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 2021-22

ऋते ज्ञानान्न मुक्तिः ।

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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.

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

Academic Year – 2021-22
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 – I 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	150
	CL471-480	Programme Elective - III	3	2	0	5	3	1		4	30	70	25	25	150
						35				**26**					**1000**
	CL456	Minor Project	0	26	**0**	**26**	**0**	**0**	**21**	**21**	**0**	**0**	250	250	500
	CL481-489	Programme Elective - IV	3	2	0	5	3	1		4	30	70	25	25	150
	CL491-495	Programme Elective - V	3	2	0	5	3	1		4	30	70	25	25	150
						36				**29**					**800**
			OR												
	CL457	Major Project	0	36	0	**36**	0	0	29	**29**	0	0	400	400	**800**
										192					

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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

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

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

CL477: FIELD APPLICATIONS OF GEOTECHNICAL ENGINEERING

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	Reinforced Soil Structures	10
2	Ground Improvement Techniques	12
3	Foundation of Marine Structures	09
4	Geosynthetics in Civil Engineering	06
5	Stabilization of soils for road constructions	08

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1 Reinforced Soil Structures **10 Hours** **22%**

1.1 Concept of soil reinforcement

1.2 Reinforcing materials and their properties

1.3 Design of soil reinforcement for stability

1.4 Durability of reinforcement materials

1.5 Applications of Reinforced earth structures

2 Ground Improvement Techniques **12 Hours** 27%

2.1 Principles of ground improvement

2.2 Properties of compacted soil, Compaction control tests.

2.3 Mechanical Stabilization: Principle of mechanical modification,

	Dynamic Stabilization, Vibro-floatation, Precompression and Compaction piles.		
2.4	Hydraulic modification, Dewatering systems, Preloading and vertical drains, Sand Drain, Electro-kinetic dewatering		
2.5	Chemical modification, Modification by admixtures		
2.6	Bearing capacity & Slope stability improvement		
3	**Foundation of Marine Structures**	**09 Hours**	20%
3.1	Origin, Nature and distribution of marine soils and their engineering properties		
3.2	Sampling and sample disturbance, In-situ testing of marine soil		
3.3	Offshore platforms		
3.4	Shallow foundations on marine soil		
3.5	Deep foundations on marine soil		
4	**Geosynthetics in Civil Engineering**	**06 Hours**	13%
4.1	Introduction: An overview on the development and applications various geosynthetics - geotextiles, geogrids, geonets, geomembranes and geocomposites.		
4.2	Designing with geotextiles: Geotextile properties and test methods, functions, designing for separation, reinforcement, stabilization, filtration, drainage.		
4.3	Different test on geosynthetics		
5	**Stabilization of Soils for Road Construction**	**08 Hours**	18%
5.1	The need for a stabilized soil, choice of stabilizers		
5.2	Testing and field control		
5.3	Stabilization in India for rural roads		
5.4	Use of geo-fabrics in unpaved road construction.		
5.5	Case studies.		

C. Course Outcomes (COs):

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

CO1 Learn the concept and designing of reinforced soil structure.

CO2 Understand the principle of ground improvement technique and various

different methods to improve the soil properties in economical way.

CO3 Identify important aspects of foundation design for marine structures.

CO4 Identify which type of geosynthetics is required for given engineering problems.

CO5 Apply fundamental knowledge of soil quality improvement in design & construction of road.

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	2	1	2	2	1	1	2	2	3	3	2	3
CO2	3	2	2	2	1	2	2	2	1	2	2	2	3	3	3
CO3	3	3	3	3	2	2	3	2	2	2	3	3	3	3	3
CO4	2	2	2	3	1	2	2	1	2	2	2	3	2	2	2
CO5	3	3	3	2	2	2	3	2	2	2	3	3	3	3	3

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

D. Recommended Study Material:

Text Books:

1. Koerner, R.M., Designing with Geosynthetics, (Third Edition), Prentice Hell, 1997.
2. Reinforced Soil and Geo-textiles- J. N. Mandal, proceedings FIGC- 1988, Oxford and IBH publishing company private Ltd., New Delhi.
3. Khanna S.K and Justo C.E.G., Highway Engineering, New Chand and Brothers, Roorkee, 1998.
4. H.G.Poulos, Marine Geotechniques, Unwin Hyman, London.
5. Swamisaran, Analysis and Design of Substructures, Oxford & IBH Publishing Company Private Ltd., Delhi.
6. Dr. Purushothama Raj, Ground Improvement Techniques, Laxmi Publications, New Delhi.

Reference Books:

1. Jewell, R.A., Soil Reinforcement with Geotextile, CIRIA, London, 1996.
2. Remote Sensing in Civil Engineering, by Kennie, T.J.M. and Matthews M.C. Surrey University Press, Glasgow. Taylor,

3. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw Hill, 1990.
4. Jones, C.J.F.P., Earth Reinforcement and Soil Structures, Butterworth Publications, 1996.

Web Materials:

1. http://edudel.nic.in
2. http://bis.org.in/other/quake.htm
3. http://www.thepeninsulaneighborhood.com/ThePlan.html

LIST OF TUTORIALS

Tutorial No.	Name of Tutorial
1	Reinforced Soil Structures
2	Ground Improvement Techniques
3	Foundation of Marine Structures
4	Geosynthetics in Civil Engineering
5	Stabilization of Soils for Road Construction

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

CL480: WATER RESOURCES ENGINEERING II

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.	Runoff and Hydrograph	08
2.	Floods	10
3.	Discharge Measurement	08
4.	Groundwater Exploration	06
5.	Sediment Transport in Alluvial Rivers and Channels	10
6.	Hydroelectric Power	03

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1. Runoff and Hydrograph **08 Hours** **18%**

1.1 Estimation of Runoff

1.2 Dependable Flow

1.3 Runoff Co – efficient, Runoff Cycle

1.4 Synthetic Unit Hydrograph

1.5 Distribution Graph

1.6 Triangular Unit Hydrograph

1.7 Instantaneous Unit Hydrograph

2.	**Floods and Flood Routing**	**10 Hours**	**22%**
2.1	Definition, Factors Affecting Flood, Classification of Floods		
2.2	Estimation of Floods		
2.3	Gumbel's Distribution		
2.4	Log-Pearson Type III Distribution		
2.5	Risk		
2.6	Flood Routing: Definition, Types of Flood Routing		
2.7	Flood Routing Through Channel		
2.8	Flood Routing Through Reservoir		
3	**Discharge Measurement**	**08 Hours**	**18%**
3.1	Definition, The stage of a River		
3.2	Measurement of Discharge: Area - Slope Method, Area – Velocity Method, Salt Titration Method		
3.3	Discharge Measurement by Hydraulic Structures, Hydraulic Model Method, Ultrasonic Method, Electromagnetic Induction Method, Moving – Boat Technique		
3.4	Stage Discharge Relation		
3.5	Stream Gauging Network		
4	**Groundwater Exploration**	**06 Hours**	**13 %**
4.1	Geophysical Investigations: Electrical Resistivity Method, Seismic Refraction and Reflection Method, Other Surveying Methods		
4.2	Borehole Geophysical Techniques: Electrical Logging, Radioactive Logging, Induction Logging, Sonic Logging, Fluid Logging, Well Construction Measurements, Downhole photography		
4.3	Water Well Design, Well Diameter, Depth, Design of Well Screen		
4.4	Open Well versus Borewells		
4.5	Infiltration Gallery		
4.6	Water Well Construction: Installation of Well Screens, Recovering Well Screens, Well Maintenance		

5	**Sediment Transport in Channels**	**10 Hours**	**22 %**
5.1	Importance of Sediment Transport		
5.2	Sediment Load, Bed Formation		
5.3	Mechanics of Sediment Transport		
5.4	Shield's Entrainment Method for Design of Non – Scouring Stable Channels having Protected Side Slope in Alluvium		
5.5	Stability of Channel Slopes (Design of Non – Scouring Channels with Unprotected Side Slope)		
5.6	Estimation of Transported Sediment in a channel: Suspended Load and Its Measurement, Bed Load and Its Measurement		
5.7	Lining of Irrigation Canals: Types and Economics of Lining		
6	**Hydroelectric Power**	**03 Hours**	**7%**
6.1	Thermal and Hydropower		
6.2	Classification of Hydel Plants		
6.3	Important Terms and Definitions Connected with Hydropower		
6.4	Principal Components of a Hydro – Electric Scheme		
6.5	Comparison of Hydropower and Thermal Power with Reference to Indian Conditions, Hydropower Potentials of India		
6.6	Electricity Generation from various Sources in the World		

C. Course Outcomes:

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

CO1 Perform engineering runoff and hydrograph computations.

