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

(Third Year Civil Engineering)

Effective from 2025-26

Chandubhai S Patel Institute of Technology

Vision

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

Mission

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

Programme Educational Objectives (PEO's):

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

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

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

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

Programme Outcomes (PO's)

Engineering Graduates will be able to:

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

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 – 2025-26

CHARUSAT

FACULTY OF TECHNOLOGY AND ENGINEERING
ACADEMIC REGULATIONS
Bachelor of Technology Programmes

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

1. System of Education

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

2. Duration of Programme

Undergraduate programme (B. Tech.)

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

3. Eligibility for Admissions

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

4. Mode of Admissions

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

5. Programme Structure and Credits

As per Annexure – 1 attached

6. Attendance

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

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

7. Course Evaluation

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

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

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

7.2 Internal Evaluation

As per Annexure – 1 attached

7.3 University Examination

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

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

7.5 Performance at Internal & University Examination

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

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

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

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

8. Grading

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

Table: Grading Scheme (UG)

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

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

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

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

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

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

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

9. Award of Degree

9.1 Every student of the programme who fulfils 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.

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY
(CHARUSAT)

FACULTY OF TECHNOLOGY & ENGINEERING (FTE)

CHOICE BASED CREDIT SYSTEM

A. Choice Based Credit System:

With the aim of incorporating the various guidelines initiated by the University Grants Commission (UGC) to bring equality, efficiency and excellence in the Higher Education System, Choice Based Credit System (CBCS) has been adopted. CBCS offers wide range of choices to students in all semesters to choose the courses based on their aptitude and career objectives. It accelerates the teaching-learning process and provides flexibility to students to opt for the courses of their choice and / or undergo additional courses to strengthen their Knowledge, Skills and Attitude.

1. CBCS – Conceptual Definitions / Key Terms (Terminologies)

1.1. Core Courses

1.1.1 University Core (UC)

University Core Courses are those courses which all students of the University of a Particular Level (PG/UG) will study irrespective of their Programme/Specialization.

1.1.2 Programme Core (PC)

A 'Core Course' is a course which acts as a fundamental or conceptual base for Chosen Specialization of Engineering. It is mandatory for all students of a particular Programme and will not have any other choice for the same.

1.2 Elective Course (EC)

An 'Elective Course' is a course in which options / choices for course will be offered. It can either be for a Functional Course / Area or Streams of Specialization / Concentration which is / are offered or decided or declared by the University/Institute/Department (as the case may be) from time to time.

1.2.1 Institute Elective Course (IE)

Institute Courses are those courses which any students of the University/Institute of a Particular Level (PG/UG) will choose as offered or decided by the University/Institute from time-to-time irrespective of their Programme /Specialization

1.2.2 Programme Elective Course (PE)

A 'Programme Elective Course' is a course for the specific programme in which students will opt for specific course(s) from the given set of functional course/ Area or Streams of Specialization options as offered or decided by the department from time-to-time.

1.2.3 Cluster Elective Course (CE)

A 'Cluster Elective Course' is a course which students can choose from the given set of functional course/ Area or Streams of Specialization options (e.g. Common Courses for EC/CE/IT/EE) as offered by or decided by the Institute from time-to-time.

1.3 Non Credit Course (NC) - AUDIT Course

A 'Non Credit Course' is a course where students will receive Participation or Course Completion certificate. This will not be reflected in Student's Grade Sheet. Attendance and Course Assessment is compulsory for Non Credit Courses.

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 3	CL341	Structural Analysis-II	4	2	0	6	4	1		5	30	70	25	25	150
	CL344	Summer Internship - I	0	3	0	3	0	0	3	3	0	0	75	75	150
	CL349	Concrete Technology	3	2	1	6	3	1		4	30	70	25	25	150
	CL350	Building Planning	3	2	1	6	3	1		4	30	70	25	25	150
	HS131.02 A	Communication And Soft Skills	0	2	0	2	0	2		2	0	0	30	70	100
	CLXXX	Programme Elective-I	3	2	0	5	3	1		4	30	70	25	25	150
						28				**22**					**850**
	CL351	Environmental Engineering-I	4	2	0	6	4	1		5	30	70	25	25	150
	CL346	Geotechnical Engineering-I	3	2	0	5	3	1		4	30	70	25	25	150
	CL352	Water Resources Engineering-I	4	2	1	7	4	1		5	30	70	25	25	150
	CL353	Transportation Engineering-I	4	2	1	7	4	1		5	30	70	25	25	150
	HS132.02 A	Contributory Personality Development	0	2	0	2	0	2		2			30	70	100
	CLXXX	Programme Elective-II	3	2	0	5	3	1		4	30	70	25	25	150
						32				**25**					**850**

CONTENTS

B. Tech. (Civil Engineering) Programme

SYLLABI (SEMESTER – 5)

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

CL341: STRUCTURAL ANALYSIS-II

B. TECH 5th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

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

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Energy Principles	10
2	Fixed and Continuous Beam	08
3	Influence Line for Indeterminate Structures	10
4	Consistent Deformation	06
5	Slope-Deflection Method	10
6	Moment-Distribution Method	10
7	Introduction to Matrix- Beam Element	06

Total Hours (Theory): 60

Total Hours (Lab): 30

Total Hours: 90

B. Detailed Syllabus:

1 Energy Principles **10 Hours 17%**

1.1 Strain energy- Introduction

1.2 Strain energy stored in linear elastic systems

1.3 Castigliano's theorems

1.4 Computation of displacements of statically determinate beams and frames by unit load method

1.6 Analysis of statically indeterminate structures-beams and frames by unit load method

2	**Fixed and Continuous Beam**	**08 Hours**	**13%**
2.1	Statically determinate and indeterminate structures		
2.2	Degree of static indeterminacy		
2.3	Advantages and disadvantages of indeterminate structures		
2.4	Analysis of fixed beams for various types of loads and secondary effects		
2.5	Claypeyron's three moment theorem and its application		
2.6	Analysis of continuous beams		
2.7	Analysis of propped cantilever beams		
3	**Influence Line for Indeterminate Structure**	**10 Hours**	**17%**
3.1	Muller-Breslau's principle		
3.2	Quantitative I.L. for reaction and internal forces in propped cantilever and continuous beams		
3.3	Qualitative I.L. for rigid jointed structures having higher degree of static indeterminacy		
4	**Consistent Deformation**	**06 Hours**	**10%**
4.1	Introduction		
4.2	Method of consistent deformation		
4.3	Analysis of Statically indeterminate beams		
5	**Slope-Deflection Method**	**10 Hours**	**17%**
5.1	Introduction		
5.2	Basic concepts, Definitions and Sign conventions		
5.3	Development of Slope-deflection equations		
5.4	Analysis of indeterminate beams		
5.5	Analysis of portal frames with no lateral translation of joints		
5.6	Analysis of frames with lateral translation of joints		
6	**Moment-Distribution Method**	**10 Hours**	**17%**
6.1	Introduction		
6.2	Absolute and relative stiffness of members, Carry over factor (COF), Distribution factor (DF)		
6.3	Sign conventions		
6.4	Applications of method		
6.5	Analysis of continuous beam with secondary effects		

6.6 Symmetrical frames

6.7 Analysis of frames with no lateral translation of joints

6.8 Analysis of frames with lateral translation of joints

7 Introduction to Matrix- Beam Element 06 Hours 09%

7.1 Introduction to flexibility and stiffness method

7.2 Application of stiffness method system approach to analysis of beam

C. Course Outcomes:

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

CO1 Identify the fundamentals of structure and various methods of Analysis

CO2 Recognize the role of professional societies in developing new structural software and updating current knowledge

CO3 Identify and formulate an engineering problem and to develop a solution

CO4 Use various classical methods for analysis of indeterminate structures

CO5 Demonstrate the concepts of qualitative influence line diagram for rigid jointed structures having higher degree of statically indeterminacy

CO6 Apply the basic concepts of matrix methods in structural analysis

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

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

D. Recommended Study Material:

Text Books:

1. Junarkar, S.B. & Shah, H.J., Mechanics of Structures Vol-I & II, Charotar Publishing House
2. Negi, L.S. and Jangid, R.S., Structural Analysis, Tata McGraw Hill
3. Vazirani, V.N. and Ratwani, N.M., Analysis of Structures, Khanna Publishers

4. Weaver William and Gere James, Matrix Analysis of Framed Structures, CBS Publishers
5. R.S. Khurmi and N. Khurmi, Theory of structures, S. Chand

Reference Books:

1. Gere & Timoshenko, Mechanics of Materials, CBS Publishers & Distributors, Delhi
2. Hibbler, R.C., Structural Analysis, Pearson Education
3. Wang, C.K., Intermediate Structural Analysis, Tata McGraw Hill
4. Reddy, C.S., Basic Structural Analysis, Tata McGraw Hill
5. Jangid, R.S., Structural Analysis, Tata McGraw Hill
6. Devdas Menon., Structural Analysis, Alpha Science
7. William M.C. McKenzie, Examples in Structural Analysis, Second Edition, CRC Press

Web Materials:

1. http://nptel.ac.in/downloads/105101085/
2. http://nptel.ac.in/courses/105101086/
3. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Structural%20Analysis/New_index1.html
4. http://www.nptelvideos.in/2012/11/structural-analysis-ii.html
5. http://nptel.ac.in/courses/105106050/2
6. http://nptel.iitg.ernet.in/Civil_Eng/IIT%20Delhi/Structural%20Analysis%201%20(Video).htm
7. http://freevideolectures.com/Subject/Civil-Engineering
8. http://freevideolectures.com/Course/97/Structural-Analysis-II

LIST OF EXPERIMENTS

Experiment No.	Name of Experiment
1	Deflections of beams and cantilevers
2	Continuous and indeterminate beam
3	Pin jointed frameworks
4	Frame deflections and reactions
5	Bending moments in a portal frame

CL344: SUMMER INTERNSHIP-I

B TECH 5th SEMESTER (CIVIL ENGINEERING)

Credit and Hours:

Teaching Scheme	Project	Total	Credit
Hours/week	30	90	3
Marks	150	150	

A. Instructional Method and Pedagogy:

- Summer internship shall be for at least 90 hours during the summer vacation only.
- Department/Institute will help students to find an appropriate company/industry/organization for their 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 is 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 will not able to attend the internship for 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 following 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 by 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. Main headings are 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 12pt. All the margins shall be 2.5cm. The report shall be submitted in printed form and filed. An electronic copy of the report shall be recorded in a CD and enclosed in 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 in the plant, and main 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 work type, administrative structure, number of employees (how many engineers, under which division, etc.), 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 location and 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, computer programs, 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. Course 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 "-"

CL349: CONCRETE TECHNOLOGY

B TECH 5th 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	Introduction	01
2	Cement	07
3	Aggregate	07
4	Admixtures	05
5	Fresh Concrete	06
6	Harden Concrete	06
7	Selection of Concrete Mix Proportion (Mix Design)	07
8	Special Concrete	04
9	Non-Destructive test of Concrete	02

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

B. Detailed Syllabus:

1 Introduction **01 Hours** **02%**

1.1 Ingredients of concrete

1.2 Strength development

1.3 Different types of concrete

1.4 New developments and future trends

2	**Cement**	**07 Hours**	**15%**

2.1 History of portland cement

2.2 Manufacture process of portland cement

2.3 Chemical composition

2.4 Hydration and heat of hydration

2.5 Structure of hydrated cement and product of hydration

2.6 Setting of cement

2.7 Field testing of cement, standard consistency test, initial and final setting time, strength of cement, soundness test

2.8 Storage of cement

2.9 Types of cement

3	**Aggregate**	**07 Hours**	**15%**

3.1 Source and classification of aggregates

3.2 Shape, size and texture of aggregates

3.3 Mechanical properties of aggregates, strength of aggregates, specific gravity, bulk density, porosity and absorption of aggregates, moisture content of aggregates, bulking of fine aggregate

3.4 Deleterious substance in aggregate

3.5 Soundness of aggregates

3.6 Alkali aggregates reaction

3.7 Grading of aggregates

3.8 Test on aggregate: Aggregates crushing value, aggregates impact value, aggregates abrasion value, sieve analysis and fineness modulus.

3.9 Quality of mixing water

3.10 Use of Sea water in concrete

4	**Admixtures**	**05 Hours**	**11%**

4.1 Advantages of admixture

4.2 Types of admixture: Accelerators, retarders, water reducing admixture, plasticizers and air entraining, super plasticizer, water proofing admixture, antibacterial admixture

4.3 Cementitious materials: Fly ash, silica fume, rice husk ash, ground granulated blast furnace slag, metakaolin

5	**Fresh Concrete**	**06 Hours**	**14%**

5.1 Rheology of fresh concrete

5.2 Workability and factors affecting workability

5.3 Measurement of workability

5.4 Segregation

5.5 Bleeding

5.6 Process of manufacture of concrete: batching, mixing, transportation, placing, compaction, curing, re-tampering, finishing

6	**Hardened Concrete**	**06 Hours**	**14%**

6.1 Gain of strength of concrete

6.2 Factors affecting strength of concrete: water cement ration, gel space ratio, age of concrete

6.3 Durability and permeability

6.4 Nature of strength of concrete

6.5 Microcraking , Creep and Shrinkage

6.6 Aggregate cement paste interface

6.7 Maturity of concrete

7	**Selection of Concrete Mix Proportions (Mix Design)**	**07 Hours**	**15%**

7.1 Concept of concrete mix design: variables in proportioning, various methods of proportioning, statistical quality control of concrete, calculation of standard deviation, relation between average design strength and specified minimum strength

7.2 Principle of mix proportioning

7.3 Factors governing the selection of mix proportion

7.4 Mix proportions and quantities per batch

7.5 ACI, IS Method, concrete mix design using admixture, mix design for pumpable concrete

7.6 Variability of test result

7.7 Acceptance criteria and IS code provisions

8 Special Concrete **04 Hours** **9%**

8.1 High performance concrete

8.2 Lightweight aggregate

8.3 High strength concrete

8.4 Polymer concrete

8.5 Fibre reinforce concrete

8.6 Ready mix concrete

8.7 Mass concrete

8.8 Self-Compacting Concrete

9 Non Destructive testing of Concrete **02 Hours** **5%**

9.1 Introduction to Destructive, Semi destructive and Non-destructive testing,

9.2 Problem faced during Non-destructive evaluation.

9.3 Rebound Hammer test,

9.4 Ultrasonic Pulse Velocity test

C. Course Outcomes:

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

CO1 The students will be able to: test all the concrete materials as per IS code.

CO2 The students will understand concrete mix design using ACI and IS code methods.

CO3 The students able to determine the properties of fresh and hardened concrete.

CO4 The students have knowledge of special concretes and their specific 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	-	-	-	-	-	-	3	-	2	-	-	1	-	1
CO2	1	-	-	-	-	-	-	3	-	2	-	-	1	-	1
CO3	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-
CO4	-	-	-	-	-	-	2	-	-	-	1	-	1	-	-

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

D. Recommended Study Material:

Text books:

1. Naville, A.M., Concrete Technology, Pearson Education.
2. Santakumar, A.R., Concrete Technology, Oxford University Press.
3. Shetty, M.S., Concrete Technology, S. Chand Publication.
4. Gambhir, M.L., Concrete Technology, Tata McGraw Hill Publication.

Reference books:

1. Paulo, Mehta P. Kumar and Monteiro, J.M., Concrete Micro-structure, Properties and Materials, Prentica Hall INC and McGraw Hill, USA.
2. IS: 10262- 2009 Recommended guidelines for Concrete Mix Design.
3. IS: 456- 2000, Indian Standard Plain and Reinforced Concrete Code of Practice.

Web Materials:

1. http://nptel.iitm.ac.in/video.php?courseId=1059
2. http://www.aboutcivil.com/concrete-technology.html
3. www.understanding-cement.com
4. http://www.engineeringcivil.com/theory/concrete-engineering/

CL350: BUILDING PLANNING

B. TECH 5th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

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

A. Outline of the Course:

Sr. No.	Title of the Unit	Min. No. of Hours
1	Building Drawing	03
2	Building Byelaws	06
3	Planning of Residential Buildings	12
4	Planning of Public Buildings	04
5	Building Services	06
6	Perspective Drawing	08
7	Introduction to Town Planning	06

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1 Building Drawing 03 Hours 07%

1.1 Classification of buildings

1.2 Basic principles of planning

1.3 Principles of Architecture

1.4 Standard conventional signs, symbols and abbreviations

1.5 ISI nomenclature: Size of scale, standard method of Dimensioning

2 Building Byelaws 06 Hours 13%

2.1 Objectives, Scope, Applicability and Principles

2.2 Basic terminology

2.3 Various forms of building coverage

2.4 Bye-laws for Open spaces, Area limitations, Height limitations,

	Plinth Area, Means of Access, Light and Ventilation, Parking spaces		
2.4	Minimum standard dimensions of building elements		
2.5	Examples on FSI or FAR		
2.6	Submission of drawings for issue of permission for construction		
3	**Planning of Residential Buildings**	12 Hours	28%
3.1	Different types of Residential Buildings		
3.2	Selection of site for residential buildings		
3.3	Orientation of Buildings		
3.4	Guidelines for making wall thickness plan from line diagram		
3.5	Detailed drawing–plan, elevation, sections		
3.6	Design of Individual rooms with particulars attention to anthropometric data, functional and furniture requirements.		
3.7	Design of buildings with particular attention to orientations, FSI and allowable built up area.		
3.8	Furniture layout, Kitchen layout with emphasis on kitchen work triangle		
4	**Planning of Public Buildings**	04 Hours	08%
4.1	School – Principles of planning a school building, Components, Design of a classroom, Sanitary Requirements		
4.2	Hospital – Site selection, Principles of planning a hospital building, Wards, Different departments, Operation theatre, Sanitary Requirements		
4.3	Hostel – Site selection, Principles of planning a hostel building, wardens office, residential area, recreation room, special requirements, Sanitary Requirements, Kitchen and Dining Hall		
5	**Building Services**	06 Hours	13%
5.1	Water supply and Drainage – water distribution systems, materials used for plumbing, drainage systems		
5.2	Electrification – distribution of electrical energy, accessories of electrical installation, purpose of earthing		
5.3	Working drawing of a building – Electrical layout, Water supply and drainage layout		

6	**Perspective Drawing**	08 Hours	18%
6.1	Introduction & technical terms		
6.2	Classifications, elements of perspective		
6.3	Examples		
7	**Introduction to Town Planning**	06 Hours	13%
7.1	History, ancient planning in India		
7.2	Objects & importance of town planning		
7.3	Principles of town planning		
7.4	Horizontal growth, vertical growth		
7.5	Satellite town, ribbon development, concentric growth		

C. Course Outcomes:

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

CO1 Discern various aspects of principles of planning and architecture in building design and read the building drawings.

