates								06
5.	Design of Industrial Roof Trusses Types of roof trusses, Assessment of dead, live and wind loads, Design of purlins, Analysis of roof trusses, Design of truss members, Typical joint and support detailing								06

DEPARTMENT OF CIVIL ENGINEERING

6.	Welded Plate Girder and Steel Detailing Concept and applications of welded plate girders, Components of plate girder, Design of plate girder cross-section, Flange and web design, Intermediate and bearing stiffeners, Web buckling and shear resistance, Detailing and fabrication considerations	06
TOTAL		39
IS Codes:		
1. IS 800-2007: Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi 2. IS 808-1989: Dimensions for hot rolled steel beam, column, channel and angle sections, Bureau of Indian Standards, New Delhi 3. IS 875- Part 1 and 2 (1987) and Part 3 (2015): Code of practice for design loads (other than earthquake) for building and structures, Bureau of Indian Standards, New Delhi 4. IS 4000-1992: Code of practice for high strength bolts in steel structures, Bureau of Indian Standards, New Delhi 5. IS 816-1969: Code of practice for use of metal arc welding for general construction in mild steel, Bureau of Indian Standards, New Delhi 6. SP-6(1) and 6(6): ISI handbook for Structural Engineers, Bureau of Indian Standards, New Delhi 7. SP-38: Handbook for typified design for structures with steel roof trusses, Bureau of Indian Standards, New Delhi.		
Text Books:		
1. Subramanian, N., <i>Design of Steel Structures</i> , Oxford University Press, New Delhi. 2. Shiyekar, M. R., <i>Limit State Design in Structural Steel</i> , PHI Learning Pvt. Ltd., New Delhi. 3. Gambhir, M. L., <i>Fundamentals of Structural Steel Design</i> , Tata McGraw-Hill Education Pvt. Ltd., New Delhi. 4. Ramchandra and Gehlot, <i>Limit State Design of Steel Structures</i> , Scientific Publishers, Pune.		
Reference Books:		
1. Ghosh, Karuna, <i>Analysis and Design: Practice of Steel Structures</i> , PHI Learning Pvt. Ltd., New Delhi. 2. Raz, Sarwar Alam, <i>Structural Design in Steel</i> , New Age International Publishers, New Delhi. 3. Shah, V. L. and Gore, M. G., <i>Limit State Design of Steel Structures</i> , Structures Publications, Pune. 4. Duggal, S. K., <i>Limit State Design of Steel Structures</i> , McGraw Hill Education (India) Pvt. Ltd., New Delhi. 5. Bhavikatti, S. S., <i>Design of Steel Structures</i> , I.K. International Publishing House Pvt. Ltd., New Delhi. 6. Arya, A. S. and Ajmani, J. L., <i>Design of Steel Structures</i> , Nem Chand & Bros., Roorkee. 7. Salmon, C. G., Johnson, J. E. and Malhas, F. A., <i>Steel Structures: Design and Behavior</i> , Pearson Education.		

DEPARTMENT OF CIVIL ENGINEERING

E-Resources:

1. NPTEL – Design of Steel Structures (IIT Kharagpur)
<https://nptel.ac.in/courses/105105162>
2. OSDAG (Open Source Design Aids for Steel Structures, IIT Bombay)
- <https://osdag.fossee.in>
3. Design of Steel Structures (IIT Kharagpur)
<https://nptel.ac.in/courses/105105162>
4. Advanced Design of Steel Structures (IIT Madras)
<https://nptel.ac.in/courses/114106047>
5. Design of Connections in Steel Structures (IIT Hyderabad)
<https://nptel.ac.in/courses/105106216>
6. INSDAG (Institute for Steel Development & Growth)
<https://www.insdag.org>

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: VI		
Course: Structural Steel Design Lab							Code: CEPC610P		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
-	02	-	01	-	-	-	50	-	50
Prerequisites:									
Fundamentals of Engineering Mechanics, Mechanics of Materials and Structural Analysis									
Course Objectives:									
1. To equip students with the principles and procedures for analysis and design of industrial steel buildings, multi-storey steel structures, and welded plate girders, including members, connections, column bases, stiffeners, and bracings as per IS 800:2007.									
2. To develop competency in applying manual design methods, structural analysis and design software, drafting tools, and practical steel fabrication and erection practices for preparing structural drawings and technical reports.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Analyze and design industrial steel buildings, multi-storey steel structures, and welded plate girders in accordance with IS 800:2007 and relevant design requirements.								
CO2	Evaluate the adequacy of steel members and connections, and justify suitable structural configurations, detailing, and fabrication arrangements using manual calculations and appropriate software.								
CO3	Develop structural layouts, fabrication and connection drawings, and technical site reports by interpreting field observations and steel construction practices.								
List of Experiments:									
1. Design of Industrial Steel Building									
Design of industrial steel building including roof truss, purlins, bracings, columns, column bases and connections as per IS 800:2007. Analysis may be carried out using suitable software. Three full imperial-size drawing sheets shall be prepared showing structural layout, member details, connection details and fabrication drawings.									
2. Design of Welded Plate Girder									
Design of welded plate girder including cross-section design, flange and web design, curtailment of flange plates, design of stiffeners and connections. One full imperial-size drawing sheet shall be prepared using suitable drafting/design software showing detailed fabrication and connection drawings.									
OR									
3. Design of Multi-Storey Steel Building									
Design of steel building including primary beams, secondary beams, columns, column bases and connections. Structural analysis shall be performed using suitable software and member design shall be carried out manually as per IS 800:2007. One full imperial-size drawing sheet shall be prepared showing framing plan, elevations and connection details.									
4. Field Visit and Technical Report									
Minimum two site visits shall be conducted to steel construction projects such as industrial buildings, steel fabrication workshops, pre-engineered buildings (PEB), warehouses, bridges or large-span steel structures. Students shall submit a detailed report containing observations, sketches, photographs, structural system details and fabrication/erection practices adopted at site.									

DEPARTMENT OF CIVIL ENGINEERING

IS Codes:

1. IS 800-2007: Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi
2. IS 808-1989: Dimensions for hot rolled steel beam, column, channel and angle sections, Bureau of Indian Standards, New Delhi
3. IS 875- Part 1 and 2 (1987) and Part 3 (2015): Code of practice for design loads (other than earthquake) for building and structures, Bureau of Indian Standards, New Delhi
4. IS 4000-1992: Code of practice for high strength bolts in steel structures, Bureau of Indian Standards, New Delhi
5. IS 816-1969: Code of practice for use of metal arc welding for general construction in mild steel, Bureau of Indian Standards, New Delhi
6. SP-6(1) and 6(6): ISI handbook for Structural Engineers, Bureau of Indian Standards, New Delhi
7. SP-38: Handbook for typified design for structures with steel roof trusses, Bureau of Indian Standards, New Delhi.

