CHARUSAT
CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

ACADEMIC REGULATIONS & SYLLABUS

(Choice Based Credit System)

Faculty of Technology & Engineering
Chandubhai S Patel Institute of Technology
M. S. Patel Department of Civil Engineering
Bachelor of Technology Programme

(Fourth Year Civil Engineering)

Effective from 2025-26

Chandubhai S Patel Institute of Technology

Vision

"To provide state of the art education in Civil Engineering guided by innovative research leading to centre of excellence in Civil Engineering education having recognition at national and international levels"

Mission

"Being a pioneering branch of Engineering, the department of Civil Engineering under the shelter of CHARUSAT is intended as a facilitator for creating a liaison between the brilliant student community and the next generation industrial needs"

Programme Educational Objectives (PEO's):

PEO 1: The graduate will possess foundation of engineering knowledge and exhibiting critical thinking and problem solving skills

PEO 2: The graduates will have trait of lifelong learning and be able to inculcate the capabilities to meet the diversified needs of industry, academia and research.

PEO 3: The graduate will exhibit the professional ethics and be supportive to the social needs

PEO 4: The graduates will possess comprehending, analyzing and designing capabilities to generate sustainable solutions

Programme Outcomes (PO's)

Engineering Graduates will be able to:

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

© CHARUSAT 2025-26

3. **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSO's):

By the completion of Civil Engineering program, the student will attain:

PSO 1: The ability to serve the infrastructure sector with capabilities to plan, design, analyze and building civil engineering-based systems

PSO 2: The ability to adopt to the state-of-the-art practices in all sectors of Civil Engineering.

PSO 3: Employability skills with the cognizance of social and environmental necessity along with ethical responsibility to have a successful career and to become an entrepreneur.

CHARUSAT welcomes you for a Bright Future

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY
Accredited with Grade A by NAAC,
Accredited with Grade A by KCG

Faculty of Technology and Engineering

ACADEMIC REGULATIONS

Bachelor of Technology (Civil Engineering) Programme

Charotar University of Science and Technology (CHARUSAT)
CHARUSAT Campus, At Post: Changa – 388421, Taluka: Petlad, District: Anand
Phone: 02697-247500, Fax: 02697-247100, Email: info@charusat.ac.in
www.charusat.ac.in

© CHARUSAT 2025-26

Academic Year – 2025-26

CHARUSAT

FACULTY OF TECHNOLOGY AND ENGINEERING
ACADEMIC REGULATIONS
Bachelor of Technology Programmes

To ensure uniform system of education, duration of undergraduate and post graduate programmes, eligibility criteria for and mode of admission, credit load requirement and its distribution between course and system of examination and other related aspects, following academic rules and regulations are recommended.

1. System of Education

The Semester system of education should be followed across the Charotar University of Science and Technology (CHARUSAT) both at Undergraduate and Master's levels. Each semester will be at least of 90 working days duration. Every enrolled student will be required to take a specified load of course work in the chosen subject of specialization and also complete a project/dissertation if any.

2. *Duration of Programme*

Undergraduate programme (B. Tech.)

Minimum	8 semesters (4 academic years)
Maximum	12 semesters (6 academic years)

3. Eligibility for Admissions

As enacted by Govt. of Gujarat from time to time.

4. *Mode of Admissions*

As enacted by Govt. of Gujarat from time to time.

5. *Programme Structure and Credits*

As per Annexure – I attached

6. Attendance

All activities prescribed under these regulations and enlisted by the course faculty members in their respective course outlines are compulsory for all students pursuing the courses. No exemption will be given to any student regarding attendance except on account of serious personal illness or accident or family calamity that may genuinely prevent a student from attending a particular session or a few sessions. However, such unexpected absence from classes and other activities will be required to be condoned by the Principal.

Student's attendance in a course should be 80%.

7. Course Evaluation

7.1 The performance of every student in each course will be evaluated as follows:

7.1.2 Internal evaluation by the course faculty member(s) based on continuous assessment, for 30% of the marks for the course; and

7.1.3 Final examination by the University through modes such as; written paper or practical test or oral test or presentation by the student or a combination of any two or more of these, is set to 70% of the marks for each the course.

7.2 Internal Evaluation

As per Annexure – 1 attached

7.3 University Examination

The final examination by the University for 70% of the evaluation for the course will be through written paper or practical test or oral test or presentation by the student or a combination of any two or more of these.

7.4 In order to earn the credit in a course a student has to obtain grade other than FF.

7.5 Performance at Internal & University Examination

7.5.1 Minimum performance with respect to internal marks as well as university examination will be an important consideration for passing a course.
Details of minimum percentage of marks to be obtained in the examinations (internal/external) are as follows:

Minimum marks in University Exam per course	Minimum marks Overall per course
40%	45%

7.5.2 A student failing to score 40% in the final examination will get an FF grade.

7.5.3 If a candidate obtains minimum required marks in each course but fails to obtain minimum required overall marks, he/she has to repeat the university examination till the minimum required overall marks are obtained.

8. Grading

8.1 The total of the internal evaluation marks and final University examination marks in each course will be converted to a letter grade **on** a ten-point scale as per the following scheme:

Table: Grading Scheme (UG)

Range of Marks (%)	**≥80**	**‹80 ≥73**	**‹73 ≥66**	**‹66 ≥60**	**‹60 ≥55**	**‹55 ≥50**	**‹50 ≥45**	**‹45**
Corresponding Letter Grade	**AA**	**AB**	**BB**	**BC**	**CC**	**CD**	**DD**	**FF**
Numerical point (Grade Point) corresponding to the letter grade	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**0**

8.2 The student's performance in any semester will be assessed by the Semester Grade Point Average (SGPA). Similarly, his/her performance at the end of two or more consecutive semesters will be denoted by the Cumulative Grade Point Average (CGPA). The SGPA and CGPA are calculated as follows:

(i) SGPA = $\Sigma C_i G_i / \Sigma C_i$ where,
C_i= Number of credits of course i
G_i = Grade Point for the course i
i = 1 to n
n = number of courses in the semester

(ii) CGPA = $\Sigma C_i G_i / \Sigma C_i$ where,
C_i = Number of credits of course i
G_i = Grade Point for the course i
i = 1 to n
n = number of courses of all semesters up to which CGPA is computed

(iii) No student will be allowed to move further in next semester if CGPA is less than 3 at the end of an academic year.

(iv) A student will not be allowed to move to third year if he/she has not cleared all the courses of first year.

(v) A student will not be allowed to move to fourth year if he/she has not cleared all the courses of first and second year.

9. Award of Degree

9.1 Every student of the programme who fulfills the following criteria will be eligible for the award of the degree:

9.1.1 He/ She should have earned minimum required credits as prescribed in course structure; and

9.1.2 He/ She should have cleared all internal and external evaluation components in every course; and

9.1.3 He/ She should have secured a minimum **CGPA of 4.5** at the end of the programme;

9.1.4 In addition to above, the student has to complete the required formalities as per the regulatory bodies, if any.

9.2 The student who fails to satisfy minimum requirement of CGPA will be allowed to improve the grades so as to secure a minimum CGPA for award of degree. Only latest grade will be considered.

10. Award of Class

The class awarded to a student in the programme is decided by the final CGPA as per the following scheme:

Distinction	:	CGPA ≥ 7.5 & ≤ 10.0
First class	:	CGPA ≥ 6.0 & < 7.5
Second Class	:	CGPA ≥ 5.0 & < 6.0
Pass	:	CGPA < 5.0

11. Transcript

The transcript issued to the student at the time of leaving the University will contain a consolidated record of all the courses taken, credits earned, grades obtained, SGPA, CGPA, class obtained, etc.

Annexure – 1

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY (CHARUSAT)															
TEACHING & EXAMINATION SCHEME FOR B TECH PROGRAMME IN CIVIL ENGINEERING (CBCS)															
Level	**Course Code**	**Course Title**	**Teaching Scheme**								**Examination Scheme**				
			Contact Hours				Credit				Theory		Practical		Total
			Theory	Practical	Tutorial	Total	Theory	Practical	Project	Total	Internal	External	Internal	External	
Level 4	CL451	Design of Reinforced Concrete Structures	3	2	1	6	3	1		4	30	70	25	25	150
	CL452	Design Of Steel Structures	3	2	1	6	3	1		4	30	70	25	25	150
	CL445	Summer Internship - II	0	3	0	3	0	0	3	3	0	0	75	75	150
	CL453	Construction Project Management	3	2	0	5	3	1		4	30	70	25	25	150
	CL454	Geotechnical Engineering - II	3	2	1	6	3	1		4	30	70	25	25	150
	CL455	Professional Practices	3		1	4	3	0		3	30	70	0	0	100
	CL470-496	Programme Elective - III	3	2	0	5	3	1		4	30	70	25	25	150
						35				**26**					**1000**
	CL458	Major Project	0	36	0	**36**	0	0	18	**18**	0	0	400	400	**800**

CONTENTS

SYLLABI (SEMESTER – 7) 12
CL451: DESIGN OF REINFORCED CONCRETE STRUCTURES 13
CL452: DESIGN OF STEEL STRUCTURES 17
CL445: SUMMER INTERNSHIP-II 21
CL453 CONSTRUCTION PROJECT MANAGEMENT 27
CL454: GEOTECHNICAL ENGINEERING – II 32
CL455: PROFESSIONAL PRACTICES 37
CL470: STRUCTURAL DYNAMICS & EARTHQUAKE ENGINEERING 41
CL471: ADVANCED STRUCTURAL ANALYSIS 45
CL478: TRANSPORATION ENGINEERING- II 48
CL479: ENVIRONMENTAL ENGINEERING- II 54
CL487: ADVANCED CONSTRUCTION TECHNOLOGY 58
CL489: ENVIORNMENTAL POLLUTION AND CONTROL 62
CL496: GREEN BUILT ENVIRONMENT 66
OCCL4001: AIR POLLUTION AND CONTROL 69
OCCL4002: SOIL STRUCTURE INTERACTION 72
OCCL4003: TRAFFIC ENGINEERING 75
OCCL4004: URBAN TRANSPORTATION SYSTEMS PLANNING 77
OCCL4005: ADVANCED FOUNDATION ENGINEERING 81
OCCL4006: VIBRATION OF CONTINUOUS SYSTEMS 83
OCCL4007: MICROWAVE REMOTE SENSING IN HYDROLOGY 86
OCCL4008: ROCK MECHANICS AND TUNNELING 89
OCCL4009 BRIDGE ENGINEERING 91
OCCL4010: FINITE ELEMENT ANALYSIS AND CONSTITUTIVE MODELLING IN GEOMECHANICS 94
ANNEXURE II – ELECTIVE for B.Tech. (Hons.) Programs in Civil Engineering 97
CL465: SMART WATER MANAGEMENT SYSTEMS 98
SYLLABI (SEMESTER – 8) 103
CL458: MAJOR PROJECT 104

© CHARUSAT 2025-26

B. Tech. (Civil Engineering) Programme

SYLLABI (SEMESTER – 7)

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

CL451: DESIGN OF REINFORCED CONCRETE STRUCTURES

B TECH 7th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

Teaching Scheme	Theory	Tutorial	Practical	Total	Credit
Hours/week	3	1	2	6	4
Marks	100	-	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Load Assessment and Design Philosophy	02
2	Design of Beams	07
3	Design of Conventional Slabs	06
4	Design of Compression Members	07
5	Design of Footings	04
6	Design of Staircase	03
7	Design of Retaining Wall	06
8	Design of Flat Slab	05
9	Analysis & Design of Multi-storied Building	05

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1 Load Assessment and Design Philosophy **02 Hours** **4%**

1.1 Dead Load, Live Load, Wind Load, Earthquake Load and Load Combinations

1.2 Basic Design Philosophy: Working Stress Method, Limit State Method

1.3 Indian Standard Provisions, Failures of Structures

2 Design of Beams **07 Hours** **16%**

2.1 Methods of design of concrete structures

2.2	Limit state of collapse: Flexure, compression, shear		
2.3	Characteristic design values & partial safety factors		
2.4	Limit state of serviceability: Deflection, cracking		
2.5	Basis of design, loads & forces		
2.6	Behavior of R.C.C. beams under design loads		
2.7	Design of singly reinforced sections		
2.8	Design of doubly reinforced sections		
2.9	Design of T- sections		
2.10	Detailing of Beams		
3	**Design of Conventional Slabs**	**06 Hours**	**13%**
3.1	Types of slabs		
3.2	Design of One-way slab (simply supported)		
3.3	Design of Two-way slab (restrained, simply supported)		
3.4	Detailing of Slab		
4	**Design of Compression Members**	**07 Hours**	**16%**
4.1	Analysis & design of axially loaded short column		
4.2	Design of axially loaded column with uni & bi-axial Bending		
4.3	Detailing of Column		
5	**Design of Footings**	**04 Hours**	**9%**
5.1	Pressure distribution under Footing		
5.2	Design of isolated footing (square & oblong)		
5.3	Design of Combined Footing		
5.4	Detailing of Footing		
6	**Design of Staircase**	**03 Hours**	**7%**
6.1	Classification of Stairs		
6.2	Design Requirements of Stairs		
6.3	Design of Dog-legged Staircase		
6.4	Detailing of Staircase		
7	**Design of Retaining Wall**	**06 Hours**	**13%**
7.1	Types of Retaining Wall		
7.2	Active & Passive Earth Pressure		
7.3	Design of Cantilever Retaining Wall		
7.4	Design of Counter fort Retaining Wall		

7.5 Detailing of Retaining Wall

8 Design of Flat Slab **05 Hours** **11%**

8.1 Types and Components of Flat Slab

8.2 Design of flat slab by direct method based on IS: 456

8.3 Detailing of Flat Slab

9 Analysis & Design of Multi-Storey Frame Buildings **05 Hours** **11%**

9.1 Structural Layout of Building

9.2 Design loads on buildings: Gravity, Wind and Earthquake loads

9.3 Member proportioning

9.4 Analysis and design of RCC framed buildings

9.5 Detailing of Members

C. Course Outcomes (CO):

On the successful completion of this course one should be able to

CO1 Analyse and design singly and doubly reinforced concrete beams under flexure and shear, including regular (rectangular shaped) and T-beams.

CO2 Analyse and design one way slab, two way slab, and reinforced concrete columns.

CO3 Analyse and design isolated and combined footings.

CO4 The students can identify the typical failure modes of staircase and retaining walls with detailing.

CO5 Students can understand the load transfer mechanism in multi-story building and also perform analysis and design of all structural members.

CO6 The students can able to understand the behaviour of flat slab under forces and application of design with detailing.

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	2	-	1	-	-	-	-	-	-	3	3	3	3
CO2	3	3	2	1	1	-	-	-	-	-	1	3	3	3	3
CO3	3	2	2	-	1	-	-	1	-	1	1	2	3	3	3
CO4	1	2	1	1	-	-	-	1	-	1	2	2	3	2	3
CO5	2	1	3	-	1	-	-	1	-	2	1	2	1	2	1
CO6	1	2	1	1	-	-	-	1	-	1	2	2	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

D. Recommended Study Material:

Text Books:

1. Shah, H. J., Reinforced Concrete Vol-I & II, Charotar Publishing House.
2. Varghese, P. C., Limit State Design of Reinforced Concrete, Prentice – Hall of India.
3. S Unnikrishna Pillai & Devdas Menon, Reinforced Concrete Design, Second Edition, Tata McGraw Hill
4. Punamia, B. C., & Jain, A.K., R.C.C. Designs (Reinforced Concrete Structures), Laxmi Publications (P) Ltd.