CO2 Understand local building bye-laws and provisions of National Building Code in respect of building and town planning.

CO3 Utilise basic principle of planning and architecture in design of residential buildings and public buildings.

CO4 Utilise the knowledge of different types of plumbing and electric fitting and laying procedure to create working drawings.

CO5 Understand perspective drawing and represent various forms in perspective view.

CO6 Have basic understanding of town planning and its history.

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

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

D. **Recommended Study Material:**

Text Books:

1. Singh Gurcharan, Building Planning, Designing and Scheduling, Standard Publishers and Distributors.
2. Dr. N. Kumara Swamy & Rao A. Kameswara, Building Planning and Drawing, Charotar Publishing House.
3. Wagh Sajjan V., Building and Town Planning, Tech-Max Publications.
4. Khasiya R. B, Motiani A. T and Khasiya K. R, Building & Town Planning, Mahajan Publishing House.

Reference Books:

1. Rangwala S. C., Town Planning, Charotar Publishing House, Anand.
2. Hiraskar G. K., Town Planning, Dhanpatrai & Sons, New Delhi.
3. Sikka V. B., Civil Engineering Drawing, S. K. Kataria & Sons Publication.
4. Shah M. G., Kale C. M and Patki S. Y., Building Drawing, Tata McGraw Hill Publication, New Delhi.
5. General Development Control Regulations published by AUDA and GICEA.
6. National Building Code of India, Indian Standard Institution (ISI), New Delhi, 2005.

Web Materials:

1. http://www.vastu-design.com/vastu-video-workshop/
2. https://www.youtube.com/watch?v=EIDXE28_8eQ
3. https://www.youtube.com/watch?v=VYiVjVulnm4
4. https://www.youtube.com/watch?v=bCn0X9RRjN0&list=PL060E3166E87E1FD5
5. https://www.designingbuildings.co.uk/wiki/Types_of_drawings_for_building_design
6. http://freevideolectures.com/Course/86/Building-Materials-and-Construction/31

List of Drawings for Lab Sessions

Sr. No.	Details
1	Conventional Signs & Symbols
2	Plan, Sectional Elevation, Front Elevation and site plan for a small house
3	Plan, Sectional Elevation, Front Elevation and site plan for Duplex Type House

4	Working Drawings
5	Design of houses with given functional requirements and climatic data and Model Making
6	Perspective Drawing: One Point Perspective
7	Perspective Drawing: Two Point Perspective

HS131.02 A: COMMUNICATION AND SOFT SKILLS

B. TECH 5th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

Teaching Scheme	Theory	Practical	Tutorial	Total	Credit
Hours/week	--	30/15	--	30/15	**02**
Marks	--	100	--	100	

Pre-requisite courses:

- Communicative English

A. Outline of the Course:

Sr. No.	Title of the unit	Minimum number of hours
1.	An Introduction to Communication	06
2.	Cross-cultural Communication and Globalization	03
3.	Communication for Career Building	10
4.	Group Dynamics and Soft Skills	05
5.	Effective Presentation Strategies	04
6.	Contemporary Issues in Communication and Soft Skills	02
	Total hours (Theory) :	--
	Total hours (Practical) :	**30**
	Total hours :	**30**

B. Detailed Syllabus:

1. An Introduction to Communication **06 Hours 20%**

1.1 Basics of Communication: Origin, Concept, Process, Levels, Principles and Barriers;

1.2 Applications of Communication;

1.3 Rhetoric in Professional Communication;

1.4 Importance of Ethos, Logos, and Pathos in Communication

2.	**Cross-cultural Communication and Globalization**	**03 Hours**	**10%**
2.1	Basic Concepts: Culture, Globalization and Cross-cultural Communication;		
2.2	Social and People Skills;		
2.3	Communicating with People of Different Cultures;		
2.4	Conflicts in Cross-cultural Communication and Tactics / techniques to resolve them;		
2.5	Persuasive Communication		
3.	**Communication for Career Building**	**10 Hours**	**33%**
3.1	Cover Letters and Resume;		
3.2	E-mail and Report;		
3.3	Types of Resume;		
3.4	Concept and Rationale of Group Discussion Skills and Aspects assessed in Group Discussion;		
3.5	Concept and Rationale of Personal Interview;		
3.6	Types of Personal Interview;		
3.7	Writing Statement of Purpose		
4.	**Group Dynamics and Soft Skills**	**05 Hours**	**17%**
4.1	An Introduction to Group Dynamics and Soft Skills;		
4.2	Groups and their Structures;		
4.3	Roles and Functions of Members in Groups;		
4.4	Conflict Management;		
4.5	Aptitude and Attitude;		
4.6	Various Intelligences;		
4.7	Developing an Open Mindset		
5.	**Effective Presentation Strategies**	**04 Hours**	**14%**
5.1	Designing Appealing Presentation;		
5.2	Audience Analysis and Supporting Material;		
5.3	Presentation Mechanics and Presentation Process;		
5.4	Managing Yourself during Q and A Session;		
5.5	Fundamentals of Persuasion		
6.	**Contemporary Issues in Communication and Soft Skills**	**02 Hours**	**06%**
6.1	Trends and Practices in Communication, Case Studies		

C. Learning Outcomes:

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

CO1 Gain thorough understanding and proficiency in various Professional Communication Skills.

CO2 Develop awareness and competence in cross-cultural communication in their personal, academic and professional environments.

CO3 Develop business writing and presentation skills to succeed in career.

CO4 Develop soft skills to stand out and take their career to the next level.

CO5 Develop various intelligences and open Mindset to function in multi-disciplinary and cross-cultural work environment.

CO6 Practice new trends in communication in multiple perspectives at personal, professional, and social level.

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) no correlation, put "-"

Recommended Study Material:

- **Text book:**
    1. Koneru, A. Professional Communication, Tata McGrow Hill Education Private Limited
    2. Disanza, J.R. &Legge, N. Business and Professional Communication, Pearson Education
    3. Raman, M & Singh, P. Business Communication, Oxford University Press

- **Reference book:**
    1. Disanza, J.R. &Legge, N. Business and Professional Communication, Pearson Education

2. Anandamurugan, A. Placement Interviews – Skills for Success, Tata McGrow Hill Education Private Limited

- **Web material:**
  1. https://www.coursera.org/learn/careerdevelopment
  2. https://www.futurelearn.com/courses/writing-applications
  3. https://www.futurelearn.com/courses/workplace-englis

CL370: CONSTRUCTION ENGINEERING MATERIALS

B. TECH 5th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - I

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 Materials	3
2	Timber	7
3	Masonry Units	8
4	Plastics	4
5	Glass	4
6	Ceramic Materials	4
7	Metals	7
8	Paint & Varnishes	3
9	Advanced Construction Materials	5

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1	**Introduction to Construction Materials**	**03 Hours**	**07%**
1.1	General Introduction		
1.2	Physical Properties		
1.3	Mechanical Properties		
1.4	Classification of materials based upon their uses		
2	**Timber**	**07 Hours**	**15%**
2.1	General Introduction		

2.2	Classification of trees		
2.3	Structure of a tree		
2.4	Seasoning of Timber – Meaning, Objects, Methods, Advantages and Disadvantages of different methods of seasoning		
2.5	Defects in Timber		
2.6	Industrial Timber		
3	**Masonry Units**	**08 Hours**	**18%**
3.1	Bricks – general, composition of good brick earth, qualities of good bricks, factors affecting qualities of bricks, tests for bricks		
3.2	Stone - Qualities of good building stone, tests for stones, dressing of stones		
3.3	AAC blocks - General introduction, Composition, Manufacturing process, Advantages and Disadvantages, properties		
4	**Plastics**	**06 Hours**	**09%**
4.1	General Introduction		
4.2	Composition of Plastic, Polymerization		
4.3	Classification of Plastics		
4.4	Properties of Plastics, Uses of Plastic		
4.5	Biodegradable plastic		
4.6	Fibre Glass Reinforced Plastic		
5	**Glass**	**04 Hours**	**09%**
5.1	General		
5.2	Classification of glass and composition of glass		
5.3	Properties of glass , Types of glass		
5.4	Coloured Glass and special varieties of glass		
6	**Ceramic Materials**	**04 Hours**	**09%**
6.1	General Introduction, Properties, Importance		
6.2	Terracota, Stoneware		
6.3	Tiles - Characteristics, types		
6.4	Glazing and refractories		

7	**Metals**	**07 Hours**	**15%**
7.1	Ferrous - Introduction to different types of ferrous metals		
7.2	Steel - General Information, Manufacture of steel, Uses of Steel, Factors affecting physical properties of Steel, Defects in steel, Properties of Mild Steel, Properties of Hard Steel, Mechanical Treatment of Steel, Market forms of steel		
7.3	Non-Ferrous Metals - Different types Aluminium - Manufacture, Properties, Evaluation as building material, Economics of using aluminium, Uses		
8	**Paint & Varnishes**	**03 Hours**	**07%**
8.1	Paints - Characteristics, Pigment Volume Concentration Number, Ingredients, Types		
8.2	Varnishing - Characteristics, Ingredients, Types		
9	**Advanced Construction Materials**	**05 Hours**	**11%**
9.1	Application of Nano Technology in construction materials		
9.2	Advanced Composite Reinforcement		
9.3	Ground granulated blast furnace slag		
9.4	Hydrophobic concrete for waterproofing		
9.5	Insulated concrete forms		

C. Course Outcomes:

On the successful completion of this course, the students will:

- CO1 Understand the constituents of various materials like timber, glass, plastic, ceramic material, metal, varnish and paint.
- CO2 Be familiar with the varieties of construction material available in market.
- CO3 Understand the application of various construction materials with their properties like timber, glass, plastic, ceramic material, metal, varnish and paint.
- CO4 Be familiar about various advanced construction materials available in market.