Reference Books:

1. Ghosh, Karuna, *Analysis and Design: Practice of Steel Structures*, PHI Learning Pvt. Ltd., New Delhi.
2. Raz, Sarwar Alam, *Structural Design in Steel*, New Age International Publishers, New Delhi.
3. Shah, V. L. and Gore, M. G., *Limit State Design of Steel Structures*, Structures Publications, Pune.
4. Duggal, S. K., *Limit State Design of Steel Structures*, McGraw Hill Education (India) Pvt. Ltd., New Delhi.
5. Bhavikatti, S. S., *Design of Steel Structures*, I.K. International Publishing House Pvt. Ltd., New Delhi.
6. Arya, A. S. and Ajmani, J. L., *Design of Steel Structures*, Nem Chand & Bros., Roorkee.
7. Salmon, C. G., Johnson, J. E. and Malhas, F. A., *Steel Structures: Design and Behavior*, Pearson Education.

DEPARTMENT OF CIVIL ENGINEERING

E-Resources:

1. NPTEL – Design of Steel Structures (IIT Kharagpur)
<https://nptel.ac.in/courses/105105162>
2. OSDAG (Open Source Design Aids for Steel Structures, IIT Bombay)
<https://osdag.fossee.in>
3. Design of Steel Structures (IIT Kharagpur)
<https://nptel.ac.in/courses/105105162>
4. Advanced Design of Steel Structures (IIT Madras)
<https://nptel.ac.in/courses/114106047>
5. Design of Connections in Steel Structures (IIT Hyderabad)
<https://nptel.ac.in/courses/105106216>
6. INSDAG (Institute for Steel Development & Growth)
<https://www.insdag.org>

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: VI		
Course: Quantity Surveying and Contract Management							Code: CEPC611		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
Basic Civil Engineering, Building Planning and Drawing, Construction Technology									
Course Objectives:									
1. To impart knowledge and practical skills in estimation, quantity surveying, and rate analysis essential for civil engineering project management.									
2. To equip students with the skills to prepare cost estimates, perform property valuation, and develop project budgets for efficient project management.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Specify type of estimate as per requirements.								
CO2	Demonstrate the drafting of specifications for civil engineering works in accordance with standard engineering practices.								
CO3	Implement quantity estimation procedures for buildings, roads, and infrastructure works to support project planning and execution.								
CO4	Evaluate the suitability of rates derived from standard schedules and market surveys.								
CO5	Analyze contract documents, tendering processes, and arbitration procedures to support the successful execution and management of construction projects.								
CO6	Develop valuation reports incorporating property characteristics, market conditions, and depreciation considerations.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Estimation and Costing Importance of estimation and costing in construction projects - Types of estimates - Units of measurement, Mode of measurements, schedule of rates (D.S.R.).								06
2.	Specifications Importance, Types, Standard Specifications for Various Works, Drafting Specifications for Major Works, Integration of Green Building Specifications.								06
3.	Quantity Estimation of Civil Works Methods of taking out quantities (centre line method, long & short wall method) - Estimation of buildings, roads, and other infrastructure - Bar bending schedule								09
4.	Rate Analysis and Costing Purpose and importance of rate analysis - Factors affecting cost of materials, labour, and machinery								06
5.	Contracts, Tendering and Arbitration Types of contracts and their suitability - Contract documents and legal aspects - Tendering procedures and bid evaluation, role of arbitrator								06
6.	Valuation and Depreciation Purpose of valuation and valuation methods - Factors affecting valuation of buildings and land - Depreciation and its types								06

DEPARTMENT OF CIVIL ENGINEERING

TOTAL	39
Text Books:	
1. B. N. Dutta, “Estimating and costing” , 28th Edition, UBH Publishing. 2. B. S. Patil, “Civil Engineering Contracts and Estimates”, 4th Edition, Universities press. 3. G. H. Birdie, “Estimating and Costing (Civil Engineering)”, 7th Edition 2015, Dhanpatrai Publishing 4. IS 1200 – Methods of Measurement of Building and Civil Engineering Works, Bureau of Indian Standards. 5. PWD and CPWD Schedule of Rates and Analysis of Rates.	
Reference Books:	
1. Chakraborti M. “Estimating, Costing and Specification in Civil Engineering”, 24th Edition, Chakraborti M 2. Rangwala, “Elements of Estimating and Costing”, 8th Edition, Charotar Publishing House. 3. D. Datta, “Valuation of Real Properties”, Eastern Law House. 4. Myneni S. R. “Arbitration, Conciliation and Alternative Dispute Resolution Systems”, Asia Law House Publishers.	
E-Resources:	
1. Various methods for the calculation of Approximate Estimate. https://www.youtube.com/watch?v=MKscrK-y6Jc 2. Specification its purpose & types. https://www.youtube.com/watch?v=xbd7DAEpx0c 3. Calculation of Detailed Quantities using Long Wall & Short Wall Method. https://www.youtube.com/watch?v=wFOTEYNesTg 4. Introduction to Rate Analysis. https://www.youtube.com/watch?v=ccH1exHjtlQ&list=PL76rcdJEAtFqKU8s8_-pAS4t677HslygN 5. Role of an Arbitrator https://www.youtube.com/watch?v=JAb5_hmdVHw 6. Types of Construction Contracts. https://www.youtube.com/watch?v=d5nXH6epJdU 7. Various methods used for calculating depreciation. https://www.youtube.com/watch?v=Ckxqx62jd_E	