CO2 Estimate flood and perform flood routing.

CO3 Implement different methods for discharge calculations in river.

CO4 Know the procedure of ground water exploration, well construction and management.

CO5 Calculate sediment load in a channel.

CO6 Demonstrate fundamentals of hydropower generation.

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	3	1	1	3	1	1	3	2	2	3	2	3
CO2	2	3	3	3	1	3	3	1	1	3	2	2	3	2	3
CO3	2	3	1	2	1	1	1	1	-	3	2	2	1	2	3
CO4	2	3	3	1	2	1	1	-	1	-	3	1	1	1	2
CO5	2	3	1	2	1	1	1	1	-	3	2	2	1	2	3
CO6	2	-	2	1	-	1	1	-	-	-	3	1	3	1	1

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

D. Recommended Study Material:

Text Books:

1. Subramanya, K., Engineering Hydrology, Tata McGraw Hill, New Delhi.
2. Raghunath, H.M., Groundwater, 1987, Wiley Eastern Ltd., New Delhi.
3. Garg, S.K., Irrigation Engineering and Hydraulic Structures, Khanna Publishers, New Delhi.

Reference Books:

1. Garg, S.P., Groundwater and Tube Wells, 1993, Oxford & IBH Publishing Co.
2. Modi, P.N., Irrigation Water Resources and Water Power Engineering, Standard Book House, New Delhi.
3. Raghunath, H.M., Hydrology – Principles, Analysis and Design, 1986, Wiley Eastern Ltd.
4. Todd, D.K., Groundwater Hydrology, 1993 John Wiley & Sons.
5. M. J. Deodhar, Elementary Engineering Hydrology, Pearson India.
6. Punmia and Pande, Lal, B.B., Irrigation and Water Engineering, Standard Publishers Distributors, New Delhi.

LIST OF TUTORIALS

Tutorial No.	Name of Tutorial
1	Runoff
2	Hydrograph
3	Floods

4	Flood Routing
5	Discharge Measurement
6	Groundwater Exploration
6	Sediment Transport in Channels
8	Hydroelectric Power

B. Tech. (Civil Engineering) Programme

SYLLABI

(Semester – 8)

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

CL456: MINOR PROJECT

B.TECH 8th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	0	26	26	21
Marks	0	500	500	

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 project work 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 once 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.
- 1 internal evaluations & 1 final evaluation are required. Internal evaluation carries 75 Marks, 75 marks for report and 100 marks from internal guide & External evaluation carries 250 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. Students Learning 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/

CL481: DESIGN OF STRUCTURES USING INTERNATIONAL CODES

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 ACI 318	15
2.	Euro code 2 – Design of concrete Structures	30

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

B. Detailed Syllabus:

1 Overview of ACI 318 **15 Hours 33%**

1.1 Standards for tests and materials

1.2 Construction Requirements: Durability, Concrete quality, mixing and placing, Formwork, Embedded pipes and construction joints
Details of Reinforcement

1.3 General Requirements : Analysis and design- general considerations, Strength and serviceability requirements, Flexural and axial loads, Shear and Torsion

1.4 Structural Systems or Elements: two way Slab systems, Walls, Footings, Composite concrete flexural members

1.5 Informatives: Appendix C (Alternative load and strength reduction factor), Appendix E (Steel reinforcement information)

2 Euro code 2 – Design of Concrete Structures **30 Hours** **67%**

2.1 Scope of Euro code 2

2.2 Materials : Concrete, Reinforcing steel, Design compressive and tensile strengths, Ductility characteristics

2.3 Durability and cover to reinforcement: Requirements for durability, Methods of verifications, Minimum cover

2.4 Ultimate Limit States (ULS): Bending with or without axial force, Shear, Members not requiring design shear reinforcement, Members requiring design shear reinforcement, Shear between web and flanges of T-sections, Shear at the interface between concrete cast at different times, Shear and transverse bending, Torsion, Design procedure

2.5 Serviceability Limit States (SLS): Stresses, Crack control, General considerations, Minimum reinforcement areas, Control of cracking without direct calculation, Calculation of crack widths, Deflection control, General considerations, Cases where calculations may be omitted.

2.6 Detailing of members and particular rules: General, Beams, Shear reinforcement, Columns, Transverse reinforcement, Deep beams, Foundations,

2.7 Informatives: Annexure A (Modification of partial factors for materials), Annexure B (Creep and shrinkage strain), Annexure C (Properties of reinforcement suitable for use with this Euro code), Annexure E (Indicative strength classes for durability), Annexure F (Tension reinforcement expressions for in-plane stress conditions), Annexure J (Detailing rules for particular situations)

C. Course Outcomes:

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

CO1 Understand and design reinforced concrete structures by using the concepts of Euro code.

CO2 Understand and design reinforced concrete structures by using the concepts of ACI code.

CO3 Deal with design procedures with different fundamentals.

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	3	2	2	1	1	1	1	1	1	1	3	1	1
CO2	3	2	3	2	2	1	1	1	1	1	1	1	3	1	1
CO3	2	2	3	-	-	1	-	1	1	-	-	-	1	-	-

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

D. Recommended Study Material:

Reference Books:

1. Prab Bhatt, T.J. MacGinley, & Ban Seng Choo, Reinforced Concrete Design to Eurocodes: Design Theory and Examples, Fourth Edition, CRC Press, United States
2. W.M.C. McKenzie, Design of Structural Elements, Palgrave Macmillan
3. W.H. Mosley, Reinforced Concrete Design: to Eurocode 2, Palgrave Macmillan

Web Materials:

1. http://www.phd.eng.br/wp-content/uploads/2015/12/en.1992.2.2005.pdf
2. http://www.eurocodes.fi/1992/paasivu1992/sahkoinen1992/1110_WS_EC2.pdf
3. http://publications.lib.chalmers.se/records/fulltext/188834/188834.pdf
4. https://archive.org/stream/gov.law.aci.318.1995/aci.318.1995#page/n11/mode/2up

CL484: TRANSPORT PROJECT PLANNING AND EVALUATION

B. TECH 8th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - IV

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	2 Hours
2	Travel Survey and Traffic Impact Assessment	4 Hours
3	Transportation Planning Process and Modeling	15 Hours
4	Public Transportation Systems	7 Hours
5	Transportation System Management	4 Hours
6	Travel Demand, Elastic Model and Demand Management	4 Hours
7	Project Formulation and Evaluation Techniques	6 Hours
8	Introduction to Transportation Engineering Software's	3 Hours

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1	**Introduction**	**2 Hours**	**4%**
1.1	Introduction to planning		
1.2	Levels of planning, Objectives & goals of planning		
1.3	Road Infrastructure planning and evaluation of projects		
1.4	Planning Morphology		
2	**Travel Survey and Traffic Impact Assessment**	**4 Hours**	**8%**