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

D. Recommended Study Material:

Text Books:

1. Duggal S. K., Building Materials, New Age International Publication.
2. Rangwala S.C.,Engineering Materials, Charotar Publishing House
3. Soni Saurabhkumar, Building Materials & Construction, S.K.Kataria publication

Reference Books:

1. Dr. Janardan Jha, Engineering Materials, Khanna Publication
2. A K Roy, Materials of Construction, Chaudhary Publication
3. Vazirani and Chandola, Engineering Materials
4. D.N. Ghose, Construction Materials, TATA Mc Graw Hill
5. TTTI ,Chandigarh,Civil Engineering materials TTTI
6. Rangwala Ketki, Essential of Civil Engineering, Charotar Publishing House

Web Materials:

1. https://onlinecourses.nptel.ac.in/m?desturl=cHJvZmlsZQ==#/course/noc19_ce42
2. https://onlinecourses.nptel.ac.in/m?desturl=cHJvZmlsZQ==#/course/noc19_ce40
3. https://en.m.wikipedia.org/wiki/Insulating_concrete_form
4. https://www.nbmcw.com/tech-articles/concrete/3725-new-construction-materials-for-modern-projects.html
5. https://nptel.ac.in/courses/105106053/
6. https://geniebelt-com.cdn.ampproject.org/v/s/geniebelt.com/blog/10-innovative-construction-materials/amp?usqp=mq331AQQKAFwAZgB47z1kNnQu6WrAQ%3D%3D&amp_js_v=a2&amp_gsa=1#referrer=https%3A%2F%2Fwww.google.com&ampshare=https%3A%2F%2Fgeniebelt.com%2Fblog%2F10-innovative-construction-materials

CL374: ARCHITECTURAL DESIGN OF FACILITIES

B. TECH 5th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - I

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	Architectural Design	12
2	Architectural Detailing	15
3	Architectural Facilities	18

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

B. Detailed Syllabus:

1	**Architectural Design**	**12 Hours**	**25 %**
1.1	The Site: Challenges and Opportunities		
1.2	Site Design and Environmental Analysis		
1.3	Sustainable Infrastructure		
1.4	The Skin: Materials and Techniques		
1.5	Evolving a Sustainable Design Practice		
1.6	Sustainable Design and Existing Buildings		
2	**Architectural Detailing**	**15 Hours**	**40%**
2.1	General Planning and Design Data		
2.2	Site work		
2.3	Masonry		
2.4	Metals		
2.5	Wood and Plastics		

2.6 Thermal and Moisture Protection

2.7 Doors and Windows

2.8 Interior Stairs and Stairwells

2.9 Specialties

2.10 Conveying Systems

2.11 Electrical

2.12 Energy and Environmental Design

2.13 Layout of Plates

2.14 Exterior Details

3 Architectural Facilities **18 Hours** **35%**

3.1 Controlling Water

3.2 Controlling Air

3.3 Controlling Heat Flow

3.4 Controlling Water Vapor

3.5 Controlling Sound

3.6 Accommodating Movement

3.7 Providing Structural Support

3.8 Providing Passages For Mechanical and Electrical Services

3.9 Health and Safety

C. Course Outcomes:

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

CO1 Use basic architectural principles in the design of buildings, interior spaces and sites

CO2 Understand the western architectural canons and traditions in architecture, landscape and urban design as well as the climatic, technological, socioeconomic and other cultural factors that have shaped and sustained them

CO3 Read architectural drawings and make technically precise drawings.

Course Articulation Matrix:

	PO 1	PO2	PO3	PO4	PO5	PO 6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	-	2	-	1	2	1	2	2	2	1	1
CO2	-	-	3	-	-	3	3	2	2	-	1	2	-	1	3
CO3	3	2	3	2	2	1	-	-	2	1	2	3	3	2	3

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

D. **Recommended Study Material:**

Text Books:

1. Daniel E. Williams., Sustainable Design: Ecology, Architecture, and Planning, John Wiley & Sons, 2007.
2. Charles George Ramsey, Harold Reeve Sleeper, Architectural Details: Classic Pages from Architectural Graphic Standards 1940 – 1980, Wiley, 2001.
3. Louis Rouillion, Charles George Ramsey, Architectural Details: Classic Pages from Architectural Graphic Standards 1940 – 1980, J. Wiley, 1924.
4. Edward Allen, Patrick Rand, Architectural Detailing: Function, Constructibility, Aesthetics, John Wiley & Sons, 2016.

Reference Books:

1. Rangwala S. C., Building Construction, Charotar Publishing House, Anand.

LIST OF TUTORIALS

Sr. No.	Details
1	Internet Case studies of sustainable buildings like Suzlon One Earth, Pune, ZED housing, Bangalore etc. (Group work)
2	Study of green building rating systems like GRIHA, TERI, LEED etc. (Individual Work)
3	Study of materials that can bring sustainability like solar panels, wind mills etc. (Group work)
4	Case study and model making on: (Group Work) A. DOORS: Types of doors, its use, materials and joinery details B. EXTERIOR DETAILS: Type of paints finishes, alco panels, aluminum panels, glass etc. C. MASONRY: Brick masonry detail and types of brick bonds D. METALS: Types of metals and its use in building construction E. INTERIOR STAIRCASES: Study and analysis of staircases used in interior spaces F. EXTERIOR STAIRCASES: Study and analysis of staircases used in exterior spaces F. ELECTRICAL SYSTEMS: Electric conducting systems, types of conduits used in construction and interior designs
5	To make a detail report on one building/mall that depicts all the Architectural facilities like; HVAC (Heating Ventilation and Air Conditioning), AHU (Air Handling Units), Fire safety

	measure and fire Exits, Plumbing and Sanitation, Structural layout, Mechanical Services, Water supply services etc. (Group work)

CL375: BUILDING SERVICES

B. TECH 5th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - I

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 Building Services	5
2	Plumbing Services in Buildings	8
3	Mechanical Services in Buildings	10
4	Illumination, Fire Protection, Acoustic and Sound Insulations	12
5	Heating, Ventilation and Air Conditioning (HVAC)	10

Total hours (Theory): 45

Total hours (Lab): 30

Total hours: 75

B. Detailed Syllabus:

1. Introduction to Building Services **05 Hours** **11%**

1.1 Definitions, Objective and uses of services

1.2 Applications of services for different types building considering

1.3 Classification of building services

1.4 Types of services and selection of services

2 Plumbing Services in Buildings **08 Hours** **18%**

2.1 **Elements of plumbing**

Objectives of plumbing, purpose of plumbing, role of plumber, licensing of plumbers their functions, sewer Air, supply pipes, drainage & vent pipes application for obtaining supply connection

2.2 **Pipes joints & fittings**

Introduction. Types of Pipe – G.I. Pipes, PVC Pipes, Copper pipes, C.I. Pipes, A.C. Pipes, prestressed concrete pipes, joints in pipes, method of fixing pipes such as G.I. fitting C.I. fitting

2.3 **Valves & Terminal Fittings**

Types of valves & its purpose, sluice valve, reflux valve, scour valve, Air relief valve, pressure relief valve, gate valves, Bio-taps & stop valve self-closing valve. Flush valve, mixing valve

2.4 **Sanitary fixture & Building drainage system**

Building sanitary fittings – water closet, flushing appliances, urinals, washbasins, flushing cisterns, principles of building drainage, siphonic action, traps & its types, capacity & sizing of pipe, soil pipe, waste pipe, rain water pipe, system of plumbing, Installation of pipes, testing of pipes

3. Mechanical Services in Buildings **10 Hours** **22%**

3.1 Introduction of mechanical services

3.2 **Lifts:** Definition, Types of Lifts, Design Considerations, Location, Sizes, Component parts- Lift Well, Travel, Pit, Hoist Way, Machine, Buffer, Door Locks, Suspended Rope, Lift Car, Landing Door, Call Indicators, Call Push

3.3 **Elevators & Escalators**: Different types of elevators and Escalators, Freight elevators, Passenger elevators, Hospital elevators, Uses of different types of elevators Escalators

3.4 **Pumps**: Reciprocating, Centrifugal, Deep well, Submersible, Automatic pumps, Sewerage pumps, Compressors, Vacuum pump – their selection, installation and maintenance

3.5 **Conveyors**: Different types of Conveyors, Uses of different types of Conveyors

4. Illumination, Fire Protection, Acoustic and Sound Insulations **12 Hours** **27%**

4.1 Natural and artificial lighting- principles and factors, Arrangement of luminaries, Distribution of illumination, Utilization factors

4.2 Causes of fire and Effects of fire, General Requirements of Fire

Resisting building as per IS and NBC 2005.,Characteristics of Fire resisting materials, Maximum Travel Distance, Fire Fighting Installations for Horizontal Exit, Roof Exit / Fire Lifts, External Stairs

4.3 Requirement of good Acoustic, Various sound absolvents, Factors to be followed for noise control in residential building

5. Heating, Ventilation and Air Conditioning (HVAC) **10 Hours** **22%**

5.1 Behaviour of heat propagation, thermal insulating materials and their co-efficient of thermal conductivity. General methods of thermal insulation: Thermal insulation of roofs, exposed walls

5.2 Ventilation: Definition and necessity, Principles, Temperature Control, Air Velocity Control, Humidity Control, Air Distribution system, Cleaners, Filters, Spray washers, Electric preceptors, Types of Air Conditioners, (Central type, Window Type, Split Unit)

C. Course Outcomes:

On successful completion of this course

CO1 The students will acquire competencies to plan various types of services required for different types of building.