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: VI		
Course: Quantity Surveying and Contract Management Lab							Code: CEPC611P		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
-	02	-	01	-	-	-	50	-	50
Prerequisites:									
Basic Civil Engineering, Building Planning and Drawing, Construction Technology									
Course Objectives:									
1. To equip students with the principles and procedures of quantity estimation, rate analysis, valuation, and costing for various building and civil engineering works.									
2. To develop competency in preparing specifications, quantities, BOQs, bar bending schedules, tender documents, and construction claim documentation using standard practices and DSR rates.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Determine quantities and approximate costs for load-bearing, RCC framed, and other civil engineering structures using appropriate estimation methods.								
CO2	Evaluate construction costs through rate analysis, DSR-based BOQs, valuation, depreciation, tendering, and claim-management procedures.								
CO3	Develop specifications, bar bending schedules, tender documents, and automated Excel-based estimation sheets and validate estimation practices through site observations.								
List of Experiments: Experiment No. 01 to 08 and 13 are compulsory and any 02 from Experiment No. 09 to 12.									
1. Estimate the approximate cost of multistoried buildings using any standard approximate estimation method.									
2. Draft detailed specifications of any five items of work.									
3. Prepare detailed quantities for a single storied load bearing structure using the Long Wall-Short Wall and Centre Line methods.									
4. Prepare detailed quantities of a G + 1 storied RCC framed structure.									
5. Prepare a Bill of Quantities (BOQ) for a single storied load bearing structure and RCC frame structure using DSR rates.									
6. Preparation of bar bending schedule for the G + 1 building as in exercise No. 4.									
7. Perform rate analysis for any five key construction items.									
8. Prepare a tender notice for a building structure based on the data provided in Assignment No. 5 and collect at least two sample tender notices for reference and comparative study.									
9. Compile a report on “Construction Claims: Documentation, Management, and Settlement”									
10. Evaluate the current value of a building considering depreciation using standard valuation techniques.									
11. Perform quantity take-off and cost estimation for water tank, road, and culvert construction projects (Any one of the above).									
12. Develop automated spreadsheets using Excel formulas for quantity estimation, cost computation for Assignment No. 3, 4, 5.									
13. A site visit related to content in Unit 3.									

DEPARTMENT OF CIVIL ENGINEERING

Reference Books:

1. Chakraborti M. "Estimating, Costing and Specification in Civil Engineering", 24th Edition, Chakraborti M
2. Rangwala, "Elements of Estimating and Costing", 8th Edition, Charotar Publishing House.
3. D. Datta, "Valuation of Real Properties", Eastern Law House.
4. Myneni S. R. "Arbitration, Conciliation and Alternative Dispute Resolution Systems", Asia Law House Publishers.

E-Resources:

1. Various methods for the calculation of Approximate Estimate.
<https://www.youtube.com/watch?v=MKscrK-y6Jc>
2. Specification its purpose & types.
<https://www.youtube.com/watch?v=xbd7DAEpx0c>
3. Calculation of Detailed Quantities using Long Wall & Short Wall Method.
<https://www.youtube.com/watch?v=wFOTEYNesTg>
4. Introduction to Rate Analysis.
https://www.youtube.com/watch?v=ccH1exHjtlQ&list=PL76rcdJEAtFqKU8s8_-pAS4t677HslygN
5. Role of an Arbitrator
https://www.youtube.com/watch?v=JAb5_hmdVHw
6. Types of Construction Contracts.
<https://www.youtube.com/watch?v=d5nXH6epJdU>
7. Various methods used for calculating depreciation.
https://www.youtube.com/watch?v=Ckxqx62jd_E

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: VI		
Course: Integrated Water Resource Management							Code: CEPE602A		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
Fundamentals of Water Resources Engineering, Hydrology, Irrigation Engineering, and Environmental Engineering.									
Course Objectives:									
1. To equip students with the principles and practices of integrated water resources planning and sustainable management.									
2. To prepare students to address water resource challenges through policy, governance, economic, environmental, and technological approaches.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Select appropriate integrated water management approaches considering policy and institutional requirements.								
CO2	Apply agricultural water management practices for sustainable water use.								
CO3	Analyze water quality, pollution control measures, and environmental regulations for effective water resource protection.								
CO4	Evaluate water economics and sustainable planning approaches for water resources projects.								
CO5	Analyze legal frameworks, water policies, and inter-basin water management strategies.								
CO6	Assess flood risks and determine appropriate flood mitigation and disaster management measures.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Integrated Water Management Framework Objectives, principles, challenges and needs, components, approaches, introduction of global water partnership (GWP), introduction of central water commission (CWC), national water policy (only introductory)								07
2.	Agriculture Context Water requirement for food production, blue Vs green water disputes, irrigation methods, current water pricing, ground water quality protection, sea water intrusion, ground water recharge, participatory irrigation management (PIM), water distribution society (WDS), water and land management institute (WALMI).								07
3.	Water Supply & Health Context Surface and ground water quality, water quality monitoring for basins, environmental impact assessment (EIA), central pollution control board (CPCB) regulations, need of training to water users, polluters pays principle, need of treatment facilities for domestic sewage and industrial effluents, implementation and monitoring of CPCB.								07
4.	Water Economics Context Water as an economic good, water scarcity, importance to the Indian economy, principles of planning and financing of water resources project, sustainability principles for water management, economics and decision making.								06

DEPARTMENT OF CIVIL ENGINEERING

5.	Legal Regulatory Settings context 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, importance of arbitration, Dublin Principles (1992)	06
6.	Flood Control & Power Generation context Importance, management of flood plains, flood risk mapping, flood forecasting and disaster relief, use of QGIS, effects of hydraulic structures on river surface profiles and sediment transport, hydro power generation, soft computing techniques for flood forecasting.	06
TOTAL		39
Text Books:		
1. Integrated Water Resources Management: Water in South Asia (Volume I), Peter P. Mollinga, Ajaya Dixit & Kusum Athukorala, SAGE Publications 2. Ecosystem Principles and Sustainable Agriculture, Sithamparanathan, Rangasamy A. & Arunachalam N. Scitech Publications (India) Pvt. Ltd., Chennai 3. Water Resources System Planning & Management, M. C. Chaturvedi, Tata McGraw Hill 4. Water Resources Systems Engineering, Daniel P. Loucks, Prentice Hall 5. Principles of Water Resources: History, Development, Management and Policy, Thomas V. Cech, John Wiley & Sons		
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 Resources 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,		

DEPARTMENT OF CIVIL ENGINEERING

E-Resources:

1. Central Water Commission
<https://cwc.gov.in>
2. Central Pollution Control Board
<https://cpcb.nic.in>
3. India-WRIS Portal
<https://indiawris.gov.in>
4. National Water Mission
<https://nwm.gov.in>
5. WALMI Maharashtra
<https://walmi.org>
6. Global Water Partnership
<https://www.gwp.org>
7. QGIS Documentation
<https://docs.qgis.org>
8. UN-Water Knowledge Hub
<https://www.unwater.org>
9. Rural Water Resources Management
https://onlinecourses.nptel.ac.in/noc22_ce45/preview
10. Groundwater Hydrology and Management
<https://nptel.ac.in/courses/105101214>
11. Engineering Hydrology – IIT Guwahati
<https://nptel.ac.in/courses/105103213>
12. Surface Water Hydrology – IIT Kharagpur
<https://nptel.ac.in/courses/105105214>
13. Water Resources Systems Planning and Management
<https://nptel.ac.in/courses/105108081>
14. Introduction to Irrigation Water Management
<https://nptel.ac.in/courses/105102159>