Reference Books:

1. Shah, V.L., & Karve, S.R., Limit State Theory and Design of Reinforced Concrete, Structures Publications.
2. Ramchandra & Gehlot V., Limit State Design of Concrete Structures, Scientific Publishers, India.
3. Sinha, S.N., Handbook of Reinforced Concrete Design, Tata McGraw Hill Publishing Company Limited.

IS Specifications:

1. IS: 456, Plain and Reinforced Concrete-Code of Practice
2. IS: 875 (Part 1 to 5), Code of Practice for Design Loads
3. SP 16, Design Aids for Reinforced Concrete to IS: 456
4. SP 34, Handbook on Concrete Reinforcement and Detailing

Term Work:

1. Design of Flexure Members
2. Design of Conventional Slabs
3. Design of Compression Members
4. Design of Footings
5. Design of Staircase
6. Design of Retaining Wall
7. Design of Flat Slab
8. Analysis & Design of Multi-storied Building along with Detailing of Structural Elements in Drawing Sheet

CL452: DESIGN OF STEEL STRUCTURES

B TECH 7th SEMESTER (CIVIL ENGINEERING)

Credit and Hours:

Teaching Scheme	Theory	Tutorial	Practical	Total	Credit
Hours/week	3	01	2	6	4
Marks	100	-	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Load Assessment and Design Philosophy	02
2	Connections Design	08
3	Design of Tension Members	07
4	Design of Compression Members	06
5	Design of Steel Beam	06
6	Design of Plate Girder	06
7	Design of Gantry Girder	05
8	Analysis & Design of Roof Truss	05

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1 Load Assessment and Design Philosophy **02 Hours 4%**

1.1 Dead Load, Live Load, Wind Load and Load Combinations

1.2 Basic Design Philosophy, Indian Standard Provisions, Failures of Structures

2 Connections Design **08 Hours 17%**

Bolted Connections

2.1 Bolt as connection, types of bolts, types of bolted joints

2.2 Load transfer mechanism, failure of bolted joints

2.3	Bearing type connections		
2.4	Tensile strength of plate		
2.5	Strength and efficiency of the joint		
2.6	Beam – Beam connection, Column – Beam connection, Unstiffened connection		
	Welded Connections		
2.7	Welding processes, welding electrodes, advantages of welding		
2.8	Types and properties of welds, types of Joints		
2.9	Effective area of welds		
2.10	Design of welds, simple joints		
2.11	Moment resistant connections		
2.12	Beam-to-column connections		
3	**Design of Tension Members**	**07 Hours**	**16%**
3.1	Types of tension members		
3.2	Net sectional area, effective net area, types of failures		
3.3	Design strength of tension members, slenderness ratio		
3.4	Design of tension member		
4	**Design of Compression Members**	**06 Hours**	**13%**
4.1	Effective length, slenderness ratio, types of sections		
4.2	Types of buckling		
4.3	Column formula, design strength of angle sections, I-section and more		
4.4	Design of axially loaded compression members		
4.5	Introduction to Built-Up columns		
4.6	Design of Lacing		
4.7	Design of Battening		
5	**Design of Steel Beam**	**06 Hours**	**13%**
5.1	Beam Type, Section Classification, Lateral Stability, Effective Length		
5.2	Design of Laterally Supported Beams in Bending		
5.3	Design of Laterally Un-Supported Beams		
5.4	Shear Behaviour		
5.5	Web Buckling and Web Crippling		
6	**Design of Plate Girder**	**06 Hours**	**13%**
6.1	Introduction		

6.2 Components of Plate Girder

6.3 Buckling of Plate Elements

6.4 Buckling of Web Plate

6.5 Requirements of Plate Girder Components

6.6 Design of Plate Girder

7 Design of Gantry Girder **05 Hours** **12%**

7.1 Introduction

7.2 Loads on Gantry Girder

7.3 Maximum Load Effects

7.4 Selection of Gantry Girder

7.5 Design of Gantry Girder

8 Analysis & Design of Roof Truss **05 Hours** 12%

8.1 Selection of the Type of Truss, Spacing of Truss

8.2 Panel Layout of Truss

8.3 Loads on the Roof Truss, Load Combinations

8.4 Analysis of Roof Truss, Deflection of Truss

8.5 Selection of Sections, Connections

8.6 End Bearings, Bracing of Truss

8.7 Design of Roof Truss

C. Course Outcomes (CO):

On the successful completion of this course one should be able to

CO1 The students will be able to understand the designing of connections.

CO2 Students will Able to design bolted and welded connections for tension members, compression members and beams.

CO3 The students will be able to design the steel structure members which are either subjected to axial loading or transverse kind of loading.

CO4 Students able to design basic elements of steel structure like tension members, compression members, beams and beam-columns.

CO5 Students can give economical design of girder considering the effects of bending and shear with proper connections.

CO6 Students can able to understand the force transfer mechanism of roof truss and economical design of members.

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	3	1	1	-	-	1	1	2	2	3	3	2	3
CO2	3	3	3	1	1	-	-	1	1	2	2	3	3	2	3
CO3	2	3	3	1	1	-	-	1	1	2	2	3	3	2	3
CO4	2	3	3	1	1	-	-	1	1	2	2	3	3	2	3
CO5	1	1	3	1	-	-	-	1	1	2	2	3	3	2	3
CO6	1	1	3	1	2	-	-	1	1	2	2	3	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

D. Recommended Study Material:

Text Books:

1. Duggal, S.K., Limit State Design of Steel Structures, McGraw Hill Education (P) Ltd, New Delhi
2. Subramanian, N., Steel Structures: Design and Practice, Oxford University Press.

Reference Books:

1. S.S. Bhavikatti, Design Of Steel Structures (By Limit State Method As Per IS: 800), I. K. International Pvt Ltd,.
2. V L Shah,Veena Gore, Limit State Design of Steel Structures, Structures publications.
3. Steel Table

IS Specifications:

1. IS: 800, General Construction in Steel- Code of Practice
2. IS: 875 (Part 1 to 5), Code of Practice for Design Loads
3. SP 6, Handbook for Structural Engineers

Term Work:

1. Design of Bolted Connections
2. Design of Welded Connections
3. Design of Tension Members
4. Design of Compression Members
5. Design of Steel Beam
6. Design of Plate Girder
7. Design of Gantry Girder
8. Design of Roof Truss

CL445: SUMMER INTERNSHIP-II

B TECH 7th SEMESTER (CIVIL ENGINEERING)

Credit and Hours:

Teaching Scheme	Project	Total	Credit
Hours / week	45	90	3
Marks	150	150	

A. Instructional Method and Pedagogy:

- Summer internship shall be at least of 90 hours during the summer vacation only.
- Department/Institute will help students to find an appropriate company/industry/organization for the summer internship.
- The student must fill up and get approved a Summer Internship Acceptance form by the company and provide it to the Coordinator of the department within the specified deadline.
- Students shall commence the internship after the approval of the department Coordinator. Summer internships in research centers are also allowed.
- During the entire period of internship, the student shall obey the rules and regulations of the company/industry/organization and also those of the University.
- Due to inevitable reasons, if the student is not able to attend the internship for a few days with the permission of the supervisor, the department Coordinator should be informed via e-mail and these days should be compensated later.
- The student shall submit two documents to the Coordinator for the evaluation of the summer internship:
    - Summer Internship Report
    - Summer Internship Assessment Form
- Upon the completion of summer internship, a hard copy of "Summer Internship Report" must be submitted to the Coordinator on the first day of the new term.
- The report must outline the experience and observations gained through practical internship, in accordance with the required content and the format described in this guideline. Each report will be evaluated by a faculty member of the department on a satisfactory/unsatisfactory basis at the beginning of the semester.

- If the evaluation of the report is unsatisfactory, it shall be returned to the student for revision and/or rewriting. If the revised report is still unsatisfactory the student shall be requested to repeat the summer internship.

B. Format of Summer Internship Report:

The report shall comply with the summer internship program principles. Title is to be centered and written in capital boldface letters. Sub-titles shall be written in small letters and boldface. The typeface shall be "Times New Roman" font with a font size of 12pt. All the margins shall be 2.5cm. The report shall be submitted in printed form and filed. A soft copy of the report shall be submitted in a CD and enclosed with the report. Each report shall be bound in a simple wire vinyl file and contain the following sections:

- Cover Page
- Page of Approval and Grading
- Abstract page: An abstract gives the essence of the report (usually less than one page). Abstract is written after the report is completed. It must contain the purpose and scope of internship, the actual work done, and conclusions arrived at.
- TABLE OF CONTENTS (with the corresponding page numbers)
- LIST OF FIGURES AND TABLES (with the corresponding page numbers)
- DESCRIPTION OF THE COMPANY: Summarize the type of work, administrative structure, number of each category of employees, etc. Provide information regarding
    - Location and spread of the company
    - Number of employees, engineers, technicians, administrators in the company
    - Divisions of the company
    - Your group and division
    - Administrative tree (if available)
    - Main functions of the company
    - Customer profile and market share
- INTRODUCTION: In this section, give the purpose of the summer internship, reasons for choosing the company, and general information regarding the nature of work you carried out.

- PROBLEM STATEMENT: What is the problem you are solving, and what are the reasons and causes of this problem.
- SOLUTION: In this section, describe what you did and what you observed during the summer internship. It is very important that majority of what you write should be based on what you did and observed that truly belongs to the company/industry/organization.
- CONCLUSIONS: In the last section, summarize the summer internship activities. Present your observations, contributions and intellectual benefits. If this is your second summer internship, compare the first and second summer internships and your preferences.
- REFERENCES: List any source you have used in the document including books, articles and web sites in a consistent format.
- APPENDICES: If you have supplementary material (not appropriate for the main body of the report), you can place them here. These could be schematics, algorithms, drawings, etc. If the document is a datasheet and it can be easily accessed from the internet, then you can refer to it with the appropriate internet link and document number. In this manner you don't have to print it and waste tons of paper.

C. Learning outcomes:

After completion of the course students will able:

CO1 To apply knowledge and skills gained in company/industry/organization to real-world problems and to solve engineering problems.

CO2 To learn to work as a team and to work with teammates from other disciplines.

CO3 To use experience related to professional and ethical issues in the actual work environment.

CO4 To explain the impact of engineering solutions employed in a project, in a global, economic, environmental, and societal context.

CO5 To find relevant sources (e.g., library, Internet, experts) and gathers information and to demonstrate knowledge of contemporary issues related with engineering in general and to use new tools and technologies.

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	2	1	1	1	3	3	3	3	3	3
CO2	-	-	-	-	-	-	-	-	3	2	-	-	-	-	-
CO3	-	-	-	-	-	1	-	3	-	-	-	-	-	-	-
CO4	3	3	2	2	2	2	3	1	-	1	1	2	1	1	1
CO5	2	3	2	3	3	2	2	1	-	2	1	2	2	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

Summer Internship Grade Form

Confidential

Name :

Supervisor Name :

Email :

Company name :

Department :

Duration :

Part-A: Work place

Average of the grades on the Summer Internship Evaluation Form filled by the employer :_____

Is the work done related to engineering? [Y/N] :_____

Does the supervisor has a similar engineering background? [Y/N] :_____

..... If all conditions in Part-A are satisfied, continue to Part-B, else mark Unsatisfactory in Overall Evaluation .....

Part-B: Report **Satisfactory** ☐ **Revision required** ☐

If revision is required, changes needed must be stated on the report. The report is returned to the student until satisfactory.

Due date for resubmission: **...../...../20....**

Student is given two weeks for each revision. *To be set by the department coordinator*

..... If the report in Part-B is Satisfactory, continue to Part-C, else return it to the student for Revision .....

Part-C: Final version of the report

Based on the final version of the report, as evaluated on the back side of this form:

Sum of the Assessment/quality scores of Performance Criteria : _____

To be satisfactory, the sum must be at least 50.

The Assessment/quality score of Report Quality : _____

To be satisfactory, the score must be at least 7.

Overall Evaluation **Satisfactory** ☐ **Unsatisfactory** ☐

Evaluator: Name:.....

Signature *Date*

...../...../20.....

Evaluation of the Company/Department

☐ I strongly recommend this place for future students
☐ I am satisfied with this place
☐ I recommend this place not be allowed for future students.

Performance Criteria	On what page(s) of the report is the **evidence** of this found?	Assessment/quality score (from 0=missing to 15=full)
1. Able to apply knowledge and skills learned in school to real-world problems		
2. Able to solve engineering problems related to systems and applications		
3. Able to function as a team		
4. Able to work with teammates from other disciplines		
5. Aware of professional and ethical issues in the work environment		
6. Able to explain the impact of engineering solutions, employed in a project, in a global, economic, environmental, and societal context		
7. Find relevant sources (e.g. library, Internet, experts, seminars) and gathers information		
8.Demonstrate knowledge of contemporary issues related with engineering in general		
9. Able to use new tools and technologies		
Report Quality	On what page(s) of the report is the **counter evidence** of this found?	Assessment/quality score (from 0=missing to 15=full)
Able to prepare reports with high standards in terms of content, organization, style and language (the Summer Internship report itself is to be evaluated)		

[1]If you think that a question does not apply to this particular summer internship, please write NA (not applicable).

CL453 CONSTRUCTION PROJECT MANAGEMENT

B TECH 7th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

Teaching Scheme	Theory	Practical/Tutorial	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction to Construction Project Management	07
2	Project Feasibility Study	03
3	Management Techniques	05
4	Project management through networks	05
5	Critical Path Method	10
6	Program Evaluation and Review Technique (PERT)	05
7	Resource Allocation and Resource Scheduling	05
8	Contracts and Tender	05

Total hours (Theory): 45

Total hours (Lab): 30

Total hours: 75

B. Detailed Syllabus:

1 Introduction to Construction Project Management **07 Hours** **15%**

1.1 Introduction to Construction Management

1.2 Necessity, objectives of construction management

1.3 Unique features of Construction Project

1.4 Stages in construction project management, Factors affecting various stages of construction management

1.5 Construction Resources

1.6 Function of Construction Management

1.7 Causes of failures construction projects and its relevance with construction management

2	**Project Feasibility Study**	**03 Hours**	**6%**
2.1	Need of Project Feasibility Study		
2.2	Technical Analysis		
2.3	Financial Analysis		
2.4	Economic Analysis		
2.5	Ecological Analysis		
3	**Management Techniques**	**05 Hours**	**11%**
3.1	Work Breakdown structure for various projects		
3.2	Gantt or Bar chart		
3.3	Mile stone Chart		
3.4	Line of Balance technique		
4	**Project management through networks**	**05 Hours**	**11%**
4.1	Definition and Objective of network techniques		
4.2	Types of network		
4.3	Elements of network like activity, dummy and event		
4.4	Interrelationship of Events, Interrelationship of Activity		
4.5	Network Rules and Fulkerson's rule for Numbering Events		
4.6	Advantages of Network techniques over conventional techniques		
5	**Critical Path Method**	**10 Hours**	**24%**
5.1	Introduction		
5.2	Activity Time estimate-EST, LST, EFT, LFT		
5.3	Event time estimate- T_E, T_L		
5.4	Critical activities, Critical path and Floats		
5.5	Cost optimization by crashing a Network		
5.6	Updating of CPM Network		
6	**Program Evaluation and Review Technique (PERT)**	**05 Hours**	**11%**
6.1	PERT Network : Introduction , Difference between PERT and CPM		
6.2	Expected time, frequency distribution, mean, variance and standard deviation		
6.3	PERT Network Analysis		
7	**Resource Allocation and Resource Scheduling**	**05 Hours**	**11%**
7.1	Introduction		
7.2	Recourse smoothing		
7.3	Resource levelling		

8 Contracts and Tender **05 Hours** **11%**

8.1 Contract- definition , Essentials of contract

8.2 Types of contract & Suitability for construction projects

8.3 Tender – definition, Tender Notice and Tender submission

8.4 Opening of tender, Scrutiny of tender, Acceptance of tender

8.5 Rejection of Tender

C. Course Outcomes:

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

CO1 Explain various functions of construction management.