CO2 Students will be able to manage building services provisions in big construction sites.

CO3 Students will be able to synchronize the construction activities with installation of building services.

CO4 Students will learn the needs of a building occupant in an enclosed built environment regarding; thermal comfort, indoor air quality, fire safety, electric usage and wet area usage.

CO5 Students will gain technological solution alternatives and knowledge of equipment in the market for ventilation, heating, cooling techniques, building service 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	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO4	1	2	-	1	-	-	-	-	-	-	-	-	-	-	1
CO5	1	-	-	-	-	-	-	-	-		-	-	-	1	-

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

D. Recommended Study Material:

Text Books:

1. Building Services by S. M. Patil, Seema Publication, Mumbai, Revised edition.
2. Building Construction by Dr. B. C. Punmia, Laxmi Publications (P) Ltd., New Delhi.
3. Water supply and Sanitary Engineering by S. K. Garg, Delhi.

Reference books

1. A text book on Building Services by R. Uday kumar. Eswar Press, Chennai.
2. Building Construction by P. C. Varghese PHI Learning (P) Ltd., New Delhi.
3. Elements of Public Health Engineering, by K. N. Duggal, New age international.
4. Building repair and Maintenance Management by P. S. Gahlot CBS Publishers & Distribution (P) Ltd.
5. Building Construction by Charotar publishing House, Anand.
6. A to Z of practical building and its management by Sandeep Mantri, Mantri Institute of Development & Research, Pune.
7. Building Systems for Interior Designers by Corky Binggeli, John Wiley & Sons, 2003.

Web Material:

1. www.academia.edu
2. www.nptel.iitm.ac.in
3. http://en.wikipedia.org/w/index.php?title=Dumbwaiter_(elevator)&oldid=62176813
4. www.bis.org.in/sf/nbc.htm
5. cpwd.gov.in/Units/handbook.pdf
6. http://www.civilengineeringnews.tk/2014/07/methods-of-demolition-of-building.html thecontractor.org

LIST OF PRACTICALS / EXERCISE

Tutorials	Tutorial 1	Introduction to building services
	Tutorial 2	Draw diagrams of various plumbing fixtures.
	Tutorial 3	Identify proper locations for Lift/ Escalator/ Elevator in a given commercial complex
	Tutorial 4	Prepare a case study for the firefighting services for commercial building.

	Tutorial 5	Suggestions for noise control methods for a given commercial complex
Seminar	Seminar on course related topic to be given to a group of students not more than three. Students have to present/ defend the seminar in front of teachers and students. This work should be accompanied in the submission	
Site visit	Visit a residential building & commercial building under construction and study the services like mechanical, plumbing, HVAC, Fire safety, acoustics and related allied services of civil engineering and prepare site visit detailed report	

CL381: INFRASTRUCTURE MANAGEMENT

B. TECH 5th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - I

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 and Infrastructure scenario	04
2	An overview of Basic Concepts Related to Infrastructure: Urban Infrastructure	10
3	Strategies for Successful Infrastructure Project Implementation	09
4	Private Involvement in Infrastructure	06
5	Infrastructure Economics and Finance	05
6	Infrastructure Risk Management	06
7	Infrastructure Maintenance	05

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	**An overview of Basic Concepts Related to Infrastructure: Urban Infrastructure**	**10 Hours**	**22%**
2.1	An overview of the Power Sector in India, Water Supply and Sanitation Sector in India, Road, Rail, Air and Port Transportation Sectors in India and Telecommunications Sector in India.		
2.2	An overview of the urban infrastructure in India, rural infrastructure in India		
2.3	Legislations pertaining to urban infrastructure		
2.4	State of urban and rural infrastructure		
2.5	Strategies to improve infrastructure in rural areas		
2.6	Stages of an Infrastructure Project Lifecycle		
3	**Strategies for Successful Infrastructure Project Implementation**	**09 Hours**	**20%**
3.1	Shaping the Planning Phase of Infrastructure Projects to mitigate risks		
3.2	Sustainable Contracts		
3.3	Introduction to Fair Process and Negotiation, Negotiating with multiple Stakeholders on Infrastructure Projects		
3.4	Sustainable Development of Infrastructure, Information Technology and Systems for Successful Infrastructure Management		
3.5	Capacity Building and Improving the Governments Role in Infrastructure Implementation		
4	**Private Involvement in Infrastructure**	**06 Hours**	**11%**
4.1	Overview		
4.2	Benefits		
4.3	Problems and challenges of infrastructure privatization		
4.4	Privatization of Infrastructure in India – Case Study		
5	**Infrastructure Economics and Finance**	**05 Hours**	**18%**
5.1	Principles of finance		
5.2	Infrastructure economics		
5.3	Introduction to project finance		
6	**Infrastructure Risk Management**	**06 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 05 Hours 9%

7.1 Introduction to Infrastructure maintenance

7.2 Need and requirement for Infrastructure maintenance

7.3 Preventive techniques for maintenance

C. Course Outcome (COs):

On the successful completion of this course

CO1 Students will be able to understand an overview of basic concepts of infrastructure and its scenario.

CO2 Students will be able to describe the strategies for successful infrastructure project implementation.

CO3 Students will be able to explain the role of private sector in infrastructure growth.

CO4 Students will be able to know about infrastructure economics and finance.

CO5 Students will be able to identify and manage risks involved in infrastructure.

CO6 Students will be able to execute maintenance of infrastructure.

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

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. Ministry of Shipping: http://shipping.nic.in/index.php
4. Indian Ports Association: http://www.ipa.nic.in/abou.htm
5. National Maritime Foundation: http://www.maritimeindia.org
6. India Maritime 2015: http://www.indiamaritime.in
7. http://nptel.ac.in/courses/105106115/

Term Work

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

OCCL3011: ENERGY EFFICIENCY, ACOUSTICS AND DAYLIGHTING IN BUILDING

B. TECH 5th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - I

Description:

This course OCCL3011 – Energy Efficiency, Acoustics and Daylighting in Building is offered from SWAYAM as noc24_ce47– Energy Efficiency, Acoustics and Daylighting in Building

URL: https://onlinecourses.nptel.ac.in/noc24_ce47/preview

Credit and Week:

Teaching Scheme	Week	Marks	Credit
	12	150	4

About the course:

The objectives of this course is to expose the students to the concepts functional design of building for thermal aspects and energy efficiency; especially in tropical climates i.e. in Indian context. Further objective is to make the student capable of performing fenestration design for natural ventilation and daylighting & design of space for external and internal noise control.

Pre-requisites: BE/BSc. Level Physics & Mathematics

Industry support: All Industry involved in Building design and construction. L&T, TERI etc. CPWD and all other PWDs. Dr. Fixit Institute

Course layout:

Week 1: Environmental Factors: Factors and their representation, tropical environments and site environments, etc.

Week 2: Human response to environment: Factors affecting human comfort, Human response to thermal environment, noise, visual environment etc.; Comfort indices

Week 3: Response of building to thermal environment: Processes of heat exchange of building with environment; Effect of solar radiation; Thermal properties of material and sections and their influence

Week 4: Steady and periodic heat transfer in buildings

Week 5: Heat flow computations: Transmission matrix, Admittance method, etc.-1

Week 6: Heat flow computations: Transmission matrix, Admittance method, etc.-2

Week 7: Structural control and design for energy efficiency: Selection of envelope elements, Orientations, shape, Glasses and shading devices

Week 8: Natural ventilation: Purpose of ventilation, Mechanisms, Fenestration Design for natural ventilation

Week 9: Noise and Building: Basic acoustics and noise, Planning, Sound in free field, protection against external noise

Week 10: Internal noise sources and protection against air borne & structure borne noise.

Week 11: Day lighting: Lighting principles and fundamentals

Week 12: Sky, Indian sky, daylight prediction and design of fenestration.