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: VI		
Course: Off-Site Construction Technologies							Code: CEPE602B		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
Basic knowledge of Building Materials, Concrete Technology, Reinforced Concrete Design, Construction Technology, Structural Analysis, and Engineering Drawing.									
Course Objectives:									
1. To equip students with the principles and practices of precast, modular, and industrialized construction systems.									
2. To prepare students to implement sustainable offsite construction using modern project management and emerging digital technologies.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Justify the adoption of precast and modular construction by evaluating their technical and economic advantages.								
CO2	Apply manufacturing techniques for precast concrete components.								
CO3	Analyze the design and connection systems of precast structures.								
CO4	Apply transportation, erection, and modular construction practices.								
CO5	Evaluate project management, quality, safety, and sustainability in off-site construction.								
CO6	Assess emerging technologies and innovations in off-site construction.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Offsite Construction Prefabrication, precast and modular construction, industrialized construction, advantages and limitations, types of precast and modular systems, applications, comparison with conventional construction, relevant Indian and international standards.								06
2.	Precast Components and Manufacturing Precast structural components, prestressed elements, production planning, moulds and formwork, reinforcement, casting, curing, quality control, storage, handling and factory logistics.								07
3.	Design and Connections of Precast Structures Structural behavior, design considerations, load transfer, tolerances, dry and wet connections, bolted, welded and grouted joints, diaphragm action, seismic provisions, detailing and design standards.								07
4.	Transportation, Erection and Modular Systems Transportation planning, lifting equipment, erection procedures, crane selection, safety during erection, volumetric, panelized and hybrid modular systems, modular housing and commercial buildings.								06
5.	Project Management, Quality and Sustainability Project planning, BIM applications, lean construction, quality assurance and control, inspection and testing, safety, risk assessment, sustainable construction, life cycle assessment and cost analysis.								06

DEPARTMENT OF CIVIL ENGINEERING

6.	Emerging Technologies and Case Studies Automation, robotics, digital fabrication, 3D printing, Industry 4.0, Modular Integrated Construction (MiC), smart cities, case studies, implementation challenges and future trends.	07
TOTAL		39
Text Books:		
1. Kim S. Elliott, Precast Concrete Structures, CRC Press. 2. Hubert Bachmann & Alfred Steinle, Precast Concrete Structures, Ernst & Sohn. 3. M. L. Gambhir, Precast Concrete Construction, McGraw Hill Education. 4. R. Chudley & R. Greeno, Building Construction Handbook, Routledge. 5. Gerhard Girmscheid, Industrialized and Automated Building Systems, Springer.		
Reference Books:		
1. IS 15916:2010 – Building Design and Erection Using Prefabricated Concrete. 2. IS 11447:1985 – Code of Practice for Construction with Large Panel Prefabricates. 3. PCI Design Handbook – Precast and Prestressed Concrete Institute. 4. fib Model Code for Concrete Structures. 5. Kim S. Elliott, “Offsite and Modular Construction Explained”, ICE Publishing. 6. R. S. Means, “Modular Construction Handbook”. 7. C. B. Burati and William C. Weed, “Quality Control in Construction Projects”. 8. Charles J. Kibert, “Sustainable Construction: Green Building Design and Delivery”, Wiley.		
E-Resources:		
1. NPTEL Course: Prefabricated Structures https://nptel.ac.in/courses 2. NPTEL Course: Modern Construction Materials and Techniques https://nptel.ac.in/courses/105106206 3. NPTEL Course: Construction Project Management https://nptel.ac.in/courses/105104161		

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: VI		
Course: Bridge Engineering							Code: CEPE602C		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
Fundamentals of Structural Analysis, Fluid Mechanics, Hydrology, and Surveying.									
Course Objectives:									
1. To develop students' ability to analyze and evaluate bridge-site, hydrological, loading, and structural requirements for safe and economical bridge planning.									
2. To enable students to select, design, and justify suitable bridge, culvert, substructure, bearing, and long-span structural systems based on functional, environmental, and site-specific conditions.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Classify and evaluate different types of bridges and select suitable bridge systems based on purpose, span, material, alignment, and site conditions.								
CO2	Analyze and determine basic hydrological parameters such as discharge, waterway, economic span, afflux, and scour depth for bridge planning.								
CO3	Apply and assess IRC loading standards and determine the effects of dead, live, impact, and load-distribution effects on bridge decks.								
CO4	Evaluate and select suitable abutments, piers, wing walls, return walls, and bearings based on structural and site requirements.								
CO5	Design and optimize basic pipe and box culverts and select suitable temporary bridge systems for given applications.								
CO6	Compare, evaluate, and recommend suitable special and long-span bridge systems based on span, structural behavior, materials, safety, economy, and site conditions.								
Course Contents:									
Unit	Description							Duration (Hrs.)	
1.	Introduction to Bridges and Bridge Site Investigation Definition and importance of bridges, classification of bridges based on purpose, span, material, alignment and structural system, factors affecting selection of bridge site, preliminary survey and detailed survey for bridge projects, data collection for bridge planning, introduction to bridge components: superstructure, substructure and foundation.							07	
2.	Hydrological Considerations in Bridge Design Computation of discharge, linear waterway, economic span, afflux, scour depth, effective width of waterway, introduction to river training works, importance of hydrological studies in bridge planning.							07	
3.	Bridge Loads and Deck Systems Introduction to design loads for bridges, IRC loading standards, dead load, live load and impact load, load distribution theory, introduction to bridge slabs, types of bridge decks, basic concepts of load transfer mechanism in bridges.							07	
4.	Bridge Substructure and Bearings Abutments: functions and types, piers: functions and types, wing walls and return walls, selection and suitability of substructure components, bearings: definition, purpose and importance, types of bearings and their suitability, introduction to							06	