CO2 Identify alternative methods of course of action and select best course of action through feasibility analysis of construction project.

CO3 Apply basic principles of management and its applications in construction industry.

CO4 Estimate, analyse and control project durations by using various management techniques like Bar Charts, PERT and CPM in construction industry

CO5 Manage resources through cost time trade off, updating, rescheduling and compressing with applications in construction industry.

CO6 Understand and apply knowledge of the tendering procedure and various construction contract systems.

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	2	-	-	-	-	3	-	-	2	-
CO2	2	2	3	1	-	1	2	1	-	1	-	-	2	-	2
CO3	3	-	-	-	-	-	-	-	1	-	-	1	1	-	-
CO4	1	-	-	-	2	-	-	-	-	3	3	-	1	-	1
CO5	1	1	1	-	2	2	2	1	1	-	-	-	1	2	1
CO6	-		1	-		3	-	2	2	2	-	2	1	1	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

D. Recommended Study Material:

Text Books:

1. Chitkara, K. K., Construction Project Management Planning, Scheduling and Controlling, Tata McGraw Hill, New Delhi.
2. Jha, K.N., Construction Project Management, Pearson Publications.
3. Seetharaman, S., Construction Engineering & Management, Umesh Publications, 2007.
4. Peurifoy, L., Schexnayder, C.J. and Shapira, A., Construction Planning, Equipment and Methods, McGraw Hill, New Delhi, 8th Edition, 2010.
5. Punamia, B.C. and Khandelwal, K.K., Project Planning and Control with PERT and CPM, Laxmi Publications, New Delhi, 2004.
6. Kotadia, A.S., Construction Management and Equipments, Mahajan Publishing House.

Reference Books:

1. Sharma, M.R., Fundamnetals of Construction Planning and Management, S.K. Kataria & Son, New delhi, 2012.
2. Srinath, L.S., PERT & CPM Principles and Applications, Tata McGraw Hill, New Delhi.
3. Gahlot, P.S. and Dhir, B.M., Construction Planning & Management, New Age International (P) Ltd., New Delhi.
4. Sharma, S.C., Construction Equipment & Managemetn, Khanna Publications, New Delhi, 1988.
5. Sengupta and Guha, Construction Management and Planning, Tata McGraw Hill, New Delhi.

Web Materials:

1. http://nptel.iitm.ac.in/courses/IIT-MADRAS/Infrastructure_Planning_Management/index.php
2. http://www.deere.com/en_US/cfd/construction/deere_const/media/pdf/attachments.pdf
3. http://www.fta.dot.gov/documents/Construct_Proj_Mangmnt_CD.pdf
4. http://www.netmba.com/operations/project/pert/
5. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/cpm/index.html
6. http://www.youtube.com/watch?v=wJ8HZ7hqUs8
7. http://www.youtube.com/watch?v=IOn-erkINAo
8. http://www.youtube.com/watch?v=2Ow8JUgRC1Q
9. http://www.youtube.com/watch?v=UEXrsZ3vkx0

10. http://www.youtube.com/watch?v=7cCaY3zBhcs
11. http://www.youtube.com/watch?v=HPC4lWTMjRM
12. http://www.youtube.com/watch?v=RYnUDLey-g4

CL454: GEOTECHNICAL ENGINEERING – II

B TECH 7th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

Teaching Scheme	Theory	Tutorial	Practical	Total	Credit
Hours/week	3	1	2	6	4
Marks	100		50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Soil Exploration	06
2	Earth Pressure	10
3	Stability of Slopes	10
4	Shallow Foundation	10
5	Deep Foundation	14
6	Stress Distribution	08

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours (Tutorial): 15

Total Hours: 90

B. Detailed Syllabus:

1 Soil Exploration **06 Hours 13%**

1.1 Introduction, Stages in sub-surface Exploration, Depth of Exploration, Location and number of pits and Borings

1.2 Methods of boring/exploration

1.3 Sampling of soils, types of soil samplers

1.4 Standard penetration test, Cone penetration test: Static and Dynamic

1.5 Field plate load test

2 Earth Pressure **07 Hours 16 %**

2.1	Introduction, effects of wall movements on earth pressure, lateral earth pressure at rest		
2.2	Rankine's & Coulomb's theory for active and passive earth pressure conditions for cohesionless and cohesive backfill		
3	**Stability of Slopes**	**09 Hours**	**20 %**
3.1	Introduction, types of slope failure, factor of safety		
3.2	Slice method, friction circle method, Taylor's stability number & other methods of analysis		
3.3	Improving stability of slopes		
4	**Shallow Foundation**	**08 Hours**	**18 %**
4.1	Introduction, bearing capacity of soil, types of failure in soil, allowable bearing pressure		
4.2	Terzaghi's bearing capacity theory, factors affecting bearing capacity, depth of foundation		
4.3	Settlement-consideration & computation, effect of water-table		
4.4	IS code of practice for computing bearing capacity		
5	**Deep Foundation**	**10 Hours**	**22 %**
5.1	Introduction, types of piles, method of installation and load carrying behavior, necessity of pile foundation		
5.2	Static pile load formulae, pile load test , dynamic pile formulae		
5.3	Bearing capacity of single pile subjected to vertical load in sands and clays, pile subjected to uplift load		
5.4	Negative skin friction, group action of piles in Cohesionless & cohesive soil		
6	**Stress Distribution**	**05 Hours**	**11 %**
6.1	Stress strain parameters, geostatic stresses, concentrated force - Boussinesq's equations		
6.2	Pressure distribution diagram, vertical stress distribution on horizontal plane, vertical stress distribution on vertical plane, vertical pressure distribution under uniformly loaded circular area, line load, strip load		
6.3	Newmark's influence charts, Westergard's analysis		
6.4	Contact pressure distribution		

C. Course Outcomes (COs):

CO1 Student will have the understanding of various soil exploration techniques and also the various I.S. code criteria for SPT test and results.

CO2 Student will understand the analysis of lateral earth pressure against retaining wall.

CO3 Students will learn to analysis the slope stability using different methods.

CO4 Students will gain the knowledge to determine the bearing capacity of shallow and deep foundation in sand and clay.

CO5 Students will learn to determine the vertical pressure through different methods.

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	1	1	-	-	2	2	3	1	1	-	1
CO2	3	2	2	1	2	-	-	-	2	1	1	1	1	-	-
CO3	3	2	2	1	2	-	-	-	2	1	1	1	1	-	-
CO4	3	3	2	1	2	-	-	-	2	1	1	1	1	1	1
CO5	3	1	1	1	1	-	-	-	2	1	1	1	1	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

D. Recommended Study Material:

Text Books:

1. Arora, K.R., Soil Mechanics & Foundation Engineering, Standard Publication, New Delhi.
2. Punamia, B.C., Soil Mechanics & Foundation Engineering, Laxmi Publication Pvt. Ltd., New Delhi.
3. Murthy, V.N.S., Soil Mechanics & Foundation Engineering; SaiKripa Technical Consultants, Bangalore.
4. Shroff A. V., Shah D. L., "Soil Mechanics & Geotechnical Engineering", Oxford-IBH New Delhi.

Reference Books:

1. Singh Alam, Soil Engineering, Vol. – I and II, Asia Publication House.
2. Fang and Einterkorn, Foundation Engineering Handbook.
3. Peck, Thomson and Thornburn, Foundation Engineering,

4. ShamsherPrakash and GopalRanjan, Analysis and Design of Retaining Structures,
5. Sarita Publications.
6. Nayak, N.B., Foundation Engineering Manual.

Web Materials:

1. http://edudel.nic.in
2. http://bis.org.in/other/quake.htm
3. http://www.vastu-design.com/india_homes.htm
4. http://www.thepeninsulaneighborhood.com/ThePlan.html
5. http://www.historytution.com/indus_valley_civilization/town_planning.html
6. http://nptel.ac.in/courses/105101083/

LIST OF EXPERIMENTS

Experiment No.	Name of Experiment
1	Relative Density
2	Standard Proctor Compaction Test
3	Unconfined Compression Test
4	Free Swell Index
5	Laboratory Vane Shear Test
6	Standard Penetration Test
7	Laboratory Plate Load Test
8	Static Cone Penetration Test
9	CBR Test

CL455: PROFESSIONAL PRACTICES

B. TECH 7th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

Teaching Scheme	Theory	Tutorial	Total	Credit
Hours / Week	3	1	4	3
Marks	100	0	100	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1.	Estimation	04
2.	Rules & Method of Measurement	03
3.	Detailed Quantity Estimation	22
4.	Specification	03
5.	Rate Analysis	05
6.	Valuation	08

Total Hours (Theory): 45

Total Hours (Lab): 0

Total Hours (Tutorial): 15

Total Hours: 60

B. Detailed Syllabus:

1. Estimation **04 Hours** **8%**

1.1 General

1.2 Purpose of estimates

1.3 Types of estimates

1.4 Approximate estimate, general principle of approximate estimate, Construction cost index, approximate method of costing for buildings, water supply and sanitary works.

1.5 Detail estimate, data required for detail estimate, preparation of detail estimate, Standard measurement form, Abstract of measurement.

	Factors to be consider during preparation of a detailed estimate.		
1.6	Procedure of estimate		
1.7	Quantity estimate, Revised estimate, Supplementary estimate, complete estimate and Annual maintenance or repair estimate Data required for sanction of project, Administrative approval, expenditure sanction, Technical Sanction		
2	**Rules and Methods of Measurement**	**03 Hours**	**6%**
2.1	General rules which are applicable during the calculation of quantity for different associated items		
2.2	Principles in selecting units of measurement for items, various units and standard modes of measurement for different item of work and materials as per IS:1200 revised		
2.3	Deduction criteria for various item of works		
3.	**Detailed Quantity Estimation**	**22 Hours**	**50%**
3.1	**Building Estimate:** General items of work for building estimate and their units of measurements, long wall short wall and centre line methods. • Estimation of quantity of load bearing structure. • Quantity analysis of R.C.C. component: footing, column, lintel, chajja, beam, slab, with schedule of bar bending, material estimate. • Quantity analysis of steel roof truss • Abstract preparation		
3.2	Estimation of earthwork for roads.		
4	**Specifications**	**03 Hours**	**7%**
4.1	Definition		
4.2	Objective, importance, use, types of specification		
4.3	General and special specification		
4.4	Specification for material and workmanship		
4.5	Design and principles of specification		
4.6	Sources of information		
4.7	Typical specification of various item of works		
5	**Rate Analysis**	**05 Hours**	**12%**

5.1 Rate analysis and requirement of the rate analysis

5.2 Factors affecting rate analysis

5.3 Method of preparation of rate analysis of work

5.4 Quantity of materials per unit rate of work

5.5 Estimating Labor

5.6 Cost of equipment or tools and plants

5.7 Overhead expenses

5.8 Contractor Profit

5.9 Task of work

5.10 Load of trucks

5.11 Rate analysis of all typical items of works for building construction

6 Valuation **08 Hours** **17%**

6.1 Valuation, value, price and cost, purpose and principle of valuation

6.2 Different form of value

6.3 Mortgage and lease

6.4 Freehold and Leasehold property

6.5 Sinking Fund, depreciation, types of depreciation

6.6 Year of purchase

6.7 Outgoings

6.8 Methods of Valuation

6.9 Rent Fixation

C. Course Outcomes:

On the successful completion of this course

CO1 The students will get a diverse knowledge of estimating, costing and professional practice, which will be use full in tackling real life problems.

CO2 The students will be able to understand the procedure to carry out the estimation and steps to prepare reports of the construction works.

CO3 The students will learn the purpose and importance of valuation

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	-	-	1	1	-	-	2	-	2	-	1	1	1
CO2	2	-	-	-	1	1	-	-	1	1	-	-	1	-	-
CO3	2	-	-	-	1	1	-	-	1	1	-	-	1	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

D. Recommended Study Material:

Text Books:

1. Dutta, B.N., Estimating & Costing in Civil Engineering Theory and Practice, UBS Publishers & Distributors Limited, New Delhi, 1997.
2. Chakraborti, M., Estimating, Costing, Specification and Valuation on Civil Engineering, M. Chakraborty Publication, 2007.
3. Roshan Namavati, Theory & Practice Of Valuation, (Land & Buildings) for Architects, Engineers, Surveyors, Advocates, & Income Tax Practitioners, Universal Book Corp

Reference Books:

1. Patil, B.S., Civil Engineering Contracts, Vol. – I, Orient Longman Publication, 1998.
2. Rangwala, S.C., Elements of Estimating and Costing, Professional practice, Charotar Publishing House, Anand.
3. Aggarwal, A., Upadhyay, A.K., Civil Estimating, Costing &Valuation, S.K Kataria & Sons, New Delhi.
4. Chandola, S.P. and Vazirani, Estimating and Costing, Khanna Publication.

Web Materials:

1. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Guwahati/cpm/index.html

CL470: STRUCTURAL DYNAMICS & EARTHQUAKE ENGINEERING

B TECH 7th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE-III

Credits and Hours:

Teaching Scheme	Theory	Practical/ Tutorial	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Theory of vibrations	15
2	Earthquake Basics & Design Philosophy	08
3	Lateral Load Analysis of Building	10
4	Ductile Detailing	06
5	Special Topics	06

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1 Theory of vibrations — **15 Hours** **34%**

1.1 Introduction, Difference between Static and Dynamic load, Basic Terminologies,

1.2 Simplified single degree of freedom system, mathematical modeling of buildings, natural frequency, resonance v/s increased response

1.2 Responses of buildings to different types of vibrations like free and forced, damped and un-damped

1.3 Response to multi degree (maximum three) of freedom systems, mode shapes

2 Earthquake Basics & Design Philosophy — **08 Hours** **18%**

2.1	Introduction of Earthquake, Definitions of basic terms,		
2.2	Causes of earthquake and their characteristics, Seismographs, Seismic Zoning practices in India, Seismic Codes		
2.3	Earthquake parameters, Characterization of ground motion		
2.4	Earthquake Intensity & Magnitude, Recording Instruments		
2.5	Philosophy of earthquake resistant design, earthquake proof v/s earthquake resistant design		
2.6	Four virtues of earthquake resistant (strength, stiffness, ductility and configuration), Seismic structural configuration		
2.7	Damages caused during past earthquakes (worldwide)		
3	**Lateral Load Analysis of Building**	**10 Hours**	**22%**
3.1	Lateral analysis of the building systems, Lateral load distribution,		
3.2	Torsionally coupled and un-coupled Systems		
3.3	Design Lateral Loads for RC Building, Earthquake resistant design of masonry structure as per IS 4326, Concept of Response Spectra, Design Response Spectrum		
3.4	Equivalent lateral load concept, Rigid floor diaphragm, Codal Provisions		
4	**Ductile Detailing**	**06 Hours**	**13%**
4.1	Importance of ductility - Methods of introducing ductility into RC structures, Ductile detailing of various structural elements, Design Methodology IS 1893, IS 13920 and IS 4326 - Codal provisions - Design as per the codes		
5	**Special Topics**	**06 Hours**	**13%**
5.1	Introduction of different control systems: Passive control: base isolation and active control: bracing system, TMD and some latest invention		
5.2	Soil liquefaction, causes and its remedial measure		
5.3	Introduction to Disaster Management: Types of Disaster, Phases of disaster management, Disaster rescue, psychology and plan of rescue operations		

C. Course Outcomes

On the successful completion of this course, the students will be able to

CO1 Apply the concepts of theory of vibration to SDOF and MDOF and understand the response of structures.