Books and references

1. Bureau of Indian Standards, " HAND BOOK OF FUNCTIONAL REQUIREMENTS OF BUILDINGS, (SP-41 & SP- 32)", BIS 1987 and 1989.
2. Koenighsberger, O.H. et al, "MANUAL OF TROPICAL HOUSING AND BUILDING PART-I CLIMATIC DESIGN", Orient Longman. 1973.
3. Markus,T.A. & Morris, E.N., "BUILDING CLIMATE AND ENERGY" Pitman publishing limited. 1980.
4. Croome, J.D. &Roberts, B.M.,"AIRCONDITIONING AND VENTILATION OF BUILDINGS VOL-1". Pergamon press.
5. Croome, J.D. "NOISE BUILDING AND PEOPLE" Pergamon press.
6. Clarke, J.A., "ENERGY SIMULATION IN List of reference materials/books/ Optional use of open source free software such as “eQUEST”, Energy plus etc. 2BUILDING DESIGN" Adam Hilger Ltd. 1985.
7. Foreman, J.E.K.,"SOUND ANALYSIS AND NOISE CONTROL". Van Nostrand Reinhold. 1990.
8. Maekawa, Z. and Lord, P."ENVIRONMENTAL AND ARCHITECTURAL ACOUSTICS" E&FN Spon. 1994. IS 2526, IS 4954 and NBC etc.

Criteria to get a certificate:

- Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
- Exam score = 75% of the proctored certification exam score out of 100

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

OCCL3012: REMOTE SENSING AND GIS FOR RURAL DEVELOPMENT

B. TECH 5th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - I

Description:

This course OCCL3012: Remote Sensing and GIS for rural development is offered from SWAYAM as noc23_ce52– Remote Sensing and GIS for rural development

URL: https://onlinecourses.nptel.ac.in/noc23_ce52/preview

Credit and Week:

Teaching Scheme	Week	Marks	Credit
	12	150	4

About the course:

India, being an agrarian nation, has a vast majority population living in rural areas. Development of rural areas is a difficult task due to the complex heterogeneity of the rural landscape and social economic and ecological conditions, and observation data is limited due to cost and logistical factors. Geospatial technologies including Remote Sensing and GIS (RS & GIS) have tremendous potential in the development of rural areas due to its ability in handling large amounts of data, conducting spatial analysis over large areas, and decision-making in a comprehensive and timely manner.

The course is aimed to create the required skill set for working professionals, students, and academicians for addressing the challenges in rural development using free open-source software (e.g. QGIS). The topics covers basic principles of RS & GIS and subsequently selected applications of geospatial technology in priority areas including; agriculture, water management, soil conservation, disaster management, and monitoring of rural development initiatives.

Pre-requisites: Nil

Industry support: All government agencies/departments related to rural development, water resources, agriculture, soil conservation and disaster management. CSR initiatives of PSUs and the private sector.

Course layout:

Week 1: Introduction to rural development; concepts, issues, and linkages to water and food security

Week 2: Introduction to geospatial technology (RS&GIS) and its importance in rural development

Week 3: Introduction to open-source software for RS& GIS applications

Week 4: Introduction to GIS Part -I (Operations on vector data sets)

Week 5: Introduction to GIS Part -II (Operations on raster data sets)

Week 6: Digital remote sensing image processing Part -I (Georeferencing of map data, cartographic maps, shape file creation)

Week 7: Digital remote sensing image processing Part -II (Digital elevation model, land use land cover change analysis)

Week 8: RS & GIS for rural water resources management – (surface water management, groundwater management)

Week 9: RS & GIS for agriculture and soil management (farm linkages, irrigation, crop management, and mapping of storage infrastructure)

Week 10: RS & GIS application for rural healthcare, education, connectivity, and communication

Week 11: RS & GIS for impact assessment of government rural development schemes

Week 12: Applications and examples of RS & GIS for rural development: Selected case studies

Books and references

Field notes from instructor

Criteria to get a certificate:

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

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

OCCL3013: APPLIED SEISMOLOGY FOR ENGINEERS

B. TECH 5th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - I

Description:

This course OCCL3013 – Applied Seismology for Engineers is offered from SWAYAM as noc24_ce05– Applied Seismology for Engineers

URL: https://onlinecourses.nptel.ac.in/noc24_ce05/preview

Credit and Week:

Teaching Scheme	Week	Marks	Credit
	12	150	4

About the course:

The present course gives an overview followed by in-depth knowledge about various topics which are required particularly for seismic analysis whether related to determination of seismic loading, understanding dominating fault mechanism in the region, understanding slope stability problems, development of synthetic ground motions, seismic hazard analysis, source characterization, ground response analysis etc. It will help reader to gain deep understanding about above subjects and how these are applied to real life problems. Theoretical explanation followed by numerical problems on above mentioned topics will be covered.

Pre-requisites: Nil

Industry support: None

Course layout:

Week 1: Plate tectonics, continental drift theory: Plate tectonics and continental drift theory

Week 2: Fault plane solution, beach ball solution, stereonets: Fault plane solution, Fault plane solution (Stereonets)

Week 3: Seismic gap and analogy for active and inactive faults: Seismic gaps, Analogy of active & inactive fault

Week 4: Seismic waves and their attenuations: Seismic waves and their use in locating EQ epicenter, EQ intensity, magnitude and wave attenuation

Week 5: Seismic source characterization, earthquake catalogue preparation and seismic activity parameters: Seismic source characterization and seismic activity, Earthquake catalogue preparation and seismic activity parameters

Week 6: Ground motion simulation models, GMPEs and seismic hazard analyses: Ground motion simulation models and GMPEs, Deterministic seismic hazard analysis (DSHA), Probabilistic seismic hazard analysis (PSHA)

Week 7: Equation of motion and its solution: One dimensional equation of motion: P wave, One dimensional equation of motion: S wave, Solution to 1D equation of motion: S wave

Week 8: Ground response analysis: Local site effect (LSE) and ground response analysis Part-I, LSE and ground response analysis part-II, ground response analysis part III, Ground response analysis part IV

Week 9: Liquefaction assessments and state criteria: State criteria for liquefaction part 1, State criteria for liquefaction part 2, Initiation of liquefaction, Assessment of liquefaction potential

Week 10: Paleo liquefaction investigations and seismic micro zonation practices: Paleo liquefaction, Seismic micro zonation

Week 11: Landslide, classification: Landslides: introduction and classification

Week 12: Seismic vulnerability, risk: Seismic vulnerability and risk part 1, Seismic vulnerability and risk part 2, Seismic vulnerability and risk part 3

Books and references

1. Quantitative seismology Aki, K. and P G Richards, Second Edition, University Science Books, Sausalito
2. Stein and Wysession, An introduction to seismology, Earthquake and earth structureBlackwell-2003.
3. Shearer, P- Introduction to seismology, Cambridge University Press, 1999.
4. Philip K, Micheal B, Hill I: An introduction to geophysical exploration, Blackwell Publishing.
5. John P McCalpin: Paleoseismology, Elsevier Academic pressBureau of Indian Standards, " HAND BOOK OF FUNCTIONAL REQUIREMENTS OF BUILDINGS, (SP-41 & SP- 32)", BIS 1987 and 1989.

Criteria to get a certificate:

- Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.

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

OCCL3014: WATER SUPPLY ENGINEERING

B. TECH 5th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - I

Description:

This course OCCL3014 – Water Supply Engineering is offered from SWAYAM as noc23_ce37 – Water Supply Engineering

URL: https://onlinecourses.nptel.ac.in/noc23_ce37/preview

Credit and Week:

Teaching Scheme	Week	Marks	Credit
	12	150	4

About the course:

Water supply schemes are a basic necessity of every town/city. With growing concerns over managing urban water demands along with resource sustainability, concept of efficient and smart urban water supply systems is progressively getting more pertinent. Incorporating sustainable design and operation principles based on innovative water technologies such as cost-effective treatment solutions, automated supervisory controls, leakage detection and control etc. into water supply systems improves water supply from sustainable perspectives. This course aims to discuss the technical aspects of modern systems for drinking water treatment and distribution in an integrated way. The course will cover topics from traditional aspects of demand calculations and source selections to the up-to-date treatment methods, network design tools etc. The course will also provide insight to smart water supply systems including automation, leakage detection. The financial sustainability of water supply systems and sustainable water pricing models will also be covered.

Pre-requisites: Nil

Industry support:

Unipro Techno Infrastructure, Envirox Protection Co., Walter P Moore shall recognize/value this course

Course layout:

Week 1: Introduction: General outline of water supply; Water availability and uses; Temporal and spatial distribution; Key issues and concerns; Features and elements of a water distribution systems

Week 2: Water Demand: Concept of water demand; Estimation of water demand; Factors affecting demand; Components of demand; Demand fluctuations; Demand forecasting; Population forecasting methods

Week 3: Water Intake: Intake of water; Types of intake; Intake Structures; Conveyance and intake conduits; Free flow and Pressure flow systems; Pumps and their capacity estimation; Economic diameter of water supply pipes

Week 4: Treatment Philosophy: Storage structures, Reservoir designing, Storage Capacity of Distribution Reservoirs; Mass curve concepts; Design considerations for hourly, daily, weekly and seasonal regulation;

Week 5: Water Quality and Treatment: Water quality assurance; Water quality standards; Philosophy of treatment; Unit operations and unit processes; Theory and operations ofaeration, sedimentation

Week 6: Conventional Water Treatment: Coagulation and flocculation; Clariflocculation; Filtration: Slow and rapid gravity filter, multi-media filters and pressure filters

Week 7: Water Treatment: Disinfection and Advanced Treatment: Disinfection through chlorination and other methods; Advanced methods of water treatment; Advanced oxidation processes; Removal of iron and manganese, hardness, fluorides, colour, taste and odour, dissolved metals and gases.