DEPARTMENT OF CIVIL ENGINEERING

	maintenance of bearings.	
5.	Culverts and Temporary Bridges Culvert: definition, location and waterway determination, types of culverts, design of pipe culvert, design of single vent box culvert, temporary bridges: definition and applications, materials used in temporary bridges, introduction to timber bridges and floating (pontoon) bridges.	06
6.	Special and Long-Span Bridges Movable bridges: bascule, swing, lift, transporter, flying and cut boat bridges, requirement and suitability of movable bridges, fixed span bridges: simple, continuous and cantilever bridges, arch bridges, suspension bridges, bowstring girder bridges, rigid frame bridges, cable-stayed bridges, materials used for bridge superstructures.	06
TOTAL		39
Textbooks:		
1. Bridge Engineering, S. Ponnuswamy, McGraw Hill Education (India) Pvt. Ltd. 2. Bridge Engineering, D. J. Johnson Victor, Oxford & IBH Publishing Co. Pvt. Ltd. 3. Bridge Engineering, Rangwala S. C., Charotar Publishing House Pvt. Ltd. 4. Design of Bridges, N. Krishna Raju, Oxford & IBH Publishing Co. Pvt. Ltd. 5. Essentials of Bridge Engineering, D. J. Johnson Victor – Oxford & IBH Publishing Co. Pvt. Ltd.		
Reference Books:		
1. Bridge Engineering Handbook (Second Edition), Wai-Fah Chen & Lian Duan, CRC Press, Taylor & Francis Group 2. Bridge Engineering, Jim J. Zhao & Demetrios Tonias, McGraw Hill Education 3. Principles of Foundation Engineering, Braja M. Das, Cengage Learning 4. Tunnel Engineering, B. N. Singh, CBS Publishers & Distributors Pvt. Ltd. 5. Tunnel Design Methods, H. Bobet & Herbert H. Einstein, Springer 6. Bridge Engineering: Design, Rehabilitation and Maintenance of Modern Highway Bridges, Demetrios E. Tonias & Jim J. Zhao – McGraw Hill Education.		
Handbooks and Manuals:		
1. Indian Road Congress (IRC), Standard Specifications and code of practice for bridges. 2. Indian Road Congress (IRC), IRC:SP:91-2019 (Guidelines For Road Tunnels) 3. IS 5878 (Code of Practice for Construction of Tunnels) 4. IS 4756 (Safety code for Tunnel Working)		

DEPARTMENT OF CIVIL ENGINEERING

E-Resources:

1. NPTEL: Bridge Engineering (IIT (ISM) Dhanbad) – Prof. Piyali Sengupta
<https://nptel.ac.in/courses/105105216>
2. NPTEL Bridge Engineering – Course Preview
[NPTEL Course Preview](#)
3. NPTEL Reinforced Concrete Road Bridges
[NPTEL Reinforced Concrete Road Bridges](#)
4. Indian Road Congress (IRC)
www.irc.nic.in/
5. Ministry of Road Transport & Highways (MoRTH)
<http://morth.gov.in/>
6. Indian Standards (BIS) IS codes related to bridge and tunnel engineering
<https://www.bis.gov.in/>

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: VI		
Course: Structural Evaluation & Rehabilitation							Code: CEPE603A		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
04	-	-	04	40	60	-	-	-	100
Prerequisites:									
Basic knowledge of Strength of Materials, Reinforced Concrete Structures, Structural Analysis, Building Materials, and Earthquake Engineering.									
Course Objectives:									
1. To equip students with the principles and techniques of structural condition assessment, repair, rehabilitation, and retrofitting of concrete, masonry, steel, and special structures.									
2. To develop competency in selecting and applying suitable strengthening methods, including FRP systems, jacketing, overlays, seismic retrofitting, corrosion protection, and other rehabilitation techniques for improving structural performance and durability.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Assess structural deterioration, distress, and failure mechanisms using visual inspection, condition evaluation, and appropriate testing techniques.								
CO2	Evaluate the health of existing structures using inspection and testing methods.								
CO3	Select appropriate repair and strengthening methods for damaged concrete structures.								
CO4	Apply FRP composite systems for retrofitting and strengthening structural members.								
CO5	Analyze rehabilitation techniques for masonry, pavement and earthquake-damaged structures.								
CO6	Recommend suitable retrofitting measures for special and steel structures.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Retrofitting and Condition Assessment Overview of retrofitting and rehabilitation of civil infrastructure, causes of structural deterioration, need and objectives of retrofitting, structural distress and failure mechanisms, visual inspection methods, condition evaluation techniques, non-destructive testing methods, destructive testing methods, structural health assessment.								08
2.	Repair and Strengthening of Concrete Structures Causes of distress in concrete structures, corrosion of reinforcement, crack assessment and repair methods, grouting and injection techniques, repair materials and admixtures, concrete jacketing, steel jacketing, strengthening of beams, columns and slabs, quality control in repair works.								09
3.	Fiber Reinforced Polymer Composites (FRPC) Introduction to FRP composites, types of fibers and resins, properties and characteristics of FRP materials, mechanical behavior, durability aspects, advantages and limitations, bonding mechanisms, design considerations, applications in civil engineering structures.								08
4.	Retrofitting Using FRP Composites and Pavement Rehabilitation Flexural strengthening using FRP, shear strengthening using FRP, confinement of columns using FRP wraps, seismic retrofitting using FRP systems, installation procedures and quality assurance, performance evaluation of FRP-retrofitted								09

DEPARTMENT OF CIVIL ENGINEERING

	structures, concrete overlays, bonded overlays, unbonded overlays, pavement rehabilitation techniques.	
5.	Retrofitting of Masonry and Building Structures Assessment of masonry structures, causes of masonry deterioration, repair techniques for masonry structures, strengthening of masonry walls, retrofitting of buildings damaged due to seismic events, seismic strengthening methods, ductility enhancement measures, performance-based rehabilitation approaches.	09
6.	Retrofitting of Special and Steel Structures Assessment of special structures damaged due to seismic events, rehabilitation of bridges, water tanks and industrial structures, strengthening techniques for special structures, repair and retrofitting of steel structures, strengthening of steel members, corrosion protection methods, rehabilitation case studies.	09
TOTAL		52
Text Books:		
1. Denison Campbell, Allen and Harold Roper, "Concrete Structures: Materials, Maintenance and Repair", Longman Scientific & Technical. 2. Raouf A. Ghali and Neville G. Buckle, "Structural Repairs and Rehabilitation", CRC Press. 3. M. L. Gambhir, "Concrete Technology", Tata McGraw Hill Education. 4. Karbhari V. M., "Rehabilitation of Concrete Structures with Fiber Reinforced Polymer", Woodhead Publishing. 5. FIB Bulletin 14, "Externally Bonded FRP Reinforcement for RC Structures", International Federation for Structural Concrete.		
Reference Books:		
1. IS 15988:2013 – Seismic Evaluation and Strengthening of Existing Reinforced Concrete Buildings. 2. IS 456:2000 – Plain and Reinforced Concrete – Code of Practice. 3. IS 13920:2016 – Ductile Design and Detailing of Reinforced Concrete Structures. 4. ACI 440.2R – Guide for the Design and Construction of Externally Bonded FRP Systems. 5. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", PHI Learning. 6. S. K. Duggal, "Earthquake Resistant Design of Structures", Oxford University Press. 7. R. Dodge Woodson, "Concrete Structures: Protection, Repair and Rehabilitation", Butterworth-Heinemann. 8. Peter H. Emmons, "Concrete Repair and Maintenance Illustrated", R.S. Means Company.		
E-Resources:		
1. NPTEL – Retrofitting and Rehabilitation of Civil Infrastructure https://nptel.ac.in/courses/105105213?utm_source=chatgpt.com 2. NPTEL – Maintenance and Repair of Concrete Structures https://nptel.ac.in/courses/105106202?utm_source=chatgpt.com 3. NPTEL – Seismic Design of Building Structures https://nptel.ac.in/courses/105106830?utm_source=chatgpt.com		