2.1	Travel Survey: Travel Survey Process		
2.2	Travel Survey: Data Processing and Interpretation, Future Methodologies		
2.3	Traffic Impact Assessment: Content of TIA		
2.4	Traffic Impact Assessment: TIA and Transportation Planning		
3	**Transportation Planning Process and Modeling**	**15 Hours**	**33%**
3.1	Conventional and Four Stage Modeling Process		
3.2	Trip Generation Models		
3.3	Trip Distribution Models and Calibration		
3.4	Trip Assignment Models		
3.5	Mode Choice and Modal Split Models.		
4	**Public Transportation Systems**	**7 Hours**	**20%**
4.1	Introduction to public transportation systems		
4.2	Transit Classification and Right of way		
4.3	Transit System Performance: Transit Capacity, Frequency and Headway, Quality of Service		
4.4	Bus Rapid Transit: System, Technology and Operation		
4.5	Rail Rapid Transit: System, Technology and Operation		
4.6	Multi-modal Transportation System		
5	**Transportation System Management**	**4 Hours**	**8%**
5.1	Introduction to TSM		
5.2	Need, scope and Strategies for TSM		
5.3	TSM planning & classification		
6	**Travel Demand, Elastic Model and Demand Management**	**4 Hours**	**8%**
6.1	Demand Management		
6.2	Elastic Model: Types of elasticity, Sensitivity & elasticity		
6.3	Sensitivity of travel demand, Factors affecting Elasticity		
6.4	Demand Model- Kraft Demand Model		
6.5	Traffic Management Measures		
6.6	Advantages and Disadvantages		
7	**Project Formulation and Evaluation Techniques**	**6 Hours**	**13%**

7.1	Surveys and Investigations- Traffic Surveys, Conventional Ground Survey, Drainage Study, Soil Investigation, Pavement Design Investigation		
7.2	Design Drawing, Estimate and Project Report- Design, Drawing, Estimate, Earthwork Quantities, Project Reports, Stages in project preparation		
7.3	Transport Pricing- Methods of road pricing, Transport costs, Elasticity of demand, Average cost and Marginal cost pricing, Pricing Policy, Congestion Pricing, Public and Private Transport Pricing		
8	**Introduction to Transportation Engineering Software's**	**3 Hours**	**6%**
8.1	Introduction		
8.2	Mx Road, TransCAD		
8.3	IIT Pave, VISSIM, VISUM		
8.4	HDM4		

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 would be able to understand and evaluate current scenarios of traffic management and improve it and they will gain the skill for collecting data about travel behaviour and analysing the data for use in transport planning.

CO2 Basic understanding of what transportation planning is, its theoretical backgrounds and applications

CO3 Students would be aware of the Principles and Planning of Transportation Infrastructure and would also be able to correlate economy and growth of transportation sector along with basic knowledge to quantify the benefits from well-developed transportation facilities.

CO4 The students would have knowledge on planning of various transit systems like bus and rail, their scheduling and management strategies.

CO5 Students would be equipped with the economic principles in dealing with transport supply and demand and would have gained knowledge on various transportation software tools and their application in solving transportation

problems on a real time basis.

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	2	-	-	1	2	1	1	1	2	2	2
CO2	2	2	1	3	1	1	-	-	2	1	1	2	3	2	2
CO3	1	1	2	1	1	1	-	-	1	2	1	1	1	1	1
CO4	-	-	2	2	2	1	1	-	1	2	1	2	1	1	2
CO5	1	1	1	1	1	-	1	1	1	1	2	1	2	2	1

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

D. Recommended Study Material:

Text Books:

1. Khanna, S.K. & Justo, C.E.G., Highway Engineering, NemChand & Bros, Roorkee (U.A).
2. Kadiyali, L.R., Traffic Engineering & Transport Planning, Khanna Publishers, New Delhi.
3. Kadiyali, L.R. & Lal, N.B., Principles & Practices of Highway Engineering, Khanna Publishers, New Delhi.
4. Jotin Khisty, S.C. and Kent Lall, B., Transportation Engineering – An Introduction, Pearson Prentice-Hall, NJ
5. Salter, R J., Highway Traffic Analysis and Design, ELBS

Reference Books:

1. Sharma, S.K., Principles, Practice and Design of Highway Engineering, S. Chand & Co., New Delhi.
2. Hutchinson, B.G., Principles of Urban Transport Systems Planning, Scripta, McGraw-Hill, NewYork, 1974.
3. Hutchison, B.G., Introduction to Transportation Engineering, & Planning, McGraw Hill Book Co.
4. John W. Dickey, Metropolitan Transportation Planning, Tata McGraw Hill Pub. Co.
5. Vukan R. Vuchic, Urban Public Transportation System & Technology, Prentice Hall, Inc.

6. Papacostas C.S., Prevedouros, "Transportation Engineering and Planning, 3rd Edition, Prentice Hall of India, New Delhi, 2002
7. Rajaraman, V., Computer Oriented Numerical Methods, Prentice – Hall of India, 1995
8. Chapra S.C., and Canale R.P., Numerical Methods for Engineers, McGraw – Hill, 2004
9. Michael J.Bruton , "An Introduction to Transportation Planning", Hutchinson,1985
10. Michael D.Meyer and Eric J.Miller , "Urban Transportation Planning – A Decision Oriented Approach", McGraw Hill Book Company, New York,1984
11. F.D.Hobbs, "Traffic Planning and Design", Poargam on Oress
12. John W.Dickey, "Metropolitan Transportation Planning" – Tata McGraw Hill Publishing Company Limited, New Delhi, 1980.
13. Paul H.Wright, "Transportation Engineering – Planning and Design", John Wiley and Sons, New York, 1989.

LIST OF TUTORIALS

Tutorial No.	Name of Tutorial
1	Introduction
2	Travel Survey and Traffic Impact Assessment
3	Transportation Planning Process and Modeling
4	Public Transportation Systems
5	Transportation System Management
6	Travel Demand, Elastic Model and Demand Management
7	Project Formulation and Evaluation Techniques
8	Introduction to Transportation Engineering Software's

CL485: WATERSHED MANAGEMENT

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	Min. number of hours
1.	Introduction and basic concepts	**04**
2.	Watershed Modeling	**07**
3.	Soil Erosion Modeling	**05**
4.	Management of Water Quality	**06**
5.	Storm Water and Flood and Drought Management	**06**
6.	Integrated Watershed Management	**07**
7.	Urban Storm-water Management	**05**
8.	Use of modern techniques in watershed management	**05**

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1 Introduction and basic concepts **04 Hours 09%**

1.1 What is Watershed, Watershed management, historical look at watershed management

1.2 Basic hydrology, occurrence and movement of water

1.3 Human interventions to manage water flow or quality

2 Watershed modeling **07 Hours 16%**

2.1 Standard modeling approaches and classifications

2.2	System concept for watershed modeling		
2.3	Modeling of rainfall-runoff process, subsurface flows and groundwater flow		
3	**Soil Erosion Modeling**	**05 Hours**	**11%**
3.1	Soil Erosion, Soil water Relationship		
3.2	Types and causes of soil erosion, Estimation of soil erosion		
3.3	Different methods to control soil erosion		
4	**Management of Water Quality**	**06 Hours**	**13%**
4.1	Water quality and pollution, types and sources of pollution		
4.2	Water quality modeling		
4.3	Environmental guidelines for water quality		
5	**Storm Water and Flood and Drought Management**	**06 Hours**	**13%**
5.1	Storm water management, design of drainage system,		
5.2	Estimation of design flood and design droughts in a watershed		
5.3	Flood routing through channels and reservoir, flood control and reservoir operation		
5.4	Drought assessment and classification, drought analysis techniques		
5.5	Drought mitigation planning		
6	**Integrated Watershed Management**	**07 Hours**	**16%**
6.1	Introduction to integrated approach, conjunctive use of water resources		
6.2	Rainwater harvesting, Different methods of water harvesting		
6.3	Proposed water harvesting in India through interlinking of rivers		
7	**Urban Stormwater Management**	**05 Hours**	**11%**
7.1	Issues pertaining to watershed management in urban environments		
7.2	Methods to control pollution from urban stormwater		
7.3	Measures to control urban stormwater pollution		

8	**Use of modern techniques in watershed management**	**05 Hours**	**11%**
8.1	Applications of Geographical Information System(GIS) and Remote Sensing(RS) in Watershed Management		
8.2	Role of RS and GIS in in Watershed Management and Decision Support System		

C. Course Outcomes (COs):

On the completion of the course one should be able to:

CO1 Understand the fundamental principles and concepts of watershed management.