CO2 Understand basic earthquake mechanisms, tectonics, types of ground motion, and propagation and interpret the earthquake ground motion data, and also understand causes types and measurement of an earthquake.

CO3 Analyze and design of various lateral load resisting systems to develop response spectrum for earthquake ground motion and estimate lateral load on the structures as per codal stipulations.

CO4 Apply the concepts of ductility and related codal specification for earthquake resistant design.

CO5 To Know the importance of energy dissipation devices, Effect of Soil liquefaction and role of disaster Management during Earthquake.

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	-	2	-	-	-	-	-	1	-	-	2	-	-
CO2	2	2	1	-	-	-	-	2	-	-	-	1	2	2	-
CO3	3	2	3	1	1	-	-	2	-	1	-	1	3	2	2
CO4	3	2	3	2	1	-	-	2	-	1	-	1	3	1	1
CO5	1	1	1	1	-	-	-	1	-	-	-	1	-	1	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

D. Recommended Study Material:

Text Books:

1. Chopra, A.K.,Dynamics of Structures, PrenticeHall, N.J.
2. MarioPaz,StructuralDynamics,McGraw-Hill
3. Manish Shrikhande & PankajAgrawal;Earthquake resistant design of structures, PHI Publication, New Delhi
4. Duggal,S.K.,Earthquake resistance design of structures ;Oxford University Press, New Delhi.

Reference Books:

1. Park & Pauly,Behavior of RC Structure
2. Clough &Penzin,Dynamics of structures, McGraw-Hill.
3. IITK-GSDMAEQ27–V-3.0, Design Example of a Six Storey Building
4. Murthy,C.V.R.,EarthquakeTips,NICEE
5. Jain A. K., Dynamics of Structures with MATLAB, Pearson

Web Materials:

1. http://en.wikipedia.org/wiki/Earthquake_engineering
2. http://www.curee.org
3. http://www.earthquakeengineering.com/
4. http://www.nicee.org/
5. http://www.earthquakeinfo.org/
6. opensees.berkeley.edu/
7. http://nptel.ac.in/
8. http://ocw.mit.edu/courses/civil-and-environmental-engineering/
9. www.eeri.org/

Other Materials:

1. IS:875,Code of Practice for Design Loads
2. IS:1893(Part-I),Criteria for Earthquake Resistant Design
3. IS:4326, Earthquake Resistant Design and Construction of Buildings- Code of Practice
4. IS:4327,Earthquake Resisting Design & Construction Building
5. IS:13920,Ductile Detailing of RC Structures
6. IITK-GSDMA Guidelines

CL471: ADVANCED STRUCTURAL ANALYSIS

B TECH 7th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE-III

Credits and Hours:

Teaching Scheme	Theory	Tutorial / Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction	02
2	Direct Stiffness Method	28
3	Finite Element Method	15

Total Hours (Theory): 45
Total Hours (Lab): 30
Total Hours: 75

B. Detailed Syllabus:

1 Introduction — **02 Hours** **04 %**

1.1 Basic concepts of Analysis

2 Direct Stiffness Method — **28 Hours** **62%**

2.1 Introduction: Stiffness Method

2.2 Overview of different stiffness & rotation-transformation matrices

2.3 Analysis of beam, plane truss, plane frames, grid, space truss and space frame by stiffness method member approach

2.4 Analysis of beam, plane truss and plane frame under various secondary effects like support sinking, prestraining and temperature effect

2.5 Symmetry and Anti-symmetry

2.6 Oblique supports and elastic supports

3	**Finite Element Method**	**15 Hours**	**34%**

3.1 Introduction to FEM, Advantages and disadvantages of FEM

3.2 Types of problems, stresses & equilibrium, strain-displacement relations, stress-strain relations

3.3 Application of FEM to one dimensional (for bar & beam) & two dimensional problems using constant strain triangles

3.4 Two dimensional iso-parametric elements: Four node quadrilateral elements, numerical integration, higher order elements

3.5 Application of FEM to two dimensional truss element

C. Course Outcomes:

On the completion of the course the students will be able:

CO1 To solve the structural problems using Finite element method.

CO2 Use Direct stiffness method for the analysis of Frame structures

CO3 To recognize the importance of structural analysis and the different tools used to determine the response of a structural system to external loads.

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	1	1	-	-	-	-	-	-	2	-	1
CO2	3	3	2	2	1	-	-	-	-	-	-	-	1	-	-
CO3	2	2	1	1	2	-	-	-	-	-	1	-	1	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

D. Recommended Study Material:

Text Books:

1. Weaver William and Gere James, Matrix Analysis of Framed Structures, CBS Publishers
2. Dawe, D.J., Matrix and Finite Element Displacement Analysis of Structures, Clarendon Press.
3. Menon Devdas, Advanced Structural Analysis, Narosa Publishing House
4. Desai & Ables, Introduction to the Finite Element Method, CBS

5. Bhavikatti S.S., Finite Element Analysis, New age international limited, publishers

Reference Books:

1. Krishnamoorthy C.S., Finite Element Analysis, Tata McGraw-Hill
2. Cook, R.D., Concepts & Applications of Finite Element Analysis, John Wiley & Sons
3. Wang, C.K., Intermediate Structural Analysis, Tata McGraw Hill

CL478: TRANSPORATION ENGINEERING- II

B TECH 7th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE-III

Credits and Hours:

Teaching Scheme	Theory	Tutorial	Practical	Total	Credit
Hours/week	3	2	-	5	4
Marks	100	50		150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Railway Engineering	12 Hours
2	Bridge Engineering	05 Hours
3	Tunnel Engineering	06 Hours
4	Airport Engineering	14 Hours
5	Harbour Engineering	08 Hours

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1 Railway Engineering **12 Hours** **26 %**

1.1 **Introduction**

Permanent way and railway track components, Ideal requirement of permanent way, Capacity of railway track, Gauge

Rails-function and types of rails, rail sections, defects in rails, creep of rails, rail joints and welding of rails

Sleepers - function, types, spacing and density

Ballast- Function and Types of Ballast material, Sub-ballast

Rail fixtures and Fastenings

	Subgrade and embankment.		
1.2	**Geometric design of Railway track** Gradients, Speed of the trains on curves, Super elevation, Curves, Radius of the curves, Widening on curves.		
1.3	**Crossing, Stations, Yards, Signaling and Interlocking** Points and crossings - turnouts, switches, crossings. Track junctions - types and salient features. Railway stations - requirements, facilities, classifications, platforms, loops, sidings, Railway yards - types, required equipment in yards. Signaling and control system - Necessity, objectives, classification. Interlocking of signals and points, Mechanical Interlocking devices.		
1.4	**Railway Track** Railway track - construction, drainage, maintenance. Recent developments in railways - high speed trains, modernization in track for high speed, Metro rails, Monorail, Maglev Rails, Tube Rails, Automation in operation and control.		
2	**Bridge Engineering**	**05 Hours**	**11 %**
2.1	Introduction: Selection of site, Data collection, Stages of investigation		
2.2	Classification, types of substructures, flooring joints, bridge bearings, movable bridges, temporary bridges, Construction methods and Maintenance of Bridge.		
3	**Tunnel Engineering**	**06 Hours**	**14 %**
3.1	Introduction: Necessity/Advantage of a tunnel, Classification of Tunnels, Size and shape of a tunnel, Alignment of a Tunnel, Portals and Shafts		
3.2	Lighting, Ventilation and Dust control: Tunnel Lighting, Ventilation of Tunnel, Methods of Ventilation, Dust control, Drainage system of Tunnel and Safety		
4	**Airport Engineering**	**14 Hours**	**31 %**

4.1	General: Introduction to Air transport authorities, Air crafts and its characteristics, Airport classifications as per ICAO.		
4.2	Airport Planning: Regional planning - concepts and advantages, location and planning of airport as per ICAO and F.A.A. recommendations, airport Elements - airfield, terminal area, obstructions, approach zone, zoning laws, airport capacity, airport size and site selection.		
4.3	Run Way Design: Wind rose and orientation of runway, wind coverage and crosswind component, factors affecting runway length, basic runway length, and corrections to runway length, runway geometrics and runway patterns (configurations). Runway marking, threshold limits cross section of runway		
4.4	Taxiway Design: Controlling factors, taxiway geometric elements, layout, exit taxiway, location and geometrics, holding apron, turnaround facility. Aprons - locations, size, gate positions, aircraft parking configurations and parking systems, Fuel storage area, blast pads, wind direction indicator		
4.5	Air Traffic Control and Visual Aids: Air traffic control objectives, control system, control network - visual aids - landing information system, airport markings and lighting.		
5	**Harbour Engineering**	**08 Hours**	**18 %**
5.1	Harbour Planning: Harbour components, characteristics of good harbour and principles of harbour planning, size of harbour, site selection criteria and layout of harbours. Surveys to be carried out for harbour planning.		
5.2	Marine Structures: General design aspects, breakwaters - function, types general design principles, wharves, quays, jetties, piers, pier heads, dolphin, fenders, mooring accessories - function, types, suitability, design and construction features.		
5.3	Docks and Locks: Tidal basin, wet docks - purpose, operation of lock gates and passage, repair docks - graving docks, floating docks.		

5.4 Port Amenities and Navigational Aids: Ferry, transfer bridges, floating landing stages, transit sheds, warehouses, cold storage, aprons, cargo handling equipment, purpose and general description, Channel and entrance demarcation, buoys, beacons, light house, electronic communication devices.

C. Students Learning Outcomes:

The course content should be taught and learning imparted with the aim to develop required knowledge and skills so that they are able to acquire following competency:

CO1 The students will gain an experience in the implementation of Railway, Bridge, Tunnel, Airport and Harbour Engineering on engineering concepts which are applied in field of Transportation Engineering.

CO2 The students will get a diverse knowledge of Railway, Bridge, Tunnel, Airport and Harbour engineering practices applied to real life problems.

CO3 The students will learn to understand the theoretical and practical aspects of Railway, Bridge, Tunnel, Airport and Harbour engineering along with the design and management applications.

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	2	-	1	1	1	-	3	2	-	1	2	1	1
CO2	1	-	2	1	2	1	-	-	2	3	2	2	2	1	1
CO3	1	-	2	-	3	-	-	-	2	2	-	1	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

D. Recommended Study Material:

Text Books:

1. Satish Chandra and M.M. Agrawal, Railway Engineering, Oxford University Press, New Delhi
2. S.C. Rangwala, K.S. Rangwala and P.S. Rangwala, Principles of Railway Engineering, Charotar Publishing House, Anand.
3. S.P.Bindra, Principles and Practice of Bridge Engineering, Dhanpat Rai &Sons, New Delhi

4. S.C. Saxena, Tunnel Engineering, Dhanpat Rai & Sons, New Delhi
5. Dr. S. K. Khanna, M.G.Arora and S.S. Jain, Airport Planning & Design, Nem Chand & Bros.,Roorkee
6. Airport Engineering, Charotar Publishing House Pvt. Ltd, Anand
7. R. Srinivasan and S. C. Rangwala, Harbour, Dock and Tunnel Engineering, 1995, Charotar Pub.House, Anand

Reference Books:

1. S.C.Saxena And S.P. Arora, A Text Book of Railway Engineering, Dhanpat Rai Sons, New Delhi
2. D.J. Victor, Essential of Bridge Engineering, Oxford & IBH Pub. Co. Ltd. Mumbai
3. G.V. Rao Airport Engineering, Tata McGraw Hill Pub. Co., New Delhi
4. S. P. Bindra, A Course in Docks and Harbour Engineering, 1992, Dhanpat Rai& Sons, New Delhi
5. Alonzo Def. Quinn, Design and Construction of Ports and Marine Structure, McGraw - Hill Book Company, New York

Web Materials:

1. http://www.cphbooks.com/html/40ae.htm
2. http://as.wiley.com/WileyCDA/WileyTitle/productCd-0471527556.html
3. http://cphbooks.com/html/38re.htm

LIST OF TUTORIALS

Tutorial No.	Name of Tutorials
1	Introduction, Railway Track Gauge, Alignment of Railway lines
2	Track and Track stresses, Rails, Sleeper
3	Ballast, Track fittings, Geometric design of Track
4	Points and crossings, Railway Stations and Yards
5	Signaling and Interlocking
6	Bridge –General, Classification of Bridge Construction methods, Maintenance
7	Tunnel Classification and Alignment
8	Lighting, Ventilation, Drainage and Safety

9	Layout of Airport, components of airport, authorities of airport
10	Factors affecting runway design , Wind rose diagram, Design of runway
11	Design of Taxiway
12	Navigational aids of Airport
13	Components of harbor, factors affecting the site selection
14	Harbour infrastructure

CL479: ENVIRONMENTAL ENGINEERING- II

B TECH 7th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE-III

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction to Solid Waste Management	08
2	Waste: Collection and Transportation	10
3	Waste Processing Techniques	09
4	Disposal of Solid Waste	10
5	Noise: Source, generation, Effects & Control	08

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1 Introduction to Solid Waste Management **08 Hours 18 %**

1.1 Municipal Solid Waste Management - Sources, nature and characteristics;

1.2 Quantitative and qualitative aspects; Engineering principles, assessment and management.

1.3 Solid waste problems - Industrial, Mining, Agricultural, Domestic (urban) wastes, Biomedical waste, E-waste, Plastic Waste and Construction Waste, Management of lead acid battery.

2 Waste: Collection and Transportation **10 Hours 22 %**

2.1	Collection and storage of municipal solid waste; Methods of collection - House to House collection		
2.2	Type of Vehicles-Manpower requirement collection routes; on site storage methods-materials used for containers Reduction of solid waste at source-on site segregation of solid waste		
2.3	Recycling and Reuse Need for transfer and transport; transfer station selection of location, operation and maintenance; transportation Methods manual, Mechanical methods with or without compaction, economy in transportation of waste optimization of transportation routes.		
3	**Waste Processing Techniques**	**09 Hours**	**20 %**
3.1	Processing techniques-biological and chemical conversion technologies – composting and its methods		
3.2	Vermicomposting, mechanical composting, In vessel composting		
3.3	Incineration, pyrolysis, gasification.		
4	**Disposal of Solid Waste**	**10 Hours**	**22%**
4.1	Segregation, reduction at source, recovery and recycle; dumping of solid waste-sanitary waste		
4.2	Sanitary landfills-site selection-design and operation of sanitary landfill-secure landfills-landfill bioreactors-leachate and landfill gas management		
4.3	Landfill closure and environmental monitoring-landfill remediation		
4.4	Municipal solid waste in Indian conditions, legal aspects of solid waste disposal		
5	**Noise: Source, generation, Effects & Control**	**08 Hours**	**18 %**
5.1	Fundamentals of Noise: Basics of Acoustics: Sound power, Sound intensity and Sound pressure levels		
5.2	Plane, Point and Line sources, Multiple sources Outdoor and indoor noise propagation;		
5.3	Effects of noise – noise induced deafness, presbycusis, acoustic trauma, other physiological and psychological effects		

5.4 Special noise environments – infrasound, ultrasound, impulsive sound and sonic boom.

5.5 Noise standards and indices.

5.6 Noise monitoring: Occupational, ambient and road traffic noise monitoring

C. Course Outcomes:

On the completion of the course one should be able to

CO1 Evaluate the subject from the technical, legal and economical points by learning of all terms related to general solid waste management

CO2 Examine the technical points that are required to set up a solid waste management system

CO3 Apply the legal legislation related to solid waste management.