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: VI		
Course: Geomatics Engineering							Code: CEPE603B		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
04	-	-	04	40	60	-	-	-	100
Prerequisites:									
Fundamentals of Physics, Mathematics, Computer basics, Surveying.									
Course Objectives:									
1. To equip students with the principles, techniques, and applications of Total Station, DGPS, Remote Sensing, and GIS for surveying, mapping, and spatial data analysis. 2. To develop competency in acquiring, processing, interpreting, and integrating geospatial data for applications in land-use mapping, topographical surveys, infrastructure planning, and water resource management.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Select appropriate Total Station methods for building layout, plot demarcation, traversing, trilateration, and road surveys based on field requirements.								
CO2	Determine suitable DGPS survey techniques, including static and RTK methods, for accurate positioning, elevation, and area measurement.								
CO3	Assess remote sensing data acquisition and processing techniques based on energy sources, electromagnetic radiation, sensor characteristics, and surface interactions.								
CO4	Differentiate satellite imagery based on spatial, spectral, radiometric, and temporal resolutions and interpret images using tone, texture, shape, pattern, and shadow.								
CO5	Organize and integrate raster, vector, spatial, thematic, and attribute data within GIS databases for effective spatial analysis.								
CO6	Recommend suitable GIS-based approaches for land-use/land-cover mapping, crop monitoring, and water-resource management using conventional and machine-learning techniques.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Total Station Construction, principle, functions, Stake out / Demarcation of Building Layouts / Plot Layouts, road survey application, special functions, Traversing and Trilateration measurement, data processing and analysis								08
2.	Differential Global Positioning System Principle, function, applications, dual and single frequency DGPS, RTK and static surveys in DGPS, use of DGPS in topographical survey, base, rover, DGPS connections and settings, point data collection (Easting, Northing and Height), area measurement, data processing and analysis.								08
3.	Remote sensing Energy Source, surface interaction, Data Acquisition (Sensors), Data Processing and analysis ,EMR, Types of remote sensing								08
4.	Resolutions and Image Interpretation Techniques Types of Resolutions, Remote sensing platforms, Bhuvan (ISRO), USGS Landsat, IRS, Sentinel, MODIS, Geostationary and polar orbit satellites. Visual interpretation techniques, Elements of interpretation: Tone, Texture, Shape, Pattern Shadow.								10

DEPARTMENT OF CIVIL ENGINEERING

5.	Geographic Information System (GIS) Components, types of data inputs, spatial data, thematic characteristics, rasters and vectors, databases and database management.	09
6.	GIS information transformation Data transfer from Raw GIS to usable GIS layer, LULC (Land Use Land Cover), traditional GIS, ML (machine Learning) GIS, case study of crop monitoring outputs, water resource intelligence	09
TOTAL		52

Text Books:

1. Principals of Remote Sensing, Panda B C, Viva Books Private Limited
2. Remote Sensing & Geographical Information System, M. Anji Reddy, BS Publications, Hyderabad.
3. Textbook on Remote Sensing, C. S. Agarwal and P. K. Garg, Wheeler Publishing
4. Advanced Surveying: Total Station, GIS and Remote Sensing, Satheesh, G., Sathikumar, R. and Madhu, N., Pearson Education, Delhi

Reference Books:

1. Remote Sensing & Digital Image Processing, John R. Jensen, Department of Geography University of South Carolina Columbia.
2. Remote Sensing and Image Interpretation, Lilles and Thomas M. and Kiefer Ralph, John Wiley
3. Basic Concept of Remote Sensing, GPS, and GIS, Shivam Pandey, Sankalp Publication, Gaurav Path, Bilaspur Chhathisgarh-4955001 ISBN: 978-81-94-77801-1

E-Resources:

1. Video on total station
<https://youtu.be/K8SEfTzpskg?si=F1mA-rVz0WqeC9wN>
2. NPTEL Video on GPS errors and DGPS
<https://www.youtube.com/watch?v=H6h5Rt7iqJA>
3. NPTEL Video on “Digital Land surveying and mapping”
<http://www.digimat.in/nptel/courses/video/105107158/L17.html>
4. NPTEL video on Remote Sensing
<https://youtu.be/WupQaRapFvw?si=aEiqR53P-24uBeIu>
5. Video on GIS
<https://youtu.be/Z1eiKW8TwVw?si=IFHTW3ZAOppRYOPV>
6. Video on A guide to GIS
https://youtu.be/gCGMWVtu1SU?si=e6UD_nQpUXg3KTV9

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: VI		
Course: Design of Prestressed Concrete Structures							Code: CEPE603C		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
04	-	-	04	40	60	-	-	-	100
Prerequisites:									
Basic knowledge of Strength of Materials, Structural Analysis, Reinforced Concrete Design, Engineering Mechanics, Concrete Technology, and Design of Concrete Structures.									
Course Objectives:									
1. To develop the fundamental concepts and principles of prestressed concrete and its applications in civil engineering structures.									
2. To enable students to analyze and design prestressed concrete members as per relevant Indian Standards for various loading conditions.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Explain the principles, materials and systems of prestressed concrete structures.								
CO2	Analyze stresses and losses in prestressed concrete members.								
CO3	Design prestressed concrete beams for flexure and shear.								
CO4	Design end block regions, anchorage zones and evaluate serviceability requirements.								
CO5	Design composite and continuous prestressed concrete structures.								
CO6	Assess the applications, construction practices and durability requirements of prestressed concrete structures.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Introduction to Prestressed Concrete Concept of prestressing, historical development, advantages and limitations, principles of prestressing, comparison between reinforced and prestressed concrete, materials for prestressed concrete, high-strength concrete, prestressing steel, methods of prestressing, pre-tensioning and post-tensioning systems, types of tendons, anchorages, ducts, relevant Indian Standards and IRC provisions.								09
2.	Analysis of Prestressed Concrete Members Basic assumptions, stress concept, load balancing concept, pressure line and thrust line, stresses at transfer and service stages, kern distances, stress distribution, cable profiles, concentric and eccentric prestressing, calculation of stresses under working loads.								08
3.	Losses of Prestress and Design for Flexure Losses due to elastic shortening, creep, shrinkage, relaxation of steel, anchorage slip, friction and wobble effect, total losses of prestress, permissible stresses, ultimate flexural strength, design of rectangular and T-section prestressed beams, tendon profile selection, limit state design provisions as per IS 1343.								08
4.	Shear, Bond, Anchorage and End Block Design Shear in prestressed concrete members, principal tensile stress, shear resistance, design for shear reinforcement, bond and transmission length, anchorage devices, bursting and spalling stresses, Guyon's method, Magnel's method, design of end blocks, detailing requirements.								09