CO2 Apply various approaches towards storm water management, rainwater harvesting, and flood and drought management.

CO3 Apprehend soil erosion, watershed modelling, and water quality problems.

CO4 Attest the concept of integrated watershed management.

CO5 Corroborate for development and planning of watershed.

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	-	1	1	-	-	-	1	2	1	1	-
CO2	3	2	1	1	-	2	1	-	-	-	1	2	1	1	-
CO3	3	2	2	2	2	2	2	-	-	-	2	2	1	2	1
CO4	3	3	3	2	2	3	3	-	1	-	3	2	2	1	2
CO5	3	2	3	3	2	3	3	1	1	1	3	3	2	-	2

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

D. Recommended Study Material:

Text Books:

1. Watershed Management by J.V.S. Murthy New Age Publishers
2. Watershed Management by Madan Mohan Das, PHI Publication

Reference Books:

1. Watershed management: Guidelines for Indian Conditions by E.M. Tideman, Omega Scientific Publishers.
2. Hydrology and Soil Conservation Engineering by Ghanshyam Das, Prentice Hall India.

3. Watershed Planning & Management by Dr. Rajvir Singh, Yash Publishing House.
4. Watersheds - Processes, Assessment and Management by Pau A. Debarry, John Wiley & Sons.

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 water and wastewater analysis
2	Determination of BOD/COD ratio
3	Monitoring of Noise
4	Determination of PM10 and PM2.5 in ambient air
5	Determination of gaseous pollutants in ambient air
6	Determination of various parameters in solid waste
7	Treatability studies of industrial wastewater

CL486: INFRASTRUCTURE MANAGEMENT

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	Introduction and Infrastructure scenario	**04**
2	Urban Infrastructure	**10**
3	Rural Infrastructure	**09**
4	Private Involvement in Infrastructure	**05**
5	Infrastructure Economics and Finance	**08**
6	Infrastructure Risk Management	**05**
7	Infrastructure Maintenance	**04**

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1	Introduction and Infrastructure scenario	**04 Hours**	**09%**
1.1	Types of Infrastructure		
1.2	Role of Infrastructure		
1.3	Need and scenario of infrastructure		
1.4	Infrastructure crisis		
2	Urban Infrastructure	**10 Hours**	**22%**
2.1	Concept of urbanization and economic development		
2.2	Scenario of municipal infrastructure		

2.3	Models of urban governance		
2.4	Municipal finances		
2.5	Major municipal reforms		
2.6	Legislations pertaining to urban infrastructure		
3	Rural Infrastructure	**09 Hours**	**20%**
3.1	Overview		
3.2	Concept of rural infrastructure planning		
3.3	State of rural infrastructure		
3.4	Growth		
3.5	Rural characteristics		
3.6	Strategies to improve infrastructure in rural areas		
4	Private Involvement in Infrastructure	**05 Hours**	**11%**
4.1	Overview		
4.2	Benefits		
4.3	Problems and challenges of infrastructure privatization		
5	Infrastructure Economics and Finance	**08 Hours**	**18%**
5.1	Principles of finance		
5.2	Infrastructure economics		
5.3	Developing financial models for infrastructure		
5.4	Introduction to project finance		
6	Infrastructure Risk Management	**05 Hours**	11%
6.1	Risks in infrastructure		
6.2	Quantitative risk analysis		
6.3	Qualitative risk management		
6.4	Risk management strategies		
7	Infrastructure Maintenance	**04 Hours**	**9%**
7.1	Introduction to Infrastructure maintenance		
7.2	Need and requirement for Infrastructure maintenance		
7.3	Preventive techniques for maintenance		

C. Students Learning Outcomes:

On the successful completion of this course

CO1 Students will be able to understand concepts of infrastructure, infrastructure economics, policies and regulation.

CO2 Students will be able to identify and analyze issues related to infrastructure projects.

CO3 Students will be able to recommend appropriate infrastructure management plan.

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	-	-	-	-	-	-	-	-	-
CO2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	2	2	-	-	-	-	-	-	2	-	1	-	-

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

D. Recommended Study Material:

Text Books:

1. J. Parkin and D. Sharma, Infrastructure planning, Thomas Telford
2. P. Chandra, Projects: Planning, analysis, selection, financing, implementation, and review, Tata McGraw-Hill
3. S. Goodman and M. Hastak, Infrastructure planning handbook: Planning, engineering, and economics, McGraw-Hill

Reference Books:

1. Ronald W Hudson, "Infrastructure Management: integrating design, Construction, maintenance, rehabilitation and renovation", MGH, 1st Edition, 1997
2. L. Squire and H. G.van der Tak, Economic analysis of projects, John Hopkins University Press, London, 1975.
3. J. D. Finnerty, Project financing - Asset-based financial engineering, John Wiley & Sons, New York, 1996.

Web Materials:

1. Ministry of Urban Development: http://moud.gov.in/
2. Indian Infrastructure Finance Company Limited: http://www.iifcl.co.in/
3. http://nptel.ac.in/courses/105106115/

TERM WORK

Term work will be based on above syllabus with seminar/group project to be incorporated.

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 & Equipments	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/

CL488: ADVANCED GEOTECHNICAL ENGINEERING

B. TECH 8th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - IV

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	01
2	Effective Stress Principle	04
3	Introduction to Rock Mechanics	08
4	Foundation on Expansive Soils	10
5	Foundation on Collapsible Soils	05
6	Environmental Waste Effects On Soils	07
7	Machine Foundations	10

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1	**Introduction**	**01 Hour**	**02%**
1.1	Course review		
1.2	Overview of Soil mechanics and Rock mechanic		
1.3	Overview of foundation engineering		
2	**Effective Stress Principal**	**03 Hours**	**07%**
2.1	Effective stresses in saturated soil		
2.2	Effective stresses in unsaturated soil		
3	**Introduction to Rock Mechanics**	**08 Hours**	**18%**
3.1	Introduction		

3.2	Geological classification of rocks		
3.3	Index properties of rocks		
3.4	Classification of rocks for engineering purpose		
3.5	Rock strength and failure criteria		
3.6	Modes of failure of rocks		
4	**Foundation on Expansive Soils**	**10 Hours**	**22%**
4.1	Identification of expansive soils		
4.2	Parameters of expansive soils		
4.3	Causes of moisture changes		
4.4	Preventive measures for expansive soils		
4.5	Techniques For Controlling Swelling: Horizontal Moisture Barriers, Vertical Moisture Barriers, Surface And Subsurface Drainage, Prewetting, Soil Replacement Sand Cushion Techniques, CNS Layer Technique.		
4.6	Modification of Swelling Characteristics: Lime Stabilization, Mechanisms, Limitations, Lime Injection, Lime Columns, Mixing, Chemical Stabilization,		
4.7	Design of Foundation on Expansive soils: Drilled Pier, Belled Drilled Pier, Under-Reamed Piles.		
5	**Foundation on Collapsible Soils**	**05 Hours**	**11%**
5.1	Types of collapsible soils		
5.2	Parameters of collapsible soils		
5.3	Treatment Methods for Collapsible Soil: Induce Collapse Prior to Construction, Decrease Foundation Pressures, Solidify the Soil, Densify Collapsible Soil, Other Methods		
5.4	Design of foundation on un-wetted collapsible soil, Soil subjected to wetting.		
6	**Environmental Waste Effects on Soils**	**08 Hours**	**17%**
6.1	Physico-chemical properties of soil		
6.2	Man made changes in geotechnical environment - mining, embankments, pumping, reservoir, landfills and reclamation effect and control.		