CO4 Plan a solid waste management system for decision makers

CO5 Link cause and effect of noise pollution

CO6 Develop noise pollution mitigation/abetment strategies

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	2	1	-	-	-	-	-	-	1	-
CO2	-	3	1	3	-	1	2	-	1	2	1	-	-	1	2
CO3	1	1	1	1	-	3	2	3	1	2	-	-	-	-	2
CO4	-	1	3	1	2	2	2	2	2	2	3	3	3	3	3
CO5	3	1	-	3	-	1	1	-	-	-	-	-	-	1	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

D. Recommended Study Material:

Text Books:

1. Garg, S.K., Environmental Engg. Vol. – II, Khanna Publications.
2. Peavy, Rowe and Tchobanoglous, Environmental Engg, Tata Mcgraw Hill.

Reference Books:

1. Solid Waste: Engineering Principles & Management Issues- G. Tchobanoglous, GH. Theisen & R. Eliassen, McGraw Hill Int. Ed. Singapore, 1977.
2. Hazardous Waste Management (2nd ed) - Lagrega, MD, P L Buchingham & JC Evans, McGraw Hill, NY, 2001.
3. Bioremediation Principles – Eweis, JB, Ergas SJ, Chang DYP and Schroeder ED, McGraw-Hill, Singapore, 1998.

Web Materials:

1. http://nptel.iitm.ac.in
2. http://www.epa.gov
3. http://www.nesc.wvu.edu
4. http://www.indiaenvironmentportal.org.in
5. http://www.filtersource.com
6. https://dgserver.dgsnd.gov.in

List of Experiments

Experiment No.	Name of Experiment
1.	Sample preparation; sampling techniques; conning and quartering method; overburden and other wastes sampling.
2.	Proximate Analysis and Ultimate Analysis
3.	Determination of Calorific Value
4.	Determination of pH & buffered pH
5.	Determination of EC & CEC
6.	Determination of exchangeable Na & K
7.	Determination of ESP and SAR
8.	Determination of organic matter and organic carbon C:N ratio;
9.	Determination of plant available P and total P
10.	Leachate Analysis
11.	Ambient and Source Noise Monitoring

CL487: ADVANCED CONSTRUCTION TECHNOLOGY

B. TECH 8th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - IV

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Substructure Construction	15
2	Superstructure Construction	08
3	Concreting Process & Equipment	06
4	Advanced Concrete Technology	08
5	Sustainable Construction Technologies	08

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1 Substructure Construction **15 Hours** **33%**

1.1 Box jacking, Pipe jacking

1.2 Under water construction of diaphragm walls and basement

1.3 Tunnelling techniques

1.4 Piling techniques and load testing, Battered piles

1.5 Driving well and Caissons,

1.6 Cofferdams: types, design considerations, construction sequence, sinking of cofferdam

1.7 Cable anchoring and grouting

1.8 Sheet piles: laying operations for built up offshore

	system		
1.9	Shoring for deep cutting		
2	**Superstructure Construction**	**08 Hours**	**18%**
2.1	Techniques of construction for continuous concreting operation in tall buildings		
2.2	Large span structures – segmental bridge construction techniques		
2.3	In-situ pre-stressing in high rise structures		
2.4	Post tensioning techniques		
3	**Concreting Process & Equipments**	**06 Hours**	**14%**
3.1	Aggregate crushers, feeders and screens, aggregate handling equipments		
3.2	Concrete batching, mixing and pumping equipments		
3.3	Ready mix concrete equipment		
3.4	Tools and plants for hot weather concreting		
3.5	Underwater concreting		
4	**Advanced Concrete Technology**	**08 Hours**	**18%**
4.1	Properties and applications of High strength and high performance concrete		
4.2	Reactive powder concrete		
4.3	Lightweight, heavyweight, and mass concrete		
4.4	Fibre reinforced concrete		
4.5	Self-compacting concrete, Self-healing concrete		
4.6	Polymer Concrete, Epoxy resins and screeds		
5	**Sustainable Construction Technologies**	**08 Hours**	**17%**
5.1	Necessity and importance		
5.2	Criteria for defining as sustainable materials		
5.3	Recycled building products from industrial, agricultural and urban waste stream materials		
5.4	Recent developments in sustainable building materials and technologies		
5.5	Smart buildings		

C. Course Outcomes (COs):

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

CO1 Understand and apply operational details of important equipment, techniques and methods employed in substructure construction.

CO2 Understand the systems and techniques used in heavy constructions works and apply the same in construction sector.

CO3 Understand the application of different equipments, techniques and methods of producing and placing of concrete.

CO4 Have in-depth knowledge of different types of advanced concrete and its application.

CO5 Apply different materials and methods used for sustainable building construction.

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	-	-	1	1	-	-	-	-	-	-	2	1	1
CO2	1	-	-	-	1	1	-	-	-	-	-	-	-	1	1
CO3	1	-	-	-	2	1	-	-	-	-	-	-	-	1	-
CO4	-	1	2	1	2	1	2	-	-	-	-	-	2	1	2
CO5	-	-	-	-	-	3	3	3	2	1	1	2	1	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

D. Recommended Study Material:

Text Books:

1. Energy Conservation Building Code, Bureau of Energy Efficiency, New Delhi, 2007.
2. J.R Waters, 'Energy Conversation in Building: A Guide to part of the building regulations', Black well publishing, 2003.
3. Peurifoy R. L., C. J. Schexnayder, A. Shapira and R. Schmitt, 'Construction planning, equipment, and methods', 8th ed., McGraw Hill, New York, 2010.
4. Jerry Irvine, 'Advanced Construction Techniques', CA Rocketr, 1984.
5. Shetty M.S., 'Concrete Technology', S.Chand and Company Ltd. Delhi, 2003.

6. Ben C. Gerwick, Construction of Pre-stressed Concrete, Wiley-Interscience; 2 edition, 1997.

Reference Books:

1. Ross Spiegel and Dru Meadows, 'Green Building Materials: A guide to Product Selection and Specification', John Wiley & Sons, 2012
2. Roy Chudley and Roger Greeno, 'Construction Technology', Prentice Hall, 2005.
3. Sankar, S.K. and Saraswati, S., 'Construction Technology', Oxford University Press, New Delhi
4. Gambhir, M. L., 'Concrete Technology', McGraw Hill Education, 2006.
5. Krishnaraju, N., 'Advanced Concrete Technology', CBS Publishers.
6. Krishna Raju N, Prestressed Concrete, Tata McGraw Hill Publishing, 2006.
7. Tyagi, A.K. (Ed). Handbook on Energy Audits and Management Tata Energy Research Institute, 2000.

Web Materials:

1. http://www.pipejacking.org/about_pipe_jacking
2. http://www.jackedstructures.com/home.html
3. https://www.youtube.com/watch?v=wUlQyiHfex0
4. http://www.deepexcavation.com/en/Diaphragm+wall+construction+methods
5. http://www.pilingcontractors.com.au/processes/diaphragm-walls
6. http://nptel.ac.in/courses/105104034/1
7. https://www.deepexcavation.com/en/shoring-engineering
8. https://www.researchgate.net/publication/281174992_A_SHORT_STUDY_ON_LAUNCHING_TECHNIQUES
9. http://www.post-tensioning.org/Uploads/Conference/2012%20Convention/Segmental%20Bridge%20Constructin%20Techniques.pdf
10. https://www.concretenetwork.com/post-tension/basics.html
11. http://www.teriin.org/

CL489: ENVIORNMENTAL POLLUTION AND CONTROL

B. TECH 8th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - IV

Credits and Hours:

Teaching Scheme	Theory	Practical/Tutorial	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the course:

Sr. No.	Title of the unit	Minimum number of hours
1.	Overview of the Course	02
2.	Industrial Wastewater Management	18
3.	Hazardous Waste Management	12
4.	Air Pollution Control	10
5.	Environmental Policies for Pollution Prevention	03

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1. Overview of the Course: 02 Hours 04%

1.1 Concept of pollution prevention and cleaner production, environmental management hierarchy

1.2 Industrialization and sustainable development

2. Industrial Wastewater Management: 18 Hours 40%

2.1 Effects of industrial wastes on sewerage system and receiving water bodies

2.2 Industrial waste survey: Process flow charts, condition of waste stream

2.3	Pre-treatment of industrial wastewater: Volume reduction, strength reduction, neutralization, equalization and proportion, removal of organic and inorganic dissolved solids		
2.4	Wastewater treatment in specific industries: Distillery, sugar, pulp and paper, cement, textile, dairy, fertilizer, pesticides, pharmaceutical, etc.		
3.	**Hazardous Waste Management:**	**12 Hours**	**27%**
3.1	Introduction, sources, classification, regulations for hazardous waste management, hazardous waste characterization		
3.2	Waste minimization and resource recovery: Approaches, development of a waste tracking system		
3.3	Transportation of hazardous waste: Requirements, regulations		
3.4	Physico-chemical, chemical and biological treatment of hazardous waste		
3.5	Sanitary landfill: Design approach, leachate and gaseous collection system, facility siting and process selection for treatment, storage, disposal facility (TSDF)		
3.6	Recent developments in hazardous wastes management		
3.7	Biomedical waste management: Sources, treatment and disposal		
4.	**Air Pollution Control:**	**10 Hours**	**22%**
4.1	Meteorology: Composition and structure of the atmosphere, wind circulation, solar radiation, lapse rates, atmospheric stability conditions, wind velocity profile, Maximum Mixing Depth (MMD), temperature inversions, windrose diagram		
4.2	Monitoring of particulate matter and gaseous pollutants: Respirable, non-respirable and nano - particulate matter, CO, CO2, Hydrocarbons (HC), SOX and NOX, photochemical oxidants		
4.3	Pollutants dispersion models: Description and application of point, line and areal sources		
4.4	Air pollution control equipment for particulate matter & gaseous pollutants: Gravity settling chambers, centrifugal collectors, wet collectors, fabric filters, electrostatic precipitator (ESP), adsorption, absorption, scrubbers, condensation and combustion		

5. Environmental Policies for Pollution Prevention **03 Hours** **07%**

5.1 Introduction to environmental legislations

5.2 Environmental auditing: Financial and managerial opportunities

C. Course Outcomes:

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

CO1 Discover correctly the knowledge related to environmental pollution

CO2 Understand the theories and practical aspects of pollution control along with the design and management applications.

CO3 Propose ideas to control environmental pollution with respects to professionalism and ethics.

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	1	-	-	-	2	-	2	-	-	2
CO2	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO3	-	1	3	1	3	3	3	3	3	3	3	3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

D. Recommended Study Material:

Text Books:

1. Mahajan, S.P., Pollution Control in Process Industries, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Washington, D.C., Eckenfelder, Industrial Water Pollution Control, McGraw hill Company, New Delhi, American Chemical Society, USA, 2000.
3. Rao, C.S., Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Age International Ltd.
4. Rao, M.N. and Rao, H.V.N., Air Pollution, Tata McGraw-Hill

Reference Books:

1. Wark, K., Warner, C.F. and Davis, W.T., Air Pollution - Its Origin and Control, Harper & Row Publishers, New York, 1998.
2. Perkins, H.C., Air Pollution, McGraw Hill, 1974.
3. Stern, A.C., Air Pollution, Vol. - I, II, III.

4. Nemerow, N.N., Liquid Waste of Industry Theories, Practices and Treatment. Addison Willey, New York, 1971.
5. Ross, R.D., Industrial Waste Disposal, Reinhold Environmental Series - New York, 1978.
6. Tchobanoglous, G., Theissen, H. and Eliassen, R., Solid Waste Engineering - Principles and Management Issues,McGraw Hill, New York, 1991.

Web Materials:

1. http://www.epa.gov
2. http://www.indiaenvironmentportal.org.in
3. http://nptel.ac.in

LIST OF EXPERIMENTS

Experiment No.	Name of Experiment
1	Introduction to Sampling in wastewater analysis
2	Determination of BOD/COD ratio
3	Determination of PM10 and PM2.5 in ambient air
4	Determination of gaseous pollutants in ambient air
5	Determination of pH and conductivity for hazardous waste
6	Determination of loss on drying for hazardous waste
7	Treatability studies of industrial wastewater
8	Leachate Analysis

CL496: GREEN BUILT ENVIRONMENT

B. TECH 7th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE-III

Credits and Hours:

Teaching Scheme	Theory	Practical/Tutorial	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Sustainable Architecture & Sites	09
2	Water Management	09
3	Energy Management	09
4	Materials & Resources	09
5	Indoor Environmental Quality	09

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1 Sustainable Architecture & Sites **09 Hours 20%**

1.1 Integrated Approach for Green Building design

1.2 Soil erosion & pollution control measures

1.3 Storm water management

1.4 Reduction of heat island effect

1.5 Minimizing night sky pollution

2 Water Management **09 Hours 20%**

2.1 Water Balance and approach for water efficiency

2.2 Water efficient plumbing fixtures

2.3 Effective irrigation techniques

2.4 Waste-water treatment & reuse

2.5	Rainwater harvesting		
3	**Energy Management**	**09 Hours**	**20%**
3.1	Energy Performance Evaluation		
3.2	Approach for Enhancing Energy Efficiency		
3.3	Performance Improvement Opportunities; Building Envelop, Air Conditioning, Lighting d. Appliances and Equipment		
3.4	Renewable Energy systems		
4	**Materials & Resources**	**09 Hours**	**20%**
4.1	Green Products and Materials for enhancing performance		
4.2	Waste management – During construction and post-occupancy		
4.3	Suggested approach - 3 R concept (Reduce, Reuse & Recycle)		
4.4	Case studies		
5	**Indoor Environmental Quality**	**09 Hours**	**20%**
5.1	Indoor Air quality – Codes and Standards		
5.2	Approach for improving Indoor air quality		
5.3	Enhancing occupants' Comfort, Health and Wellbeing; Thermal comfort, Visual Comfort, Acoustics, Olfactory comfort, Ergonomics		

C. Course Outcomes:

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

CO1 Understand and apply trends & technologies of Green concepts in construction Industry.

CO2 Have in-depth knowledge and exposure to the Green concepts in design, construction and operation of buildings and built environment.

CO3 Apply different materials and methods used for sustainable building construction.

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	2	1	2	2	3	1	2	1	1	2	2	1	2
CO2	2	-	2	2	2	2	2	-	1	-	-	1	1	1	1
CO3	1	-	1	-	1	1	2	-	1	-	-	-	-	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

D. Recommended Study Material:

Books:

1. Energy Conservation Building Code, Bureau of Energy Efficiency, New Delhi, 2007.
2. Ross Spiegel and Dru Meadows, 'Green Building Materials: A guide to Product Selection and Specification', John Wiley & Sons, 2012
3. Karthik Karuppu and NVICO, 'Green Building Guidance: The Ultimate Guide for IGBC Accredited Professional Examination', Notion Press, 2019.
4. A. K. Jain, 'The Idea Of Green Building', Khanna Publishers, 2014
5. David Johnston, 'Toward a Zero Energy Home: A Complete Guide to Energy Self-Sufficiency at Home', Taunton Press Inc, 2010
6. Francis D. K. Ching and Ian M. Shapiro, 'Green Building Illustrated', Wiley, 2014

Web Materials:

1. https://igbc.in/igbc/redirectHtml.htm?redVal=showResourcesnosign
2. https://igbc.in/igbc/redirectHtml.htm?redVal=showGreenNewBuildingsnosign#overview
3. https://igbc.in/igbc/redirectHtml.htm?redVal=showGovtIncentivesnosign
4. http://cdn.ifma.org/sfcdn/membership-documents/green-rating-systems-htg-final.pdf

OCCL4001: AIR POLLUTION AND CONTROL

B. TECH 7th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE-III

Description:

This course OCCL4001 – Air Pollution and Control is offered from SWAYAM as noc23_ce14 - Air Pollution and Control

URL: https://onlinecourses.nptel.ac.in/noc23_ce14/preview

Credit and Week:

Teaching Scheme	Week	Marks	Credit
	12	150	4

About the course:

The objective of the course is to impart the knowledge and understanding of causes and effects of air pollution and their controlling mechanisms. The course will provide a deeper understanding of air pollutants, pollution inventory and modelling. The course also imparts knowledge on the impacts of air pollution on different aspects such as policy, human health and various contemporary technological innovation for betterment of air quality.