DEPARTMENT OF CIVIL ENGINEERING

5.	Composite and Continuous Prestressed Concrete Structures Composite beams, precast and cast-in-situ construction, analysis and design of composite sections, continuous prestressed beams, secondary moments, redistribution of moments, serviceability requirements, deflection and crack control, durability considerations.	09
6.	Applications and Construction Practices Prestressed bridges, railway sleepers, water tanks, silos, pressure pipes, piles, offshore and marine structures, construction techniques, grouting operations, inspection and quality control, maintenance and rehabilitation of prestressed structures, recent developments including external prestressing, segmental construction and UHPC applications.	09
TOTAL		52
Text Books:		
1. N. Krishna Raju, Prestressed Concrete, Tata McGraw-Hill. 2. P. Dayaratnam, Prestressed Concrete Structures, Oxford University Press. 3. T.Y. Lin and Ned H. Burns, Design of Prestressed Concrete Structures, Wiley. 4. M.L. Gambhir, Prestressed Concrete Design, McGraw Hill Education. 5. S. Ramamrutham, Prestressed Concrete, Dhanpat Rai Publications.		
Reference Books:		
1. IS 1343:2012 – Code of Practice for Prestressed Concrete. 2. IRC:112 – Code of Practice for Concrete Road Bridges. 3. PCI Design Handbook – Precast/Prestressed Concrete Institute. 4. Edward G. Nawy, Prestressed Concrete – A Fundamental Approach, Pearson. 5. Y. Guyon, Prestressed Concrete, Wiley. 6. R.I. Gilbert and N.C. Mickleborough, Design of Prestressed Concrete, CRC Press. 7. FIB Model Code for Concrete Structures. 8. BIS SP:34 – Handbook on Concrete Reinforcement and Detailing.		
E-Resources:		
1. NPTEL – Prestressed Concrete Structures https://nptel.ac.in/courses 2. NPTEL – Design of Concrete Structures https://nptel.ac.in/courses 3. IIT Madras – Prestressed Concrete (NPTEL Video Lectures) https://nptel.ac.in/courses/105106118 4. IIT Hyderabad – Advanced Reinforced and Prestressed Concrete https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ce132 5. Indian Roads Congress (IRC) Publications https://irc.nic.in/ 6. Precast/Prestressed Concrete Institute (PCI) Technical Resources https://www.pci.org/		

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: VI		
Course: Smart Cities and Technology							Code: CEMD604		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
03	-	-	03	40	60	-	-	-	100
Prerequisites:									
Basic Civil Engineering, Project Management									
Course Objectives:									
1. To familiarize students with concepts, policies, and planning approaches for smart and sustainable cities.									
2. To develop students' understanding of digital technologies, urban infrastructure planning, and disaster resilience in smart cities.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Justify smart city planning decisions based on sustainability principles and performance benchmarks.								
CO2	Apply smart planning approaches and infrastructure development techniques for urban systems.								
CO3	Analyze the feasibility, governance, and financing of smart city infrastructure projects.								
CO4	Examine the role of smart technologies in urban planning and infrastructure development.								
CO5	Recommend appropriate GIS and remote sensing applications for sustainable urban planning and decision-making.								
CO6	Evaluate smart technologies for disaster management considering ethical and societal aspects.								
Course Contents:									
Unit	Description								Duration (Hrs.)
1.	Smart cities Smart & sustainable cities, dimensions, scope, global standards and performance benchmarks, practice code, principal stakeholders, key trends in smart cities developments, concept of sustainable cities								08
2.	Planning and Development City planning, Sustainable features for smart cities, role of planner in the provision of urban networks for different services.								06
3.	Infrastructure Planning and Development Feasibility studies for infrastructure projects, planning for major infrastructure projects, various infrastructure programs and policies by the Ministry of Urban Development, Dimension, Finance, Governance, Regulations								07
4.	Smart Technologies Enabling, infrastructure, applications in urban planning, challenges and future trends.								06
5.	GIS and remote sensing approach to smart cities: Applications, urban planning and management, transportation planning, environmental management and sustainability.								06
6.	Smart Technologies for disaster management Phases of disaster management, Role of technology, Drones, use of automation and robotics, Sensor based technologies, Real-world examples of smart								06

DEPARTMENT OF CIVIL ENGINEERING

	technologies, Ethical issues related to the use of smart technologies.	
	TOTAL	39
Text Books:		
1. Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia – Anthony M. Townsend – W. W. Norton & Company. 2. Geographic Information Systems and Science – Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind – John Wiley & Sons. 3. Remote Sensing and Image Interpretation – Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman – John Wiley & Sons. 4. Urban Planning: Theory and Practice – S. P. Singh – CBS Publishers & Distributors Pvt. Ltd. 5. Smart Cities: Concepts, Perceptions and Lessons for Planners – H. S. Geyer (Ed.) – Edward Elgar Publishing.		
Reference Books:		
1. Inclusive and Sustainable Urban Planning: A Guide for Municipalities (Volume 3: Urban Development Planning) – UN-Habitat – United Nations Human Settlements Programme. 2. A City for All: Valuing Differences and Working with Diversity – Jo Beall – Zed Books Ltd. 3. Insights into Inclusive Growth, Employment and Wellbeing in India – Arup Mitra – Springer India. 4. Smart City Mission: Statement and Guidelines – Ministry of Housing and Urban Affairs (Government of India) – Government of India Publication. 5. GIS Fundamentals: A First Text on Geographic Information Systems – Paul Bolstad – Eider Press.		
E-Resources:		
1. NPTEL – Smart Cities (IIT Indore) https://nptel.ac.in/courses/105106832 2. NPTEL – Geo Spatial Analysis in Urban Planning (IIT Kharagpur) – https://nptel.ac.in/courses/105105202 3. NPTEL – Remote Sensing and GIS (IIT Guwahati) – https://nptel.ac.in/courses/105103193 4. NPTEL – Remote Sensing: Principles and Applications (IIT Bombay) – https://nptel.ac.in/courses/105101206 5. NPTEL – Urban Transport Systems Planning (IIT Kharagpur) – https://nptel.ac.in/courses/105105208		