Week 8: Water Distribution Networks: Water Distribution; Hydraulics of pipe network design; Layouts of Distribution Network; Pipe network analysis; Hardy Cross method

Week 9: Water Losses and Control: Water-losses in water supply systems; Concepts of NRW and UFW; Apparent and real losses; water loss detection methods; water lossesreduction strategies

Week 10: Advanced Water Distribution Design Approaches: Sectorization of distribution networks; DMA Demarcation; Advantages and risks; Software for network design (WaterGEMS and EPANET)

Week 11: Automation in Water Supply: Automation in water supply; Real time monitoring and control; SCADA; Case studies of WTP automation; Automation in distribution systems; Concept of Smart Water Supply System for India cities

Week 12: Water Economics and Pricing: Economics of water supply systems; Calculation of investments and operational costs; Cost optimization; Approaches of water metering; Water pricing for sustainability; Pricing water in context to Indian cities; Issues and approaches; Existing water pricing models; Case studies

Books and references

1. Environmental Engineering (2015) by Peavy, Rowe and Tchobanoglous; Publisher - McGraw-Hill
2. Water Quality Engineering: Physical / Chemical Treatment Processes (2013), by Lawler and Benjamin; Publisher - John Wiley & Sons
3. Water Supply and Pollution Control (2008) by Warren Viessman Jr. and Mark J. Hammer; Publisher: Pearson Education.
4. Unit Operations and Processes in Environmental Engineering (1996) by Reynolds and Richards Publisher - CL Engineering
5. Manual on Water Supply and Treatment (1999); Publisher - CPHEEO (MoUD)

Criteria to get a certificate:

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

B. Tech. (Civil Engineering) Programme

SYLLABI (SEMESTER – 6)

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

CL351: ENVIRONMENTAL ENGINEERING- I

B. TECH 6th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

Teaching Scheme	Theory	Practical	Tutorial	Total	Credit
Hours/week	4	2	1	7	5
Marks	100	50		150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction to Environmental Engineering	02
2	Water Demands and Sources of Water	06
3	Water Conveyance and Distribution Systems	08
4	Quality and Treatment of water	14
5	Sewage: Quality, Collection and estimation of discharge	06
6	Unit operations/ processes for sewage treatment	10
7	Design of sewage treatment units	10
8	Plumbing and House Drainage	04

Total Hours (Theory): 60

Total Hours (Lab): 30

Total Hours: 90

B. Detailed Syllabus:

1	**Introduction to Environmental Engineering**	**02 Hours**	**04%**
1.1	Scope of Environmental Engineering, Environmental Ethics and Role of Environmental Engineer		
1.2	Necessity of planned water supply and Sewerage System		
2	**Water Demands and Sources of Water**	**06 Hours**	**10%**
2.1	Various types of water demands & factors affecting per capitademand, Sources of water, Impurities in water		
2.2	Variations in Demand & Design Periods		

2.3	Population Forecasting Methods, Examples		
3	**Water Conveyance and Distribution Systems**	**08 Hours**	**13%**
3.1	Water Intake Structures-Types and design		
3.2	Types of Conduits, Flow in pipe systems and types of pressure pipes		
3.3	Distribution System-Requirements, layouts and methods		
3.4	Distribution Reservoirs-functions, types and determination ofstorage capacity		
4	**Quality and Treatment of water**	**14 Hours**	**23%**
4.1	Water Quality Parameters and Standards for drinking water		
4.2	Layout of water treatment plant, Design period, and factors considered for selection of design period. Treatment plant site selection, factors considered, selection of treatment train		
4.3	Plain sedimentation, aeration, sedimentation tank & its design, sedimentation with coagulation, types of coagulants, optimum dose of coagulants, mixing devices, design of flocculation unit. theory of filtration, types of filters and their comparison, design of rapid sand filter, washing of filter, methods of disinfection, methods of removing hardness Computation of dose of chemicals for removal of hardness		
5	**Sewage: Quality, Collection and estimation of discharge**	**06 Hours**	**10%**
5.1	Characteristics - physical, chemical, biological		
5.2	Standards for effluent disposal & receiving water body		
5.3	Different types of sewers, sewerage systems, variation in sewage flow, sewer appurtenance, estimation of wastewater discharge in a sewer, separate and combined sewerage systems and design of sewers		
6	**Unit operations/ processes for sewage treatment**	**10 Hours**	**17%**
6.1	Layout plan and section of sewage treatment plant		
6.2	Physical unit operation screening, flow equalization, mixing, flocculation, sedimentation		
6.3	Chemical unit processes: chemical precipitation		

6.4 Biological unit processes: Aerobic attached growth and aerobic suspended growth treatment processes, anaerobic suspended growth treatment processes low cost sanitation systems, septic tanks, soak pit, stabilization ponds

7 Design of sewage treatment units **10Hours** **17%**

7.1 Design of racks, screens, grit chamber, aeration units, primary & secondary clarifiers, activated sludge plant and trickling filter units, rotating biological contactors

7.2 Sludge dewatering units, sludge digesters and drying beds

8 Plumbing and House Drainage **04Hours** **06%**

8.1 Principles of Plumbing and House Drainage, House drainage plan for residential building

8.2 Types of Traps

C. Course Outcomes:

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

CO1 The water quality criteria and standards with their relation to public health and environment.

CO2 Water and sewage characteristics and their relation with treatment process selection.

CO3 To understand the design principles involved in treatment of water and sewage

CO4 To apply appropriate breadth and depth of skills in identification of engineering problems designed with realistic constraints and contribute to sustaining and improving community.

CO5 To improve written communication and design skills by preparing a preliminary design report of water and sewage treatment plant units.

CO6 The fundamentals of plumbing and house drainage system.

Course Articulation Matrix:

	PO1	PO2	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
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-		1
CO3	3	3	3	-	-	-	2	-	-	-	3	-	3	2	1
CO4	-	3	3	2	1	3	3	3	2	-	3	3	3	2	3

CO5	-	-	-	2	1	1	2	2	3	3	-	3	-	-	3
CO6	3	-	-	-	-	-	1	1	-	-	1	-	3	2	1

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

D. Recommended Study Material:

Text Book:

1. Garg, S.K., Environmental Engg. Vol. – I & II, Khanna Publications.
2. Punmia, B.C., Environmental Engg. Vol. - I & II, Laxmi Publications.
3. Peavy, Rowe and Tchobanoglous, Environmental Engg, Tata Mcgraw Hill.

Reference Books:

1. Bhole, A.G., Water Treatment Plant Design, Indian Water Works Association.
2. Dix, H.M., Environmental Pollution, Edward Arnold Publishers Ltd.
3. Mackenzie L. Davis, David, A. Cornwell, Introduction to Environmental Engineering, TataMcgraw Hill Publications.
4. Sanitary Engg. and Sewage Treatment, Manual, Ministry of Works & Housing, New Delhi
5. Chaterjee, A.K., Environmental Engg, Khanna Publishers.
6. Steel, E.W. and McGhee, T.J., Water Supply & Sewerage, McGraw-Hill College.
7. Water Supply and Treatment, Manual, Ministry of Works and Housing, New Delhi.
8. Wastewater Engineering Treatment, Disposal, Refuse: Metcalf and Eddy, Tata McGrawHill Publishers, New Delhi, 1995.
9. Introduction to Environmental Engineering :P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition
10. CPHEEO Manual on Sewage and Treatment

Web Materials:

1. http://nptel.iitm.ac.in
2. http://www.epa.gov
3. .http://www.nesc.vu
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
A	**Analysis of Water and Sewage Samples**
1.	Determination of pH, Turbidity and Conductivity
2.	Determination of Solids
3.	Determination of Acidity and Alkalinity
4.	Determination of Hardness
5.	Determination of Chlorides and Residual Chlorine
6.	Determination of Dissolved Oxygen (DO) and Bio chemical Oxygen Demand (BOD)
7.	Determination of Chemical Oxygen Demand (COD)
8.	Determination of Oil and Grease
9.	Determination of Optimum Coagulant Dose by Jar Test
10.	Determination of Nitrate and Sulphate
11.	Determination of Most Probable Number (MPN)
B.	**Design Problems on Water and Sewage Treatment Plant Units**

CL346: GEOTECHNICAL ENGINEERING-I

B. TECH 6th SEMESTER (CIVIL ENGINEERING)

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	02
2	Origin & Evolution of Soil	03
3	Index Properties & Plasticity Characteristics	07
4	Soil water	06
5	Compaction	08
6	Shear Strength	10
7	Consolidation	09

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1 Introduction **02 Hours** **06%**