Pre-requisites: Nil

Industry support:

Environmental consultancies, research centers, Laboratories shall recognize/value this course.

Course layout:

Week 1: Air Pollution: Introduction and Impacts of air pollution on human health, vegetation, animals, building materials, structures, and atmosphere, soil and water bodies.

Week 2: Sources, classification and formation/transformation of air pollutants: Meteorology and Atmospheric Stability.

Week 3: Lapse Rate, Plume Behaviour, and Air Quality Monitoring, Air Quality Index (AQI)

Week 4: Air Quality Modelling, Gaussian dispersion models: point, line and area source models

Week 5: Emissions Inventory: Transport, Industrial, Agricultural, Residential and Commercial sectors

Week 6: Application of Remote sensing/Satellite based data in emission inventory, Source apportionment using receptor modelling.

Week 7: Indoor air pollution: sources, types and health impacts. Sampling, assessment and evaluation of Indoor air quality.

Week 8: Global and regional environmental issues of air pollution: Ozone depletion, Climate change, Global warming, Acid rain.

Week 9: Air pollution control devices, equipment and their design.

Week 10: Air pollution emission standards, National and international policies, acts, rules and regulations.

Week 11: Emerging technologies and strategies to mitigate air pollution, Current challenges and way forward.

Week 12: Lab-based measurements of air pollutants.

Books and References

1. Wark, K., Warner, C.F., and Davis, W.T., "Air Pollution: Its Origin and Control", Addison-Wesley Longman. 1998.
2. Boubel, R.W., Fox, D.L., Turner, D.B., Stern, A.C., "Fundamentals of Air Pollution", Academic Press. 2005.
3. Seinfeld, J.H., Pandis, S.N., "Atmospheric Chemistry and Physics", John Wiley. 2006.
4. Lodge, J.P. (Ed.), "Methods of Air Sampling and Analysis", CRC Press. 1988.
5. Gurjar, B.R., Molina, L., Ojha, C.S.P. (Eds.), "Air Pollution: Health and Environmental Impacts", CRC Press. 2010.

Criteria to get a certificate:

- Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
- Exam score = 75% of the proctored certification exam score out of 100
- Final score = Average assignment score + Exam score
- YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75. If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.

- Certificate will have your name, photograph and the score in the final exam with the breakup. It will have the logos of NPTEL and IIT Roorkee. It will be e-verifiable at nptel.ac.in/noc.
- Only the e-certificate will be made available. Hard copies will not be dispatched.

OCCL4002: SOIL STRUCTURE INTERACTION

B. TECH 7th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE-III

Description:

This course OCCL4002: Soil Structure Interaction is offered by SWAYAM as noc20_ce22 - Soil Structure Interaction.

URL: https://archive.nptel.ac.in/courses/105/105/105105200/

Credit and Week:

Teaching Scheme	Week	Marks	Credit
	12	150	4

About the course:

The course will focus on the different soil-structure interaction models for shallow foundation under various loading conditions and subgrade characteristics. Piles under uplift and lateral loading conditions will also be discussed. In the undergraduate core course on Foundation Engineering, these topics are either not covered or discussed in simplified form. Beams and plates on elastic foundation problems & different foundation models and their solution with the help of Finite Difference Method (FDM) will be discussed. The application of foundation models in real life problems will also be discussed.

Pre-requisites: Soil Mechanics and Foundation Engineering

Industry support: Most of the Civil Engineering companies

Course layout:

Week 1: Introduction, critical study of conventional methods of shallow foundation design: bearing capacity and settlement calculation.

Week 2: Critical study of conventional methods of shallow foundation design (continued), contact pressure and soil-structure interaction for shallow foundation, concept of subgrade modulus, determination of subgrade modulus, parameters influencing subgrade modulus.

Week 3: Determination of subgrade modulus and parameters influencing subgrade modulus (continued). Different foundation models (such as one-parameter, two-parameter models etc.) with linear and non-linear stress-strain characteristics.

Week 4: Time-dependent response, Beams on Elastic Foundation, infinite beam.

Week 5: Infinite beam (continued), infinite beam subjected to various loading conditions, semi- infinite beam.

Week 6: Semi-infinite beam (continued), beams with finite length.

Week 7: Beams with finite length and various end conditions, continuity among the foundation soil layers.

Week 8: Continuity among the foundation soil layers (continued), beams on two-parameter soil medium (infinite and finite beam), beam with variable EI and subgrade modulus.

Week 9: Plates on Elastic Foundation (rectangular and circular), plates on two-parameter soil medium, use of Finite Difference Method (FDM) for soil structure interaction problems

Week 10: Use of Finite Difference Method (FDM) for soil structure interaction problems (continued), computer programs based solution of different interaction problems such as beams, plates, application of foundation models in real life problem.

Week 11: Group action of pile, Elastic Analysis, settlement of pile group under compressive load by Interaction Factor Approach, negative skin friction.

Week 12: Laterally loaded piles, Reese and Matlock's generalized solution, displacement of pile group under lateral load by Interaction Factor Approach, Uplift capacity of piles and anchors.

Books and References

1. John P. Wolf, Soil-structure interaction
2. Bowels, J.E., "Analytical and Computer methods in Foundation" McGraw Hill Book
3. Co., New York.
4. Desai C.S. and Christian J.T., "Numerical Methods in Geotechnical Engineering" McGraw Hill Book Co. New York.
5. Soil Structure Interaction, the real behavior of structures, Institution of Structural Engineers, 1989.
6. Prakash, S., and Sharma, H. D., "Pile Foundations in Engineering Practice." John Wiley & Sons, New York, 1990.

Criteria to get a certificate:

- Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
- Exam score = 75% of the proctored certification exam score out of 100
- Final score = Average assignment score + Exam score
- YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75. If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.
- Certificate will have your name, photograph and the score in the final exam with the breakup. It will have the logos of NPTEL and IIT Guwahati. It will be e-verifiable at nptel.ac.in/noc.
- Only the e-certificate will be made available. Hard copies will not be dispatched.

OCCL4003: TRAFFIC ENGINEERING

B. TECH 7th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE-III

Description:

This course OCCL4003 – Traffic Engineering is offered from SWAYAM as noc24-ce35 – Traffic Engineering.

URL: https://onlinecourses.nptel.ac.in/noc24_ce35/preview

Credit and Week:

Teaching Scheme	Week	Marks	Credit
	12	150	4

About the course:

This course will help in capacity building amongst master students, policy makers, practitioners, etc. to understand traffic engineer's role in all relevant dimensions, and develop strategies, programs and projects accordingly.

Pre-requisites: Any B.E/BTech in Civil Engineering/ Transportation Engineering/ Construction Engineering or equivalent at U.G level.

Industry support: This is a core course in all IITs, NITs and universities offering M.E. / M.Tech in Transportation Engineering and therefore recognized by companies/industries in relevant areas

Course layout:

Week 1: Traffic Components and Characteristics.

Week 2: Traffic Stream Parameters and their Relationships.

Week 3: EIA Procedure - Scoping & Screening and Establishing Baseline Conditions, Shockwave and Queuing.

Week 4: Capacity and LOS (U.S HCM-2016).

Week 5: Capacity and LOS (INDO-HCM-2016).

Week 6: Traffic Control at Intersections.

Week 7: Traffic Control at Intersections (Continued…).

Week 8: Traffic Control at Intersections (Continued…).

Week 9: Car Following Models and Traffic Simulation.

Week 10: Traffic Control and Management.

Week 11: Parking Management.

Week 12: Traffic Safety.

Books and References

1. Roess, Roger P., Elena S. Prassas, and William R. McShane. Traffic engineering. Pearson/Prentice Hall, 2019.
2. May, Adolf Darlington. Traffic flow fundamentals. 1990.
3. Garber N.J., and Hoel L.A., Traffic and Highway Engineering, 4th Edition, Cengage Learning, 2009
4. Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, 2013.
5. Chakroborty, Partha, and Animesh Das. Principles of transportation engineering. PHI Learning Pvt. Ltd., 2017
7. Chandra, Satish, S. Gangopadhyay, S. Velmurugan, and Kayitha Ravinder. "Indian highway capacity manual (Indo-HCM)." (2017).
8. Gartner, Nathan H., Carrol Jl Messer, and Ajay Rathi. "Traffic flow theory-A state-of-the-art report: revised monograph on traffic flow theory." (2002).

Criteria to get a Certificate:

- Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
- Exam score = 75% of the proctored certification exam score out of 100
- Final score = Average assignment score + Exam score
- YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75. If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.
- Certificate will have your name, photograph and the score in the final exam with the breakup. It will have the logos of NPTEL and IIT Kharagpur. It will be e-verifiable at nptel.ac.in/noc.
- Only the e-certificate will be made available. Hard copies will not be dispatched.

OCCL4004: URBAN TRANSPORTATION SYSTEMS PLANNING

B. TECH 7th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE-III

Description:

This course OCCL4004 – Urban Transportation Systems Planning is offered from SWAYAM as noc24-ce37– Urban Transportation Systems Planning.

URL: https://onlinecourses.nptel.ac.in/noc24_ce37/preview

Credit and Week:

Teaching Scheme	Week	Marks	Credit
	12	150	4

About the course:

This course covers the challenging need for effective and efficient planning of urban transport addressing the growing travel demand in a sustainable and affordable way. This course will help in capacity building amongst master students, policy makers, practitioners, etc. for urban transport planning and decision making, to understand urban transport in all relevant dimensions, and develop urban transport plans, programs and projects.

Pre-requisites: Nil

Industry support: This is a core course in all IITs, NITs and universities offering M.E. / M.Tech in Transportation Engineering and therefore recognized by companies/industries in relevant areas

Course layout:

Week 1: Introduction to Urban Transportation Planning

Urbanization, Urban Transportation: Impacts, Behavioral Changes, Urban Transportation problems & Externalities- Congestion, Safety, Emissions, etc. Introduction to Transport planning; Transport Planning Morphology: Problem definition, Solution generation, solution analysis, Evaluation and choice, Implementation Hierarchical levels of Urban Transport Planning: Conceptual Plan, Outline plan, Master plans, statutory or advisory plans, detailed development plans

Week 2: Overview of 4-Stage Urban Transportation Planning Process

Overview of traditional four step travel demand forecasting process: Urban Activity forecasts, Trip generation, Trip Distribution, Mode Choice, Traffic assignment Specification, Calibration, Validation and Forecasting; Information needs for Travel Demand Forecasting: Study Area, Urban Activities, Zoning, Urban Activities, Transportation System, Travel information, Types of Movements Data Collection Techniques (Home-interview survey, Commercial vehicle survey, Innovative Commercial Vehicle Tracking Methods, Intermediate Public Transport Survey, Cordon-Line Survey, Post-Card Questionnaire Survey, Registration – Number Survey, License Plate Follow-Up Survey Technique, Tag-on- Vehicle Survey)

Week 3: Trip Generation

Introduction; Basic considerations in trip generation - amount of urban activity, character of urban activity, other considerations, special generators; Trip classification; Factors affecting trip generation Methods of trip Generation- Regression analysis, trip rate analysis, cross classification analysis; Multiple Linear Regression- Regression analysis concept; The step wise approach with examples

Week 4: Trip Generation (Continued…)

Multiple Linear Regression- Considerations for zonal based multiple regression, Considerations for household based multiple regression, matching productions and attractions Category analysis- Basic approach, specifying trip generation model (trip production model structure, trip attraction model structure, Internal- External trip generation), Trip generation model calibration (developing trip production rates, developing trip attraction rates), advantages and disadvantages Stability of trip generation model- Temporal stability, geographical stability; Trip generation model application- Trip production model application, Trip attraction model application

Week 5: Trip Distribution

Introduction, Basic considerations in Trip Distribution, P-A Matrix to O-D Matrix, Factors affecting trip distribution: Properties of transport network, spatial separation between various zones Growth factor methods- Uniform factor method, Average factor method, Detroit Method, Fratar method; Furness method Synthetic methods - Introduction to Gravity Model

Week 6: Trip Distribution (Continued…)

Gravity Model- Calibration, BPR Approach of Calibration Intervening opportunities model: Concept, Advantages, Limitations, Illustrative example, competing opportunities model, Limitations Doubly restrained model: Concept, Calibration, Linear programming approach to Trip Distribution: Concept, limitations

Week 7: Modal Split

Introduction; Influencing factors of mode choice; Types of modal split models- Trip end type and trip interchange type; Types of modal split models - Trip end type (Southern Wisconsin Model) and trip interchange type (Diversion curve model), Limitations, Aggregate and disaggregate models, advantages of disaggregate over aggregate modelling; Elements of choice decision process; Framework for the choice process of an individual Disaggregate mode choice models- Introduction, Utility theory, Probabilistic choice theory

Week 8: Modal Split (Continued…)

Binary choice models- Binary logit model, discriminant analysis, Probit analysis; Logit model; Multinomial Logit model; Nested logit model, Estimation of logit models, Two-stage modal split models

Week 9: Traffic Assignment

General, link cost function, Person-trips and vehicle Trips, diurnal patterns of demand, Trip directions Network properties: Link, nodes, characteristics of link (capacity, free flow speed, travel time, etc.), link flows, inter-zonal flows, Network connectivity, Minimum spanning tree, shortest path, etc.; Network Algorithms: Kruskal, Prims, Dijkstra, Floyd

Week 10: Traffic Assignment (Continued…)

Route Choice Behavior: User equilibrium, system equilibrium, stochastic equilibrium, Diversion Curves: California diversion curves, Detroit diversion curves, Bureau of Public roads diversion curves Deterministic traffic assignment techniques- All-or-nothing assignment, Multi-Path Traffic Assignment; Incremental assignment, capacity restraint assignment; Stochastic Traffic assignment techniques; Dynamic traffic assignment techniques: Basic Concepts and Approach

Week 11: Land Use and Transportation

Introduction; Urban land use planning- land use and land cover, land use classification; Land use transportation interaction; Accessibility and mobility, Land use models **Module-H: Urban Goods Movement** Introduction; Classification of urban goods movement;

Factors affecting goods movement; Modelling Approaches Data collection; Strategy for goods transport facility planning; Facilities required in goods terminals; Time series techniques for forecasting truck traffic

Week 12: Urban Goods Movement (Continued…)

Introduction; Classification of urban goods movement; Factors affecting goods movement; Modelling Approaches Module I: Emerging Trends in Transportation Planning Activity based modelling; Spatial data infrastructure (SDI); Big Data analytics

Books and References

1. Hutchinson, B.G., Principles of Urban Transport Systems Planning, McGraw Hill, London, 1974.
2. Khisty, C. Jotin and Lall, B. Kent., Transportation Engineering and Planning, 3rd Edition, Pearson India, 2001
3. Papacostas, C. S., and Prevedouros, P. D., Transportation Engineering and Planning. 3rd Edition, Prentice - Hall of India Pvt. Ltd., 2002.
4. Garber N.J., and Hoel L.A., Traffic and Highway Engineering, 4th Edition, Cengage Learning, 2009
5. Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, 2013

Criteria to get a Certificate:

- Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
- Exam score = 75% of the proctored certification exam score out of 100
- Final score = Average assignment score + Exam score
- YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75. If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.
- Certificate will have your name, photograph and the score in the final exam with the breakup. It will have the logos of NPTEL and IIT Kharagpur. It will be e-verifiable at nptel.ac.in/noc.
- Only the e-certificate will be made available. Hard copies will not be dispatched.