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: VI		
Course: Computer-Aided Building Drafting with Revit							Code: CEVS605		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
-	04	-	02	-	-	25	50	-	75
Prerequisites:									
Engineering Drawing / Engineering Graphics, Basic knowledge of Building Construction, Fundamentals of CAD (AutoCAD preferred), Basic understanding of building components (walls, slabs, beams)									
Course Objectives:									
1. To equip students with the fundamental principles and tools of Autodesk Revit Architecture for developing accurate architectural models and drawings. 2. To develop competency in building modeling, detailing, site development, visualization, rendering, documentation, and preparation of professional architectural presentation sheets using Revit.									
Course Outcomes: After completion of this course students will be able to -									
CO1	Navigate the Revit Architecture interface and configure project settings, units, levels, grids, templates, and basic drafting tools.								
CO2	Create and modify architectural building elements such as walls, floors, roofs, columns, doors, windows, curtain walls, and mullions.								
CO3	Develop detailed building models incorporating stairs, ramps, railings, openings, shafts, dormers, rooms, materials, tags, and area calculations.								
CO4	Generate site models and architectural massing with topography, parking layouts, graded regions, and external site elements.								
CO5	Produce 3D views, camera perspectives, rendered images, and visualization presentations using appropriate Revit display and rendering tools.								
CO6	Prepare professional architectural sheets with dimensions, annotations, legends, schedules, and documentation suitable for project submission and presentation.								
List of Experiments:									
1. Introduction to Revit Interface, Project Setup, Units, and Levels 2. Creation of Walls, Floors, and Architectural Layouts 3. Modeling of Doors, Windows, and Curtain Walls 4. Roof Creation and Staircase Modeling 5. Architectural Detailing using Railings, Ramps, and Openings 6. Interior Components, Materials, and Room Tagging 7. Site Development using Topography and Parking Components 8. Preparation of 3D Views, Rendering, Sheets, and Submission Drawings									
Text Books:									
1. Autodesk Revit Architecture Essentials – Ryan Duell & Tobias Hathorn 2. Mastering Autodesk Revit Architecture – James Vandezande 3. Introducing Autodesk Revit Architecture – Patrick Davis									
Reference Books:									
1. Autodesk Revit Architecture for Designers – Prof. Sham Tickoo 2. Residential Design Using Autodesk Revit – Daniel John Stine 3. Interior Design Using Autodesk Revit – Daniel John Stine									

DEPARTMENT OF CIVIL ENGINEERING

E-Resources:

1. Autodesk Revit Product Page
<https://www.autodesk.com/in>
2. Autodesk Knowledge Network
<https://boards.autodesk.com/aec-pabm-nurture/>
3. Autodesk Revit Tutorials YouTube Channel
<https://www.youtube.com/c/RevitTutorials>

DEPARTMENT OF CIVIL ENGINEERING

Program: B. Tech (Civil Engineering)							Semester: VI		
Course: Internship – IV							Code: CEIN605		
Teaching Scheme (Hrs/week)				Evaluation Scheme (Marks)					
Lecture	Practical	Tutorial	Credit	CIE	ETE	TW	OR	PR	Total
4 Weeks			02	-	-	25	-	-	25
Preamble:									
Internships serve as vital educational and career development experiences, offering practical exposure in a specific field. Employers seek individuals who possess the necessary skills and an understanding of industry environments, practices, and cultures. This internship is designed as a structured, short-term, supervised training program, often centered on specific tasks or projects with clear timelines. The primary goal is to immerse technical students in an industrial setting, providing experiences that cannot be replicated in the classroom. This exposure aims to develop competent professionals who understand the social, economic, and administrative factors influencing the operations of industrial organizations.									
Course Objectives:									
1. Exposure to students to the industrial environment, which cannot be provided in the classroom and hence creating deployable professionals for the industry. 2. Learn to implement the technical knowledge in real industrial situations									
Course Outcomes: After completion of this course students will be able to -									
CO1	Gain exposure to industry practices and understand how academic concepts are applied in professional settings.								
CO2	Develop and demonstrate effective communication and teamwork skills within a work environment.								
CO3	Improve your problem-solving and time management skills by working in real-world industry settings.								
Internship Requirements:									
1. Internship Duration: It is mandatory for all students to undergo an internship after every semester during vacations for the duration of 4 weeks. Internships completed during this period will be considered for the assessment of Term Work (TW). 2. Internship Opportunities: Students can explore various opportunities for internships at: a. Industries b. Research labs or organizations c. Collegiate clubs d. In-house research projects e. Online internships 3. Support and Assistance: Students can seek assistance for securing internships from: a. The Training and Placement cell, along with departmental coordinators b. Department or institute faculty members c. Personal contacts d. Directly connecting with industries or organizations 4. Request Letter: Once an industry, research organization, or collegiate club is identified, students must obtain a request letter from the concerned department or placement office. This letter, in the standard format must be duly signed by the authority, should be addressed to the HR manager or relevant authority.									

DEPARTMENT OF CIVIL ENGINEERING

5. **Confirmation Letter:** Students must submit the confirmation letter from the industry, research organization, or collegiate club to the Internship Coordinator and the Head of Department (HOD) office.
6. **Joining Report:** Upon commencing the internship, students must submit the joining report, joining letter, or a copy of the confirmation email to the Internship Coordinator and the HOD office.
7. **Faculty Mentor:** A faculty member will be assigned as a mentor to a group of students. The mentor will be responsible for monitoring, evaluating, and assessing student internship activities. The faculty mentor is also required to visit the internship location and submit formal feedback to the Internship Coordinator.
8. **Faculty Visits:** Faculty members are advised to visit the internship site once or twice during the internship period to monitor progress.
9. **Progress Report:** Students must submit progress report fortnightly to their faculty guide and the final internship report to the Internship Coordinator and department office.
10. **Evaluation Report:** After the completion of the internship, the mentor, along with the assessment panel members, should submit the evaluation report of the students to the department office and the Internship Coordinator.
11. **Internship Certificate:** Students must receive the Internship Certificate from the industry and submit it to the Internship Coordinator and department office.
12. **Presentation and Assessment:** Students are required to give a presentation on their internship work as part of the term work. The internship diary and report will also be verified and assessed.