6.3	Control of contamination with use of clay barriers, geosynthetics, cut-off walls, leachate collection systems.		
6.4	stabilization of contaminated soils: materials and techniques in control of ground pollution and treatment		
7	**Machine Foundations**	**10 Hours**	**23%**
7.1	Introduction of Soil dynamics, basic definitions		
7.2	Types of machine foundation		
7.3	General criteria for design of machine foundation		
7.4	Vibration analysis of a machine foundation		
7.5	Examples based on topic		
7.6	Indian Standard on Design and Construction of Foundation for		
7.7	Reciprocating Machines		
7.8	Liquefaction		

C. Course Outcomes (COs):

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

CO1 Learn the various theoretical and practical aspects of geotechnical engineering and apply a diverse knowledge that is applicable to real life problems and can conduct independent work along with the design.

CO2 Understand the concept of effective stress and its influence on soil behavior, and able to understand of the influence of water flow on the engineering behavior of soils.

CO3 To be able to analyze and to determine mechanical and engineering properties of rocks for engineering application, critically review rock mechanics principles and methods and their applications to engineering practices. And analyses rock slope stability and foundations on rock.

CO4 Design and analyze the foundation on problematic soils.

CO5 The student will learn to assess the quality of soil and extent of soil pollution and soil degradation and suitable remediation.

CO6 Understand soil response when subjected to dynamic actions, fundamentals of wave propagation and seismology and the knowledge of in situ and laboratory tests for soil dynamic characterization.

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	3	3	1	1	-	1	1	2	1	3	2	-	3
CO2	1	1	2	1	-	-	-	-	-	1	1	2	2	1	1
CO3	3	2	3	1	-	-	1	1	1	2	-	3	3	-	2
CO4	3	2	3	2	-	1	1	1	-	2	-	2	2	1	2
CO5	1	2	1	3	2	2	2	-	-	1	-	2	-	1	1
CO6	3	3	3	2	1	2	1	-	1	1	-	2	2	1	2

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

D. Recommended Study Material:

Text Books:

1. Soil Mechanics & Foundation Engineering, K.R Arora, Standard Publication, New Delhi.
2. Soil Mechanics & Foundation Engineering, B.C Punamia, Laxmi Publication Pvt Ltd. New Delhi
3. Soil Mechanics & Foundation Engineering by Murthy, V.N.S, Sai Kripa Technical Consultants, Bangalore.
4. Geo-environmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies by Hari D Sharma and Krishna R Reddy, John Wiley & Sons.

Reference Books:

1. Singh Alam, Soil Engineering, Vol. I and II, Asia Publication House.
2. Basics and Soil Mechanics by Gopal Ranjan and A S R Rao, New Age International pvt ltd., New Delhi.
3. Design Aids in Soil Mechanics and Foundation Engineering by Kaniraj, McGraw Hill Education.
4. Principles of Foundation Engineering by B.M Das, Cengage, US.
5. Fang and Einterkorn, Foundation Engineering Handbook, Springer.
6. Foundation Engineering by Peck, Thomson and Thornburn, Wiley, India.

7. Foundation Engineering Manual by Nayak, N.B., Dhanpat Rai Publications,New Delhi.
8. Handbook of Machine Foundation by Sribivasula and Vaidyanathan, Tata McGraw Hill Book Co., New Delhi.
9. Geo-Environmental Engineering – Principles and Applications by Lakshmi N. Reddy, Hilary. I. Inyang, Makcel Dekker Ink, 2000
10. Geotechnical and Geo-environmental Engineering Handbook by R. Kerry Rowe, Springer, US.
11. Geotechnical Practice for Waste Disposal by D.E .Daniel, Chapman & Hall, London.

LIST OF TUTORIALS

Tutorial No.	Name of Tutorial
1	Effective Stress Principle
2	Introduction to Rock Mechanics
3	Foundation on Expansive Soils
4	Foundation on Collapsible Soils
5	Environmental Waste Effects On Soils
6	Machine Foundations

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

CL491: DISASTER PREPAREDNESS & PLANNING MANAGEMENT

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	Introduction to Disaster Management	6
2	Role of Remote sensing, Geographical Information System and Information Technology in Disaster Management	10
3	Risk Assessment and Vulnerability Analysis	10
4	Disaster Preparedness and Response	8
5	E-Governance and Emerging Technology in Disaster Management	6
6	Community Linkage in Disaster Management	5

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1 Introduction to Disaster Management **6 Hours 13%**

1.1 Concepts of : Hazard, Risk, Vulnerability, Disaster

1.2 Natural and Manmade Disasters – Meaning, Types and effects

Hydrological Disasters – Flood, Flash flood, Drought, Cloud burst, Cyclone, Storm, Storm surge, Tidal waves

Geological Disasters – Earthquakes, Tsunamis, Landslides, Avalanches, Volcanic eruptions, Mudflow

	Climatic Change, Global Warming, Sea Level Rise, Ozone Depletion, Deforestation, Industrial Waste, Heat and Cold Waves CBRN – Chemical disasters, Biological disasters, Radiological disasters, Nuclear disasters, Road accidents, Rail accidents, Air accidents, Sea accidents, Armed conflicts, Technological disasters Fire – Building, Coal, Forest, Oil fire Pollution – Air, Water, Soil pollution		
1.3	Importance, Dimensions & Scope of Disaster Management		
1.4	Disaster Management Cycle		
1.5	Disaster and Development		
2	**Role of Remote Sensing, Geographical Information System and Information Technology in Disaster Management**	**10 Hours**	**22%**
2.1	Definition of GIS, Concept of Space and Time, Spatial data, Map Projection and Datum, Domains of Spatial information system, Components of GIS (Hardware, Software, Data, People and Process), GIS Functionalities for end user / system (Data Acquisition, Data Input, Data Management, Data Analysis, Data Modeling and Data Output), Web based GIS Technology		
2.2	Introduction to Remote Sensing, Fundamentals of Remote Sensing, Electromagnetic Radiation, Electromagnetic Spectrum, Energy interaction with Atmosphere, Energy interaction with Earth Surface, Platform and Sensors, Characteristics of Image, Image Interpretation and Analysis – Visual Image Interpretation & Digital Image Processing, Microwave Remote Sensing, Indian Remote Sensing Satellites		
2.3	Importance of Information in Disasters : Methods of collecting relevant information – libraries, internet, interviews questionnaires, survey, observation, Mass media, Meetings, Role of Information from disaster affected community		
2.4	Organizing an effective dissemination of information: feedback for improving information, Role of Communication in Disasters, Types of communication in case of disasters – HAM radio, Satellite, Video Conferencing, Electronics devices		

3	**Risk Assessment and Vulnerability Analysis**	**10 Hours**	**22%**
3.1	Risk Concepts, Elements Of Risk, Perception of Risk, Acceptable risk, Requirements in Risk assessment		
3.2	Risk analysis techniques; Process of Risk assessment, Analytical systems for risk assessment, Natural hazard/ risk assessment, Understanding climate risk, Mapping of risk assessment, Decision making for risk reduction, Problems in risk assessment		
3.3	Observation and perception of vulnerability – Vulnerability Identification, Vulnerability types and dimensions, Vulnerability – Social factors and economic factors		
3.4	Strategic development for Vulnerability reduction : Physical & Social infrastructure for vulnerability reduction, Hazard resistant designs and construction, Systematic management and Strategic planning for vulnerability reduction		
4	**Disaster Preparedness and Response**	**8 Hours**	**18%**
4.1	Disaster Preparedness: concept and significance		
4.2	Essentials of Disaster Preparedness Plan		
4.3	Disaster Response Plan – Communication, Participation, and Activation of Emergency Preparedness Plan, Search, Rescue, Evacuation and Logistic Management		
4.4	Relief and Recovery, Psychological Response and Management (Trauma, Stress, Rumor and Panic)		
5	**E-Governance and Emerging technology in Disaster Management**	**6 Hours**	**13%**
5.1	E-Governance : Concept and Significance		
5.2	E-Governance in Urban and Rural Development		
5.3	ICT Implementation in Governance: Issues and Challenges		
6	**Community Linkage in Disaster Management**	**5 Hours**	**12%**
6.1	Community Based Disaster Management, Human Behavior and Response: Individual, Community, Institutional		
6.2	Community Participation and Awareness		
6.3	Community Health During Disasters : Drinking Water, Food and Nutrition, Hygiene and Sanitation		

6.4 Soft skills for Disaster Manager : Leadership and Coordination, Life skills, Time Management Skills

C. Course Outcomes (COs):

On the completion of the course one should be able to:

CO1 To become familiar with definitions and terms used within the disciplines of disaster preparedness and emergency management.