OCCL4005: ADVANCED FOUNDATION ENGINEERING

B. TECH 7th SEMESTER (CIVIL ENGINEERING)
PROGRAMME ELECTIVE-III

Description:

This course OCCL4005: Advanced Foundation Engineering is offered by SWAYAM as noc22_ce32 - Advanced Foundation Engineering.

URL: https://archive.nptel.ac.in/courses/105/105/105105207/

Credit and Week:

Teaching Scheme	Week	Marks	Credit
	12	150	4

About the course:

The course will focus on the design of shallow foundation on sloping ground, layered soil and under inclined & eccentric loading conditions. Piles under uplift and lateral loading conditions will also be discussed. In the undergraduate core course on Foundation Engineering, these topics are either not covered or discussed in simplified form. In the proposed course, these advanced topics will be discussed in detail.

Pre-requisites: Soil Mechanics and Foundation Engineering

Industry support: Most of the Civil Engineering companies

Course layout:

Week 1: Introduction, planning of soil exploration for different projects, methods of borings along with various penetration tests, geophysical soil exploration.

Week 2: Shallow foundations, methods of estimating bearing capacity of footings and rafts, foundations under eccentric loading.

Week 3: Foundations under inclined loading, foundations on slope, foundations with tilted base.

Week 4: Bearing capacity of foundations on layered soil.

Week 5: Methods of estimating settlement of footings and rafts. Concept of Beams on Elastic Foundation.

Week 6: Concept of Beams on Elastic Foundation (continued).

Week 7: Proportioning of foundations using field test data, IS codes.

Week 8: Pile foundations, pile load tests, methods of estimating load transfer of piles, analytical estimation of load settlement behavior of piles.

Week 9: Pile group capacity and settlement, negative skin friction of piles.

Week 10: Laterally loaded piles.

Week 11: Uplift capacity of piles, foundations/anchors under uplift loads, well foundation, bearing capacity of well foundations, lateral stability of well foundations.

Week 12: IS and IRC codal provisions, elastic theory and ultimate resistance methods for well foundations, foundations on problematic soils: foundations for collapsible and expansive soil.

Books and References

1. J. E. Bowles, "Foundation Analysis & Design", Mc.Graw Hill Book Co.
3. W. C. Teng, "Foundation Design", Prentice Hall of India Ltd.
4. Tomlinson, "Foundation Design and Construction", ELBS, Longman Group Ltd.
5. Winterkorn and Fang, "Foundation Engineering Hand Book", Van Nostrand Reinhold Co, New York.

Criteria to get a Certificate:

- Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
- Exam score = 75% of the proctored certification exam score out of 100
- Final score = Average assignment score + Exam score
- YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75. If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.
- Certificate will have your name, photograph and the score in the final exam with the breakup. It will have the logos of NPTEL and IIT Guwahati. It will be e-verifiable at nptel.ac.in/noc.
- Only the e-certificate will be made available. Hard copies will not be dispatched.

OCCL4006: VIBRATION OF CONTINUOUS SYSTEMS

B. TECH 7th SEMESTER (CIVIL ENGINEERING)
PROGRAMME ELECTIVE-III

Description:

This course OCCL4006 – Vibration of Continuous Systems is offered from SWAYAM as noc24_ce38 – Vibration of Continuous Systems

URL: https://onlinecourses.nptel.ac.in/noc24_ce38/preview

Credit and Week:

Teaching Scheme	Week	Marks	Credit
	12	150	4

About the course:

All structures or mechanical systems are in fact, continuous having their physical parameters, external forces and their response are distributed in space. The dynamic behavior of the structures or machine components, can only be truly reflected in the continuous systems. The slenderness of the structures necessitates the adoption of continuous modelling. The exact solutions that can be obtained from continuous models provide true physical behavior in addition to yielding various bench mark results for testing the efficacy of many numerical methods used in discrete approaches. Keeping this in mind, the present course has been framed to teach the students about the formulation and solution of vibration problems of the continuous systems by exact method as well as by numerical techniques with application of MATLAB tool box. The course is designed for 12 modules in which each module will consist of 3 or 4 lecture hours.

Pre-requisites: BE/B.Tech in Civil/Mechanical/Aerospace Engg./ Marine Engg.

Industry support: Aeronautics Research & Development Board, Delhi; Indian Space Research Org.

Course layout:

Week 1: Introduction to continuous system: Modelling of undamped and damped system, Concepts of time domain and frequency domain approach, Generalized approach for forced vibration

Week 2: Different approaches for problem formulation: Equation of motion of continuous system by force balance, Energy approach and Hamilton's principle, Lagranges equations and their applications.

Week 3: One dimensional wave equation: D,Alembert solution of the wave equation, Transverse vibration of stretched string, Modal analysis and dynamic response of flexible string.

Week 4: Axial and torsional vibration of bar: Development of equation of motion by force balance and energy principle, Free vibration problems in axially loaded bar and torsional system, Dynamic response of Shaft subjected to distributed couple or concentrated couple.

Week 5: Flexural vibration of beams: Equation of motions of slender beams Eigen value problems in beams, Forced vibration analysis using mode superposition techniques

Week 6: Vibration of beams subjected to moving load: Formulation of problems in vibration of beams subject to moving load, Solution of Problems using mode superposition principles, Some practical applications

Week 7: Combination of continuous and lumped parameter system: Exact solution of beam vibration with a concentrated mass, Semi-analytical approach for vibration of beams with several concentrated masses, Beam vibration problem with moving oscillator

Week 8: Vibration of membranes and plates: Equation of motion for the vibration of stretched membranes, Vibration of rectangular plates, Practical applications of vibration of plates

Week 9: Approximate methods in vibration of continuous system: Rayleigh-Ritz method, Gallerkin's approach, Finite difference method in vibration of beams and plates.

Week 10: Vibration isolation: Continuous system subject to support excitation, Force transmission and vibration isolation, Tuned mass damper for vibration reduction.

Week 11: Transient vibration analysis; Unit impulse and response to arbitrary excitation, Response to step, ramp and pulse excitation, Dynamic analysis using ground motion data

Week 12: Numerical techniques with MATLAB applications: Eigenvalues and Eigen vector computation including state space form, Direct integration methods, Spectral analysis of structures for earthquake excitation.

Books and References

1. Meriovitch, L (1986) "Elements of Vibration Analysis", Mc Graw Hill Book Co., New York
2. Thompson, W. T (1990) "Theory of Vibration with applications" CBS Publishers, New Delhi
3. Inman, D (2014) "Engineering Vibration" Pearson, New Delhi
4. Hurty, W. C and Rubinstein (1967) M. F, "Dynamics of Structures", Prentice Hall of India Pvt Ltd, New Delhi.
5. Fryba, L (2012), "Vibration of Solids and Structures under moving loads", Springer.
6. Paz, M and Kim, Y. H (2018), "Structural Dynamics: Theory and Computation", Springer

Criteria to get a Certificate:

- Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
- Exam score = 75% of the proctored certification exam score out of 100
- Final score = Average assignment score + Exam score
- YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75. If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.
- Certificate will have your name, photograph and the score in the final exam with the breakup. It will have the logos of NPTEL and IIT Guwahati. It will be e-verifiable at nptel.ac.in/noc.
- Only the e-certificate will be made available. Hard copies will not be dispatched.

OCCL4007: MICROWAVE REMOTE SENSING IN HYDROLOGY

B. TECH 7th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE-III

Description:

This course OCCL4007 – Microwave Remote Sensing in Hydrology is offered from SWAYAM as noc22_ce23 – Microwave Remote Sensing in Hydrology

URL: https://onlinecourses.nptel.ac.in/noc22_ce23/preview

Credit and Week:

Teaching Scheme	Week	Marks	Credit
	12	150	4

About the course:

This course shall explain the fundamentals of microwave remote sensing in passive and active domain with application in civil engineering (hydrology, meteorology). An emphasis is made to teach microwave image processing through open source programming languages like python. Further objective of this course is to make a student capable to interpreting and deciphering the microwave data for complex scientific and policy problems in the water arena, all of which require high quality training.

Pre-requisites: Nil

Industry support: RMSI, ERDAS and similarly all firms/companies which have a remote sensing and GIS applications wing shall recognize/value this course

Course layout:

Week 1: Fundamentals of Electromagnetic Waves, Introduction to microwave remote sensing, Overview of non-imaging and imaging microwave sensors, principles, physical fundamentals, Installation of python using Anaconda Environment and basic commands

Week 2: Scattering of Microwaves, Fundamentals of Synthetic Aperture Radar (SAR), Basics of Image formation, Basics of SAR Image processing using python

Week 3: Radar equation, Image defects - Geometric distortions, Introduction to Sentinel Application Platform (SNAP)

Week 4: Speckle, Doppler Shift in SAR Imagery, Multilooking, Spatial Convolution, Introduction to plotting and image statistics in python

Week 5: Introduction to Texture, GLCM, Introduction to Image statistics in Python

Week 6: Radar remote sensing, Speckle filtering using python

Week 7: Image classification, geometrical basis, Supervised Classification, SAR Image Classification using SNAP

Week 8: Unsupervised classification, Accuracy Assessment, Fuzzy Classification, Handling Active microwave data in Python

Week 9: Active microwave remote sensing: Principles, Application of active microwave remote sensing in hydrology, Doppler weather radar data visualization

Week 10: Radar Altimetry, concepts and applications in hydrology, measuring soil moisture using active microwave remote sensing, Fundamentals of Passive microwave remote sensing and data handling using python

Week 11: Applications of passive microwave remote sensing in hydrology, Handling Precipitation data in python

Week 12: Radar Interferometry, using phase as a relative distance measure, Digital Elevation Models, Hydrological Models – An Introduction

Books and References

1. Microwave Remote Sensing Active and Passive by Fawwaz T Ulaby, Richard K Moore, Adrian K Fung
2. Passive microwave remote sensing of the Earth by Eugene A Sharkov
3. Microwave Remote Sensing tools in Environmental Science by Costas A Varotsos and Vladimir F Krapivin
4. Introduction to Microwave Remote Sensing (Iain H. Woodehouse)

Criteria to get a Certificate:

- Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
- Exam score = 75% of the proctored certification exam score out of 100
- Final score = Average assignment score + Exam score
- YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75. If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.

- Certificate will have your name, photograph and the score in the final exam with the breakup. It will have the logos of NPTEL and IIT Guwahati. It will be e-verifiable at nptel.ac.in/noc.
- Only the e-certificate will be made available. Hard copies will not be dispatched.

OCCL4008: ROCK MECHANICS AND TUNNELING

B. TECH 7th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE-III

Description:

This course OCCL4008: Rock Mechanics and Tunneling is offered from SWAYAM as noc23_ce77 – Rock Mechanics and Tunneling

URL: https://onlinecourses.nptel.ac.in/noc23_ce77/preview

Credit and Week:

Teaching Scheme	Week	Marks	Credit
	12	150	4

About the course:

A good understanding about the mechanics behind the load transfer mechanism and the stability of different geotechnical structures constructed in/on the rocks becomes very much essential for the civil and mining engineers. On the other hand, the tunneling is a very efficient solution for the public transport as well as other underground transport systems. The course 'Rock Mechanics and Tunneling' will give an overall idea about the rock mechanics and its applications

Pre-requisites: Nil

Industry support: Most of the Civil infrastructure development companies and the Companies dealing with the mining operations.

Course layout:

Week 1: Introduction: objective, scope, and associated problems; Discontinuities in rock; Classification of the rock based on origin.

Week 2: Methods for rock exploration: rock coring, geophysical methods.

Week 3: Physico-mechanical properties of rock.

Week 4: Laboratory testing on rock sample and in-situ testing of rock mass.

Week 5: Rock mass classification systems.

Week 6: Rock and rock mass failure criteria.

Week 7: Rock and rock mass failure criteria.

Week 8: Applications of rock mechanics: slopes, underground excavations.

Week 9: Applications of rock mechanics: foundations, rock support systems.

Week 10: Basic features of tunneling: shapes, usages, methods of construction, problems associated with tunnels, tunneling in various subsoil conditions and rocks.

Week 11: Analysis of stresses: methods to determine stresses around openings, Kirsch equation, Greenspan's method. Basic concepts for lined, unlined, and pressure tunnels.

Week 12: Improvement of rock mass response: rock bolts, rock anchors, steel mats, precast concrete segments, shotcrete, grouting etc.

Books and References

1. Goodman R. E. Introduction to rock mechanics. Ed.2, Wiley, 1989.
2. Jaeger J. C., Cook N. G. W., and Zimmerman R. W. Fundamentals of rock mechanics. Ed. 4, Wiley Blackwell, 2007.
3. Deb D., and Verma A. K. Fundamentals and applications of rock mechanics. PHI Learning Pvt. Ltd., 2016.
4. Ramamurthy T. (Editor). Engineering in rocks for slopes, foundations and tunnels. Ed. 3, PHI Learning Pvt. Ltd.,2015.

Criteria to get a certificate:

- Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
- Exam score = 75% of the proctored certification exam score out of 100
- Final score = Average assignment score + Exam score
- YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75. If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.
- Certificate will have your name, photograph and the score in the final exam with the breakup. It will have the logos of NPTEL and IIT Kharagpur. It will be e-verifiable at nptel.ac.in/noc.
- Only the e-certificate will be made available. Hard copies will not be dispatched.

OCCL4009 BRIDGE ENGINEERING

B. TECH 7th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE-III

Description:

This course OCCL4009 Bridge Engineering is offered from SWAYAM as noc22_ce63–Bridge Engineering

URL: https://onlinecourses.nptel.ac.in/noc22_ce63/preview

Credit and Week:

Teaching Scheme	Week	Marks	Credit
	12	150	4

About the course:

Bridges constitute a significant portion of the national economy of a country and serve as a foundation for infrastructure development. With several new bridges required to be constructed and numerous existing bridges required to be repaired and retrofitted across the world, it is essential to study a course on "Bridge Engineering". This course on "Bridge Engineering" aims at knowledge development of principles of engineering mechanics, load transfer mechanisms, analysis methodologies, design principles, damage mechanics, failure mechanisms, construction, inspection, maintenance, repair and retrofit strategies in the realm of bridge engineering. Additionally, advanced topics in the domain of bridge engineering, like, fatigue and fracture in bridges, use of shape memory alloys (SMA) and special concrete for repair of bridges, 3D printing of bridges, high speed railway bridges, will also be introduced in this course. After successful completion of this course, the students will be able to equip themselves with fundamental concepts, acquire an in-depth knowledge on analysis and design of a wide variety of bridges, understand field-based construction, inspection, maintenance, repair and rehabilitation techniques of bridges and comprehend the emerging global trends in the domain of bridge engineering.