CO2 To understand the scope and extent to which disasters and emergencies influence the social and political environment.

CO3 To know the scope of modern technologies in disaster management

CO4 To understand planning, mitigation, in-crisis decision making, evacuation, response, and recovery within the leadership during an event.

CO5 To illustrate knowledge about development of viable plans and appropriately consider management options for disaster planning and emergency management.

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	-	1	1	-	-	1	1	2	1	1	-
CO2	-	1	1	1	-	2	1	-	1	-	1	3	1	1	-
CO3	-	1	2	2	2	2	2	1	-	-	2	2	1	1	1
CO4	1	3	2	1	2	2	3	-	1	3	3	3	1	1	2
CO5	2	2	3	3	2	3	3	1	1	1	3	3	2	-	1

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

D. Recommended Study Material:

Text Books:

1. Singh Jagbir, Disaster Management Future challenges and opportunities, I K International Pub.
2. Pandey Mrinalini, Disaster Management 1st ed. Wiley India
3. Joseph George, Fundamentals of Remote Sensing, Universities Press.

Reference Books:

1. Natural Disaster Hotspots A Global Risk Analysis, The World Bank
2. Sahni Pardeep, Disaster Risk Reduction in South Asia, Prentice Hall of India.

3. Gupta Harsh K , Disaster Management, Universities Press
4. Modh Satish , Introduction to Disaster Management, Macmillan Pub
5. Sensarma Suman Ranjan, Disaster Risk Management Conflict And Cooperation, Concept Publishing Company
6. Modh Satish, Citizens Guide to Disaster Management, Macmillan Pub.
7. Panchal Priyank K., State Disaster Resource Network, Macmillan Pub.
8. Shah Riddhi, State Disaster Resource Network (UNDP), Macmillan Pub.
9. Sulphey M M. Disaster Management, PHI Learning
10. Sharma Sanjay K., Environment Engineering and Disaster Management, University Science

Web Materials:

1. Geneva: Sphere Project. https://www.spherestandards.org/handbook-2018/
2. https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030
3. https://gidm.gujarat.gov.in/
4. https://ndma.gov.in/en/
5. https://www.undrr.org/

LIST OF TUTORIALS

Experiment No.	Name of Tutorial
1	Role of Engineers in Disaster Management
2	Study of Recent Disasters : at state level, preparation of Disaster Risk Management Plan of an Area or Sector
3	Study of Recent Disasters : at national level, preparation of Disaster Risk Management Plan of an Area or Sector
4	Study of Recent Disasters : at international level, preparation of Disaster Risk Management Plan of an Area or Sector

Global-National-State level Case Studies in Disaster Management

1	Japan's Tohoku Earth Quake (2011) and Nepal Earthquake (2015)
2	East Africa Drought (2011)
3	Indian Ocean Earthquake (2004)(Tsunami) and Gujarat Earthquake (2001)

4	Uttarakhand Flash Floods and Kashmir Floods
5	Drought Management in Gujarat & Rajasthan
6	Landslides in Shiwalik Hills Case Study
7	Avalanches in Jammu and Kashmir: Case Studies
8	Pukhrayan train derailment 20 November 2016 and Bhopal Gas Tragedy
9	Case studies as per the interest and suggestions from the students
10	Case studies as per the interest and suggestions from the students

CL492: GIS & REMOTE SENSING APPLICATIONS IN CIVIL ENGINEERING

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	Introduction to Remote Sensing	**03**
2	Remote sensors and platforms	**07**
3	Satellite data Analysis	**05**
4	Digital Image processing	**07**
5	Introduction to Geographic Information System (GIS)	**05**
6	GIS data processing	**06**
7	Introduction to navigational systems	**06**
8	Integration of GIS and Remote Sensing, Applications in Civil Engineering	**06**

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1	**Introduction to Remote Sensing**	**03 Hours**	**7 %**
1.1	History and development of remote sensing		
1.2	Electromagnetic radiation and its interaction with matter		
1.3	Atmospheric effects and corrections		
2	**Remote sensors and platforms**	**07 Hours**	**16 %**
2.1	Overview of Remote sensors		

2.2	Remote sensing satellite platforms and orbits		
2.3	Optical sensor systems		
2.4	Microwave sensor systems		
2.5	Indian Satellite Program		
2.6	Recent trends in Remote Sensing techniques: Microwave remote sensing, Lasers and radars, Hyper spectral remote sensing		
3	**Satellite data Analysis**	**05 Hours**	**11 %**
3.1	Methods of acquisition of digital images from conventional and space-borne scanners		
3.2	Satellite data products		
3.3	Visual image interpretation		
3.4	Image Processing Systems		
4	**Digital Image processing**	**07 Hours**	**16%**
4.1	Digital Image, Media for digital data recording, Storage, Data formats		
4.2	Distortions in Space-borne Digital images and Restoration		
4.3	Matching and Registration of satellite images		
4.4	Image enhancement through Point Operations : Neighborhood Operations on Satellite Images,		
4.5	Image Transforms : Fourier, Wavelet, Hough, color and PCT Arithmetic Operations,		
4.6	Digital Image Analysis Through Supervised and Unsupervised Classification,		
4.7	Post-classification Analysis: statistical accuracy estimation.		
4.8	Image processing softwares.		
5	**Introduction to Geographic Information System (GIS)**	**05 Hours**	**11 %**
5.1	Introduction to GIS, Concept of GIS and Functions and advantages		
5.2	Spatial data concepts, map reference systems		
5.3	Spatial data - sources, models, structures, Data quality		
5.4	Analysis and interpolation		
6	**GIS data processing**	**06 Hours**	**13 %**
6.1	Spatial data model, Geospatial analysis		
6.2	Attribute management and metadata concept		

6.3	GIS Data sources, Organizing data for analysis		
6.4	Linking spatial and attribute data		
6.5	Spatial decision support systems,		
6.6	GIS Softwares		
7	**Introduction to navigational systems**	**06 Hours**	**13 %**
7.1	Overview of GPS and GNSS		
7.2	Current navigational system, components, Functioning and Uses		
8	**Integration of GIS and Remote Sensing and their Applications in Civil Engineering**	**06 Hours**	**13 %**
	Case studies in the following areas:		
8.1	Environmental engineering		
8.2	Water Resources		
8.3	Intelligent Transport Systems		
8.4	Land-use – Land cover – Urban planning		
8.5	Disaster Management		

C. Course Outcomes:

On the successful completion of this course:

CO1 Ability to develop thematic maps using Remote Sensing Images and carry out multilayer analysis using GIS technology

CO2 The students will be in a position to use geo-information science and earth observation technology to generate, integrate, analyze and visualize spatial data

CO3 The students be able to apply practical skills to carry out an independent final assignment (a case study project).

CO4 The students may undertake GPS based surveys and geographical positioning assignments.

CO5 The students can be able to pursue careers in the field of remote sensing and GIS academia, governmental agencies, businesses and consultancies around the world.

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	1	3	2	1	-	-	-	1	2	1	1	1
CO2	3	-	1	1	3	2	1	-	-	-	1	2	1	1	1
CO3	3	1	1	1	3	2	1	-	-	-	1	2	1	1	1
CO4	3	1	1	1	3	2	1	-	-	-	1	2	1	1	1
CO5	3	1	1	1	3	2	1	-	-	-	1	2	1	1	1

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

D. Recommended Study Material:

Text Books:

1. B. Bhatta, Remote Sensing and GIS, 2nd Edition, Oxford University Press, New Delhi
2. George Joseph, Fundamentals of Remote Sensing, Universities Press, India, 2005
3. A.M. Chandra and S.K. Ghosh, Remote Sensing and Geographical Information System, Narosa Publishing House, New Delhi.

Reference Books:

1. Gopi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson Education India, 2006, (ISBN 8131743012, 9788131743010)
2. J.R. Jensen, Introductory Digital Image Processing, Prentice-Hall, New Jersey
3. J.R. Jensen, Remote Sensing of Environment: An Earth Perspective, Pearson Education, Delhi, 2004
4. P.A. Burrough and R.A. McDonnell, Principles of Geographical Information Systems, 2nd ed. Oxford, England, Oxford University Press.
5. T.M. Lillesand, R.W. Kiefer and J.W. Chipman, Remote Sensing and Image Interpretation, 5th edition, John Wiley and Sons, India
6. Kali Charan Sahoo, Textbook of Remote Sensing and Geographical Information System, Atlantic Publishers.

LIST OF EXPERIMENTS

Experiment No.	Name of Tutorial / Experiment
1	Visual Image Interpretation: Photographic Products
2	Digital Interpretation of True Color Composite and False Color Composite
3	Image Registration and Geo-referencing
4	Image Enhancement
5	Image Transformation
6	Multiband Image Operations
7	Supervised Image Classification
8	Unsupervised Image Classification
9	Accuracy Assessment of image classification
10	Introduction to GIS, Spatial Data Generation
11	Linking of Spatial and Attribute Data
12	Linking of Spatial and Attribute Data
13	Integration of GIS and RS, civil engineering application

CL493: COMPUTATIONAL METHODS IN WATER RESOURCES ENGINEERING

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	03
2.	Probabilistic analysis	06
3.	Regression Analysis	08
4.	Ordinary Differential Equations	10
5.	Partial Differential Equations	10
6.	Infinite Series	08

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1. Overview of the Course: 03 Hours 7%

1.1 Need for computational and statistical methods, overview of the applications in Civil Engineering in general and Water Resources Engineering in particular.

1.2 Review of numerical techniques for finding roots of non-linear equations

2. Probabilistic analysis: 06 Hours 13%

2.1 Review of basic concepts of probability and probability distributions

2.2 Probabilistic analysis and treatment of hydro-meteorological and

	water quality data		
2.3	Flood frequency analysis		
3.	**Regression Analysis:**	**08 Hours**	**18%**
3.1	Simple linear and multiple linear regression, evaluation of regression, confidence limits		
3.2	Applications – rainfall-runoff analysis, rating curves, water quality modeling		
4.	**Ordinary Differential Equations:**	**10 Hours**	**22%**
4.1	Nature of problems, boundary and initial equations		
4.2	Euler's method, modified Euler's method, Predictor-Corrector method, Runge-Kutta method, Boundary value problems		
4.3	Applications for reservoir routing, gradually varied flow problems, pipe networks.		
5.	**Partial differential equations:**	**10 Hours**	**22%**
5.1	Classification and nature of problems, Concepts of finite difference method, Solution of parabolic equations, pollutant transport, Solutions of elliptical equation, Laplace equation and Poisson equation.		
5.2	Flow through porous media, Solution of hyperbolic equation		
5.3	Unsteady flow through open channels, propagation of waves		
5.4	Concept of finite volume method		
6.	**Infinite Series:**	**08 Hours**	**18%**
6.1	Basics of Finite Element Method, FEM vs FDM, Element shapes, shape functions, development of shape functions for linear elements		
6.2	Formulation of FEM for stress analysis problems		
6.3	Flow through porous media, Galerkin's method and Variational method		

C. Course Outcomes:

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

CO1 Apply numerical methods for solution of differential equations in Water Resources Engineering

CO2 Apply finite difference schemes for solution of hydraulic and hydrologic models.

CO3 Formulate finite element model for solution of flow through porous media.

CO4 Perform statistical analysis of water resources 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	3	3	3	2	3	3	2	1	2	1	-	2	3	3	2
CO2	3	3	3	2	3	3	1	1	2	1	-	2	3	3	2
CO3	3	3	3	2	3	3	1	1	2	1	-	2	3	3	2
CO4	3	3	3	3	3	3	2	3	2	2	3	3	3	3	3

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

D. Recommended Study Material:

Text Books:

1. Hoffman, J.D., (2011), "*Numerical Methods for Engineers and Scientists*", CRC Press, Special Indian Edition
2. Numerical Methods by Chapra and Canale.
3. Schilling, R.J., and S.L. Harris, (2007), "*Applied Numerical Methods for Engineering*", CENGAGE Learning, India Edition

Reference Books:

1. Kotteguda, N.T. and Renzo Resso, (1998), "*Statistics, Probability and Reliability for Civil and Environmental Engineers*", McGraw Hill Companies Inc., New York
2. Neural Network Fundamentals with Graphs, Algorithms, Applications-Bose N.K. & Liang P. McGraw Hill N.Y.
3. Computational Fluid Dynamics by Anderson.
4. Abbot, M.A. and Vervey (1996), "*Computational Hydraulics*", Elsevier Publications

LIST OF TUTORIALS

Tutorial No.	Name of Tutorial
1	Probabilistic analysis and treatment of hydro-meteorological and water quality data
3	Flood frequency analysis
4	rainfall-runoff analysis, rating curves, water quality modelling
5	Euler's method, modified Euler's method, Predictor-Corrector method, Runge-Kutta method, Boundary value problems
6	Applications for reservoir routing, gradually varied flow problems, pipe networks.
7	Flow through porous media, Solution of hyperbolic equation
8	Unsteady flow through open channels, propagation of waves
9	Applications of infinite series

CL494: ADVANCED HIGHWAY & TRAFFIC ENGINEERING

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	Pavement Materials Characterization	10
2	Pavement Evaluation	08
3	Road Safety & Environmental Impact Assessment	07
4	Design of Intersections and Parking Analysis	05
5	Traffic Flow Theory	10
6	Road Making Machinery & Modern Highway System	05

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1 Pavement Materials Characterization **10 Hours** **22%**

1.1 Requirements of paving concrete, Design of mixes – IRC, Absolute volume, Vibrated Concrete mix design

1.2 Composites, Plastics and Geo-synthetics: Plastics and polymerization process, properties, Durability and chemical composition, Reinforced Polymer Composites, Geo-synthetics, Dry Powdered Polymers- Enzymes.