Pre-requisites: Structural Analysis, Solid Mechanics, Design of Concrete Structure, Design of Steel Structure

Industry support: Construction Industry, Design and Consultancy Firms

Course layout:

Week 1: Introduction

Week 2: Reinforced Concrete Slab Bridge Decks

Week 3: Box Culverts and Pipe Culverts

Week 4: Steel Truss Bridges

Week 5: Plate Girder Bridges

Week 6: Arch Bridges, Suspension Bridges, Cable-Stayed Bridges, Balanced Cantilever Bridges

Week 7: Prestressed Concrete Bridges and Composite Bridges

Week 8: Rigid Frame Bridges and Continuous Girder Bridges

Week 9: Piers, Abutments and Foundations

Week 10: Bridge Bearings, Joints and Appurtenances

Week 11: Construction, Maintenance and Rehabilitation of Bridges

Week 12: Advanced Topics in Bridge Engineering

Books and References

1. N. Krishna Raju, Design of Bridges, Oxford & IBH Publishing Co. Pvt. Ltd.
2. D.J. Victor, Essentials of Bridge Engineering, Oxford & IBH Publishing Co. Pvt. Ltd.
3. S. Ponnuswamy, Bridge Engineering, McGraw Hill Education.
4. T.R. Jagadeesh and M.A. Jayaram, Design of Bridge Structures, PHI Learning Pvt. Ltd.
5. W.F. Chen, and L. Duan, Bridge Engineering Handbook, CRC Press, Taylor & Francis Group.
6. G. Parke and N. Hewson, ICE manual of Bridge Engineering, Thomas Telford Publishing.

Criteria to get a Certificate:

- Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
- Exam score = 75% of the proctored certification exam score out of 100.
- Final score = Average assignment score + Exam score.
- YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75. If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.

- Certificate will have your name, photograph and the score in the final exam with the breakup. It will have the logos of NPTEL and IIT Kharagpur. It will be e-verifiable at nptel.ac.in/noc.
- Only the e-certificate will be made available. Hard copies will not be dispatched.

OCCL4010: FINITE ELEMENT ANALYSIS AND CONSTITUTIVE MODELLING IN GEOMECHANICS

B. TECH 7th SEMESTER (CIVIL ENGINEERING)
PROGRAMME ELECTIVE-III

Description:

This course OCCL4010 – Finite Element Analysis and Constitutive Modelling in Geomechanics is offered from SWAYAM as noc22_ce23 – FEM & Constitutive Modelling in Geomechanics

URL: https://onlinecourses.nptel.ac.in/noc23_ce53/preview

Credit and Week:

Teaching Scheme	Week	Marks	Credit
	12	150	4

About the course:

The course will introduce the students to both theoretical and practical aspects of finite element methods applicable to geotechnical engineering. The course will start from the fundamental aspects of matrix structural analysis and move into finite element techniques through variational principles. Special focus of this course will be on topics related to geotechnical problems like modelling of infinite soil media, construction and excavation sequences, jointed mass, and nonlinear analysis techniques. Fundamentals of different topics of isoparametric computations and nonlinear & elastic plastic analysis are explained through simple to use computer programs and detailed flow-charts.

Pre-requisites: Exposure to Mechanics courses & Shear strength of soils

Industry support: Most design companies working in Geotechnical Engineering like L&T ECC, AFCONS, HCC, Keller, Golder Associates, etc.

Course layout:

Week 1: Introduction to course, introduction to matrix algebra, concepts of finite element analysis through prismatic elements (spring, bar & beam elements) and matrix structural analysis

Week 2: Variational principles & Rayleigh-Ritz procedures in structural mechanics as a prelude to finite element techniques

Week 3: Continuum, stress & strain states, equations of equilibrium, compatibility & linear elastic constitutive equations, derivation of equilibrium equations for continuum, Plane stress, plane strain and axisymmetric and 3-d stress states

Week 4: Generalized Coordinate methods for deriving shape functions, Lagrange methods for shape functions 3-node CST element for finite element analysis and some simple calculations using this element

Week 5: Numerical integration techniques, Isoparametric transformations, shape functions in isoparametric space, Patch test & convergence

Week 6: Isoparametric element calculations - numerical examples & computer programs for different computations like stiffness matrix, load vector due to self-weight, stresses, etc.

Week 7: In situ stress states in soil medium, Simulation of construction and excavation sequences in finite element analysis, Joint elements for simulating discontinuities in geologic medium

Week 8: Infinite elements for simulating semi-infinite soil domains subjected to static and dynamic loading

Week 9: Stress and strain tensors & invariants, Introduction to nonlinear finite element techniques. Different types of constitutive models

Week 10: Nonlinear constitutive models like variable moduli models, Hyperbolic models, Mohr Coulomb model, stress correction methods & numerical procedures

Week 11: Elastic-Plastic constitutive models Simulation of dilation of soils Hardening soil models for excavation problems

Week 12: Undrained and drained response of soils Consolidation analysis of soils Introduction to simulation of impact and dynamic loading, Introduction to nonlinear finite element techniques, Different types of constitutive models

Books and References

1. Bathe, K.J. (1996) Finite Element Procedures in Engineering Analysis, Prentice Hall, Prentice-Hall of India Pvt. Ltd., New Delhi. (topics – 2, 3, 6, 11 & 12)
2. Bhatti, M. A. (2005) Fundamental Finite Element Analysis and Applications, John Wiley & Sons, Inc., Hoboken, NJ, USA.
3. Britto, A.M and Gunn, M.J. (1987) Critical State Soil Mechanics Via Finite Elements, Ellis Horwood Publishers, Chichester, England.

4. Cook. R.D., Malkus, D.S. and Plesha, M.E. (2000) Concepts and Applications of Finite Element Analysis, 4th Edition, Prentice Hall-India, New Delhi. (all topics)
5. Desai, C.S. and Siriwardane, H.J. (1984) Constitutive Laws for Engineering Materials, Prentice-Hall, Inc., Englewood Cliffs, N.J.
6. Desai, C.S. and Zaman, M. (2014) Advanced Geotechnical Engineering: Soil-Structure Interaction Using Computer and Material Models, CRC press, Boca Raton, FL, USA.
7. Hinton, E. and Owen, D.R.J. (1977) Finite Element Programming, Academic Press.
8. Hinton, E. and Owen, D.R.J. (1979) An Introduction to Finite Element Computations, Pineridge Press, Swansea.
9. Krishnamoorthy, C.S. (1994) Finite Element Analysis: Theory and Programming, Tata McGraw Hill, New Delhi.
10. Owen, D.R.J. and Hinton, E. (1980) Finite Elements in Plasticity: Theory and Practice, Pineridge Press Limited, Swansea, U.K.
11. Potts D.M. and Zdravkovic, L. (2001) Finite element analysis in geotechnical engineering: Theory and application, Vols. 1 & 2, Thomas Telford, London, UK
12. Rao, S.S. (2001) The Finite Element Method in Engineering, Butterworth Heinemann, New Delhi. 13. Zienkiewicz, O.C. and Taylor, R.L. (1989) Finite Element Method (4th edition) McGraw-Hill, London, U.K.

Criteria to get a Certificate:

- Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
- Exam score = 75% of the proctored certification exam score out of 100
- Final score = Average assignment score + Exam score
- YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75. If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.
- Certificate will have your name, photograph and the score in the final exam with the breakup. It will have the logos of NPTEL and IIT Guwahati. It will be e-verifiable at nptel.ac.in/noc.
- Only the e-certificate will be made available. Hard copies will not be dispatched.

B. Tech. (Civil Engineering) Programme

ANNEXURE II – ELECTIVE for B.Tech. (Hons.) Programs in Civil Engineering

7th Semester

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

© CHARUSAT 2025-26

CL465: SMART WATER MANAGEMENT SYSTEMS

B TECH 7th SEMESTER (CIVIL ENGINEERING)
SMART CITIES SPECIALIZATION COURSE

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	4	2	6	5
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction to Smart Water Management System	06
2	Environmental & Asset Monitoring: Leak Detection, Water Quality Monitoring, Flood Monitoring, Asset Monitoring	14
3	Smart Applications in the Water Sector	10
4	Water Sensitive Urban Design and Planning (WSUDP)	10
5	Smart Rainwater Management	14
6	Smart Water Management using IoT	06

Total Hours (Theory): 60
Total Hours (Lab): 30
Total Hours: 90

B. Detailed Syllabus:

1	**Introduction to Smart Water Management Systems**	**06 Hours**	**10%**
1.1	Current State of the Water Industry Across the Globe		
1.2	Need of smart technology in water management system, ,		
1.3	Introduction to smart water management system		
1.4	Components of smart water management: Water distribution management, Strom Water Management		
2	**Environmental & Asset Monitoring**	**14 Hours**	**23%**
2.1	Leak Detection: Leak detection and location methods, Basic mechanisms of bursts and leakage, Laying leak-free new		

	networks, Water accounting and quantification, Leakage innovation heat mapping		
2.2	Water Quality Monitoring: Water quality systems – drinking water, Water quality sensors, Water quality and distribution system optimization, Using turbidity to control PRV's		
2.3	Flood Monitoring: Flood measurements, Fleet monitoring, Manhole covers		
2.4	Asset Monitoring: Smart Water Metering, Tool and Techniques		
3	**Smart Applications in the Water Sector**	**10 Hours**	**17%**
3.1	Technology for Smart Water Management		
3.2	Digital output instruments (meters and sensors)		
3.3	Supervisory control and data acquisition (SCADA) systems		
3.4	Geographic information system (GIS)		
4	**Water Sensitive Urban Design and Planning (WSUDP)**	**10 Hours**	**17%**
4.1	Concept of Water Sensitive Urban Design and Planning, essential elements of WSUDP, essential elements of WSUDP		
4.2	SUDS, RWH(Rain water Harvesting) and local reuse of treated wastewater		
4.3	planning and designing of water sensitive structures, their techno-economic feasibility, operation and maintenance measures etc.		
4.4	Case study: Managing the water distribution network with a Smart Water Grid in Singapore		
5	**Smart Rainwater Management**	**14 Hours**	**23%**
5.1	Introduction, Rainwater harvesting, History		
5.2	Methods of rainwater harvesting		
5.3	Traditional methods of rainwater harvesting in India		
5.4	Rain centre Advantages, Disadvantages		
6	**Smart Water Management using IoT**	**06 Hours**	**10%**
6.1	Introduction to IOT and Terminologies		
6.2	LPWAN Technologies for Industrial IOT, Advantages and limitations of different technologies		
6.3	Different Applications / Case Studies of IOT for water applications in Singapore		

C. Course Outcomes (COs):

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

CO1 Have in-depth understanding of the state of art, challenges and opportunities of smart water systems

CO2 Use data driven approaches and probabilistic optimization tools to solve relevant problems in water management in the context of smart water systems

CO3 develop a systems viewpoint to smart water and its link to emerging AI technologies and enhance their ability to critically evaluate problems and solutions in the context of smart water systems

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	1	-	-	2	1	-	-	-	-	1	1	1	1
CO2	2	2	2	2	2	3	3	1	2	-	-	1	2	2	2
CO3	-	-	-	-	3	3	2	1	2	-	-	1	1	1	1

D. List of Practical/ Tutorial

Sr. Number	List of Practical/ Tutorials
1	Various Smart Water Management Systems
2	Environmental & Asset Monitoring
3	Smart Applications in the Water Sector
4	Water Sensitive Urban Design and Planning (WSUDP)
5	Smart Rainwater Management
6	Smart Water Management using IoT

E. Recommended Study Material:

References:

- Harrison, Roy M., Sustainable Water. United Kingdom: Royal Society of Chemistry, 2011.
- Lloyd Owen, David A., Smart Water Technologies and Techniques: Data Capture and Analysis for Sustainable Water Management. Germany: Wiley, 2018.

- Panagiotis Tsakalides, Athanasia Panousopoulou, Grigorios Tsagkatakis., Smart Water Grids, CRC press, Taylor & Francis Group, 2018

Web Materials:

- https://development.asia/explainer/what-smart-water-management
- https://www.waterworld.com/international/wastewater/article/16190746/smart-water-a-key-building-block-of-the-smart-city-of-the-future
- https://www.cseindia.org/training-programme-on-water-sensitive-urban-design-and-planning-at-building-and-neighborhood-scale-9461
- https://www.mdpi.com/2073-4441/12/1/58/htm
- https://www.gsma.com/iot/wp-content/uploads/2016/11/Smart-water-management-guide-digital.pdf
- https://www.cseindia.org/training-programme-on-water-sensitive-urban-design-and-planning-at-building-and-neighborhood-scale-9461
- https://smartwaterjournal.springeropen.com/articles/10.1186/s40713-016-0004-4
- https://theconstructor.org/water-resources/methods-rainwater-harvesting/5420/
- https://www.swa.org.sg/smart-water-management-using-iot-and-ai/

B. Tech. (Civil Engineering) Programme

SYLLABI (SEMESTER – 8)

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

CL458: MAJOR PROJECT

B TECH 8th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	0	36	36	29
Marks	0	800	800	

A. Outline of the Course:

- Students have to select their domain of work and company/ industry/ organization well in advance before the commencement of the project.
- Students are advised to carry out project in such a way that it is complete in all aspects and report should reflect comprehensive domain knowledge
- Students have to take approval of company/ industry/ organization from concerned faculty.
- Students have to take NOC from the concerned faculty, if needed and then they have to submit their confirmation letter from company/ industry/ organization before the commencement of project.
- Students must meet and report to their assigned faculty mentor about outline of the project work which they are going to carry out in the whole semester in 15 days after the commencement of the project.
- Students have to keep the record of activities carried out during their project tenure in the form of daily progress report and weekly progress report. Report weekly to your faculty mentor/ internal guide with filled weekly report as per the guidelines will be issued by concerned faculty.
- Project will be evaluated internally twice during the semester along with final evaluation at the end of the semester as a part of continuous evaluation.
- Students are required to prepare a report as per the guidance and directions from their assigned faculty mentor.
- After the completion of the project work, students must have to take completion certificate from the concerned company/ industry/ organization and submit the certificate to the concerned faculty.

- Students have to submit hard binding report with CD.
- Content of reports should be unique such that, Plagiarism check of project report of individual student shall be less than the university norms. Also, students have to attach completion certificate in their project report.

B. Instructional Method and Pedagogy:

- Type of Project will be assigned to an individual/ group of students based on their inclination/ willingness/ interest.
- The project may include a site visit/ software training/ research project/ real life problem as per the project type, where individual/ group of students can avail an opportunity to build an appreciation for the concepts to be utilized in understanding the actual scenario.
- 2 internal evaluations & 1 final evaluation are required. Each internal evaluation carries 100 Marks, 100 marks for report and 100 marks from internal guide & External evaluation carries 400 marks
- At the end of the semester, students have to submit the final project report. The project report should consist of at least 40 - 50 pages.
- At the end of semester, a presentation of the project is required to be done in group or individually on scheduled date for at least 15 minutes.

C. Course Outcomes:

On the successful completion of this course

CO1 The students will be able to hold ideas about projects and understand the significance of projects. They will be able to demonstrate a sound technical knowledge, skills and attributes of a professional engineer.

CO2 The students will also gain a better approach towards design and performance of various infrastructure related projects. They will be able to provide design engineering solutions to complex problems utilizing a systems approach.

CO3 Students will be able to communicate with engineers and community at large in written as well as in oral forms. Students will also be able to learn about the technical writing which is adopted at organization.

Course Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	2	2	-	1	1	2	1	-	2	1	2	2	1
CO2	2	3	3	2	1	2	1	-	-	-	1	1	3	3	-
CO3	-	-	-	-	3	-	-	-	-	3	-	-	-	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation "-"

D. Recommended Study Material:

Project related study is to be carried out by each student/group of students.

1. Reading Materials, web materials, blogs, Project reports with full citations
2. Books, magazines & Journals of related topics
3. Various software tools and programming languages compiler related to topic
4. Various codes related to civil engineering

Web Links:

1. https://www.asce.org/
2. https://cecr.in/
3. https://www.sciencedirect.com/
4. https://www.elsevier.com/en-in
5. https://bis.gov.in/