1.3 Reclaimed/Recycled Waste Products: Reclaimed Materials – waste products in civil engineering applications, Effect of waste

	products on materials, Structure and properties, Self-healing and Smart materials.		
2	**Pavement Evaluation**	**08 Hours**	**18%**
2.1	Pavement Evaluation: Methods of Pavement Evaluation, Visual Rating Pavement Serviceability Index (PSI).		
2.2	Roughness Measurements: Importance of smooth riding surface, measurement of road roughness, Towed Fifth Wheel Bump Integrator, Skid Resistance: Measurement, Importance and Governing Factors Pavement Deterioration Research.		
3	**Road Safety & Environmental Impact Assessment**	**07 Hours**	**16%**
3.1	Introduction, Collision & condition diagram, Causes of accidents, Accident studies & records, Analysis of accident studies, Road Safety Improvement Strategies.		
3.2	Road Safety Audit Process, Black Spot, Black Route, Area Identification		
3.3	Transport related different types of pollution& their sources, Effects of Weather Conditions, Vehicular emission parameters, Pollution standards, Measurement and analysis of vehicular emission, Mitigative Measures.		
3.4	Urban and non-urban traffic noise sources, Noise level factors, Effects of traffic noise, Propagation and measurement of traffic noise, Prediction and control measures, Noise studies, Noise standards.		
3.5	EIA requirements of highway projects, EIA procedures, guidelines, EIA practices in India.		
4	**Design of Intersection and Parking Analysis**	**05 Hours**	**11%**
4.1	Principles of design, Channelization, Roundabouts, Staggered intersections, Design of rotary intersection.		
4.2	Introduction to Parking Studies ,Types of parking facilities, Modes of parking , Parking studies and analysis, Evaluation of parking parameters, Ill effects of parking		
5	**Traffic Flow Theory**	**10 Hours**	**22%**
5.1	Uninterrupted traffic Flow Theory :		

	Fundamentals of Traffic flow theory, Uninterrupted Traffic flow including Macroscopic and Microscopic Traffic flow models		
5.2	Interrupted traffic Flow Theory : Fundamentals of Interrupted Traffic Flow, Shockwave Analysis, Car following theory, Queuing Theory, Vehicle arrival: Gap and Gap acceptance		
6	**Road Making Machinery & Modern Highway System**	**05 Hours**	**11%**
6.1	Role of Labour vs. machinery in road construction, Earth work machinery, volume changes, clearing and grubbing, Tractors, Tractor Dozers, scrapers, Graders.		
6.2	Rock excavation machinery, Transporting Equipment, Compaction Equipment , Production of aggregates		
6.3	Bituminous concrete road equipment, Cement Concrete road making Equipment, Equipment Usage charges		
6.4	Automated Highway System , ITS		
6.5	Green Highway, Smart Highway, Electric Highway & Solar Highway		

C. Course 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 student will develop an understanding of the basic concepts of different paving material and their characteristics.

CO2 The student will be able to identify the distress in pavement and will be able to decide the evaluation and maintenance strategies for the pavement.

CO3 The student will able to understand about the road safety audit process and EIA.

CO4 The student will able to design the parking facilities and at grade intersection.

CO5 The student will capable to understand the traffic flow behavior on the basis of flow theories.

CO6 The student will learn about the modern equipment and highway system.

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	2	2	2	-	2	-	1	1	-	2	1	2	2
CO2	1	2	2	2	3	1	-	-	2	2	1	2	3	1	3
CO3	1	3	3	1	3	2	3	1	2	3	1	3	2	1	3
CO4	2	3	1	2	3	1	1	-	2	2	-	2	3	1	2
CO5	2	2	1	2	3	1	-	-	2	2	-	2	2	1	2
CO6	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. Dr. L. R. Kadiyali and Dr. N. B. lal, Principles & practices of Highway Engineering, Khanna Publication Delhi
2. Dr. L. R. Kadiyali, Traffic Engineering & Transport Planning, Khanna Publication Delhi.
3. S. K Khanna & C. E.G Justo, Highway Engineering, Nem Chand & Bros, Roorkee.
4. Elvik, R., and Vaa, T., The Handbook of Road Safety Measures, Elsevier, 2004.
5. Chakroborty & Das, Principles of Transportation Engineering, PHI Learning Pvt. Ltd. Delhi

LIST OF TUTORIALS

Tutorial No.	Name of Tutorials
1	Pavement Materials Characterization
2	Pavement Evaluation
3	Road Safety Audit Process
4	Environmental Impact Assessment
5	Numerical on Design of Intersection
6	Numerical on Parking Analysis
7	Traffic Flow Theory
8	Road Making Machinery & Modern Highway System

CL495: INSTRUMENTATION & SENSOR TECHNOLOGIES FOR CIVIL ENGINEERING APPLICATIONS

B. TECH 8th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - IV

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	03	02	05	04
Marks	100	50	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Fundamentals of Measurement, Sensing and Instrumentation	10
2	Sensor Installation and Operations	10
3	Data Analysis and Interpretation	12
4	Frequency Domain Signal Processing and Analysis	13

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1 Fundamentals of Measurement, Sensing and Instrumentation 10 Hours 22%

1.1 Definition of measurement and instrumentation, physical variables, common types of sensors.

1.2 Describe the function of these sensors;

1.3 Use appropriate terminology to discuss sensor applications; and qualitatively interpret signals from a known sensor type, types of instrumentation, Sensor Specifics, Permanent installations, Temporary installations;

2	**Sensor Installation and Operations**	**10 Hours**	**22%**
2.1	Predict the response of sensors to various inputs; Construct a conceptual instrumentation and monitoring program		
2.2	Describe the order and methodology for sensor installation Differentiate between types of sensors and their modes of operation and measurement		
2.3	Approach to Planning Monitoring Programs, Define target, Sensor selection, Sensor siting, Sensor Installation & Configuration, Advanced topic, Sensor design, Measurement uncertainty		
3	**Data Analysis and Interpretation**	**12 Hours**	**27%**
3.1	Fundamental statistical concepts, Data reduction and interpretation, Piezometer, Inclinometer, Strain gauge, etc.		
3.2	Time domain signal processing, Discrete signals, Signals and noise		
3.3	Examples of statistical information to calculate are: Average value (mean), On average, how much each measurement deviates from the mean (standard deviation), Midpoint between the lowest and highest value of the set (median), Most frequently occurring value (mode), Span of values over which your data set occurs (range)		
4	**Frequency Domain Signal Processing and Analysis**	**13 Hours**	**29%**
4.1	Explain the need for frequency domain analysis and its principles; Draw conclusions about physical processes based on analysis of sensor data;		
4.2	Combine signals in a meaningful way to gain deeper insight into physical phenomena, Basic concepts in frequency domain signal processing and analysis,		
4.3	Fourier Transform, FFT (Fast Fourier Transform), Example problems: Noise reduction with filters, Leakage, Frequency resolution		

C. Course Outcomes (CO):

On the completion of the course one should be able to

CO1 Analyze the errors during measurements

CO2 Specify the requirements in the calibration of sensors and instruments

CO3 Describe the noise added during measurements and transmission

CO4 Describe the measurement of electrical variables

CO5 Describe the requirements during the transmission of measured signals and construct Instrumentation/Computer Networks

CO6 Suggest proper sensor technologies for specific applications and design and set up measurement systems and do the studies

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	2	-	-	-	-	1	1	1	1	1
CO2	3	2	2	1	2	2	-	-	-	-	1	1	1	1	1
CO3	3	2	2	1	2	2	-	-	-	-	1	1	1	1	1
CO4	3	2	2	1	2	2	-	-	-	-	1	1	1	1	1
CO5	3	2	2	1	2	2	-	-	-	-	1	1	1	1	1
CO6	3	2	2	1	2	2	-	-	-	-	1	1	1	1	1

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

D. Recommended Study Material:

Text Books:

1. Alan S Morris (2001), Measurement and Instrumentation Principles, 3rd/e, Butterworth Hienemann
2. David A. Bell (2007), Electronic Instrumentation and Measurements 2nd/e, Oxford Press
3. S. Tumanski (2006), Principle of Electrical Measurement, Taylor & Francis
4. Ilya Gertsbakh (2010), Measurement Theory for Engineers, Springer

LIST OF EXPERIMENTS

Experiment No.	Name of Experiment
1.	Instrumentation of typical civil engineering members/structures/structural elements
2.	Use of different sensors, strain gauges, inclinometers,
3.	Performance characteristics
4.	Errors during the measurement process
5.	Calibration of measuring sensors and instruments
6.	Measurement, noise and signal processing
7.	Analog Signal processing
8.	Digital Signal Processing
9.	Demonstration & use of sensor technologies

CL457: 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/