1.1 Historical Development of Soil Engineering

1.2 Importance of Soil Engineering

1.3 Major soil deposit in India

2 Origin & Evolution of Soil **03 Hours** **10%**

2.1 Origin and General types of soils

2.2 Geological cycle, physical and chemical agencies for soil

2.3 Soil structure & Clay minerals

3 Index Properties & Plasticity Characteristics **07 Hours** **15%**

3.1 Three phase diagram of soil

3.2	Volumetric relationship and Weight – Volume relationships		
3.3	Determination of different index properties		
3.4	Grain size distribution by sieve analysis, Hydrometer analysis		
3.5	Atterberg's Limits and indices		
3.6	Activity, sensitivity & thixotropy of soil		
3.7	Different classification systems: Textural Classification, AASHTO classification, Unified soil classification, IS classification		
3.8	Field Identification of soil		
4	**Soil water**	**06 Hours**	**14%**
4.1	Types of soil water, capillary phenomena		
4.2	Concept of effective and neutral stresses		
4.3	Permeability of soil, Darcy's law, Factors affecting permeability		
4.4	Seepage velocity, Permeability of Stratified soil		
4.5	Tests for determination of coefficient of permeability in field and laboratory		
4.6	Seepage pressure, quick sand phenomenon and piping		
4.7	Introduction of flow net		
5	**Compaction**	**08 Hours**	**16%**
5.1	Definition and importance, factors affecting compaction, Influence of compaction on soil properties		
5.2	Laboratory compaction test, relative density and its determination		
5.3	Field compaction and its control,		
6	**Shear Strength**	**10 Hours**	**20%**
6.1	Definition, Mohr strength theory, Mohr-coulomb's strength theory		
6.2	Shear test based on drainage condition		
6.3	Factors affecting shear strength of granular and cohesive soil		
6.4	Direct shear test, Triaxial compression test, unconfined compression test, vane shear test		
7	**Consolidation**	**09 Hours**	**19%**
7.1	Compressibility of soil & its type, mechanism of consolidation		
7.2	Assumptions and Terzaghi's one dimensional consolidation theoretical equation		
7.3	One dimensional consolidation test, Co-efficient of consolidation and		

its determination, determination of pre-consolidation pressure

7.4 Consolidation settlement, rate of settlement for uniform pressure increment in a clay layer

7.5 Introduction to secondary compression

C. Course Outcomes (COs):

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

CO1 students will be able to evaluate soil properties by performing various experiments

CO2 students will be able to carry out soil classification

CO3 students will be able to solve practical problems related to permeability, seepage and consolidation settlement,

CO4 Students will be able to relate soil properties to workout theoretical soil strength with confidence.

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	2	-	-	-	-	-	-	-	-	-	1	1	-
CO2	1	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-	1	1	-
CO4	2	2	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 Publicaiton, New Delhi.
2. Punamia, B.C., Soil Mechanics & Foundation Engineering; Laxmi Publication Pvt. Ltd., Delhi.
3. Murthy, V.N.S., Soil Mechanics & Foundation Engineering, Sai Kripa Technical Consultants, Bangalore.
4. Shroff, A. V., Shah D. L., Soil Mechanics & Geotechnical Engineering, Oxford & IBH, Delhi.

Reference Books:

1. Singh Alam, Soil Engineering, Agion Publishers, Jodhpur.
2. Purshottam Raj, Geotechnical Engineering, Tata McGraw Hill Publication.
3. Purushothama, P. Raj, Soil Mechanics and Foundation Engineering, Pearson Education.

4. Singh, Alam, Soil Mechanics & Foundation Engineering, CBS Publishers & Distributors, New Delhi.
5. Taylor, D.W., Fundamentals of Soil Mechanics, Asia Publishing House, Mumbai.
6. Ranjan Gopal and Rao, A.S.R., Basic and Applied Soil Mechanics, New Age International Pvt. Ltd.
7. Braja Das, M., Principles of Geotechnical Engineering, Thomson Asia Pvt. Ltd.

Web Materials:

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

LIST OF EXPERIMENTS

Experiment No.	Name of Experiment
1	Moisture Content by Oven-drying Method
2	Specific Gravity by Pycnometer Method
3	Sieve Analysis
4	Hydrometer Analysis
5	Liquid Limit & Plastic Limit Tests
6	Shrinkage Limit Test
7	In Situ Density by Core Cutter Method
8	In Situ Density by Sand Replacement Method
9	Direct Shear Test

CL352: WATER RESOURCES ENGINEERING - I

B. TECH 6TH SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

Teaching Scheme	Theory	Practical	Tutorial	Total	Credit
Hours/week	4	2	1	7	5
Marks	100	50		150	

A. Outline of the course:

Sr. No.	Title of the unit	Minimum number of hours
1	Introduction to Water Resources Engineering	01
2	Surface water Hydrology	12
3	Groundwater Hydrology	08
4	Irrigation & Crop Water Requirement	03
5.	Dams	12
6.	Reservoir	04
7.	Diversion Head Works	06
8.	Spillways & Energy Dissipators	05
9.	Canal Irrigation System	09

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

B. Detailed Syllabus:

1	**Introduction to Water Resources Engineering**	**01 Hours**	**2%**
1.1	Need of water resources projects		
1.2	Hydrologic cycle - scope and application, Hydrologic Equation (Water Balance Equation)		
2	**Surface water Hydrology**	**12Hours**	**20%**
2.1	Precipitation: Types, forms, measurement, estimation of missing data, mean rainfall computation		

2.2	Evaporation: Process, factors affecting, measurement of evaporation		
2.3	Evapotranspiration: Transpiration, evapotranspiration, factors affecting, measurement of evapotranspiration		
2.4	Infiltration: Process, infiltration rate, infiltration capacity, infiltration indices, measurement - infiltrometers		
2.5	Runoff: Types, factors affecting, estimating volume of runoff (yield) – rainfall runoff correlation		
2.6	Hydrograph: Components, unit hydrograph, S-Hydrograph, computation of flood		
3	**Groundwater Hydrology**	**08 Hours**	**13%**
3.1	Occurrence and movement of groundwater, Darcy's law, Types of aquifers, Aquifer properties		
3.2	Hydraulics of wells under steady & introduction to unsteady condition in confined and unconfined aquifers yield of wells, pumping and recuperation tests4		
3.3	Needs of ground water recharge, ground water recharge methods, Rain water harvesting		
3.4	Occurrence and causes of saline water intrusion, Ghyben-Herzberg Relation, Upconing of saline water, Control of saline water intrusion		
4	**Irrigation & Crop Water Requirement:**	**03 Hours**	**5%**
4.1	Irrigation: Definition, merits, demerits		
4.2	Irrigation methods: Detailed classification		
4.3	Duty of water and delta, factors affecting on duty and delta, relation between duty-delta & examples		
4.4	Irrigation efficiencies and calculation of efficiencies		
5	**Dams**	**12 Hours**	**20%**
5.1	Definition, classification, factors affecting selection of type of dam, Selection & investigation of site for a dam		
5.2	Earth dams: Types, foundation requirements, causes of failure, design criteria, suitable preliminary sections, seepage line determination & analysis, stability analysis - side slope, foundation, checking of stability, seepage control measures		
5.3	Rockfill dams: Foundation requirements, typical sections, design		

	consideration for a rockfill dam		
5.4	Gravity dam: Definition, forces acting on dams, load combination for design, modes of failure & criteria for structural stability, stability analysis, elementary & practical profile, design of gravity dam, openings in dams		
6	**Reservoir**	**04 Hours**	**7%**
6.1	Definition, types, Storage zones		
6.2	Capacity-elevation and area elevation curves of a reservoir site		
6.3	Reservoir capacity: Catchment yield and reservoir yield, fixing the reservoir capacity for the computed value of the dependable yield of the reservoir catchment, relation between the inflow, outflow and storage data for a reservoir, fixing the reservoir capacity from the annual inflow and outflow data, mass curve and demand curve		
6.4	Reservoir losses, Reservoir sedimentation and control		
7	**Diversion Head Works**	**06 Hours**	**10%**
7.1	Types & components of diversion head works		
7.2	Location & typical layout of diversion headworks		
7.3	Difference between dam, weir and barrage, Types of weirs		
7.4	Criteria for designing weir and barrage		
7.5	Theories of subsurface flow: Bligh's creep theory, Lane's weighted creep theory, theory of seepage flow (critical gradient), Khosla's theory		
8	**Spillways & Energy Dissipators**	**05 Hours**	**8%**
8.1	Spillways: Definition, location, essential requirements, components, classification		
8.2	Energy Dissipators: Formation & types of hydraulic jump; Jump Height Curve (JHC), Tail Water Rating Curve (TWRC) and alternatives of JHC & TWRC, types of energy dissipators		
9	**Canal Irrigation System**	**09 Hours**	**15%**
9.1	Classification of canals, alignment		
9.2	Distribution system		
9.3	Cross section and longitudinal sections of canals		
9.4	Design of unlined canal in alluvial & non-alluvial soils		

9.5 Design of channel using Kennedy's Garrat's diagram & Lacey's regime diagram, Canal lining

9.6 Cross Drainage Works: Definition, types, selection criteria

9.7 Outlets: Definition, requirements, types

9.8 Falls: Definition, necessity, location, types

9.9 HR & CR: Definition, functions

9.10 Escapes: Definition, necessity, types

C. Course Outcomes:

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

CO1 Understand Concepts of different hydraulic structures

CO2 Plan and design irrigation projects.

CO3 Design channels and other irrigation structures required for irrigation, drainage, soil etc.

CO4 Estimate the quantity of water required by crops.

CO5 Understand types of irrigation systems and different hydraulic structures

CO6 Develop Conservation, flood control and other water-management projects.

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

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. Karanth, K.R., Ground Water Assessment Development and Management, Tata
6. McGraw Hill, New Delhi.
7. Patel, A.S. and Shah, D.L., Water Management – Conservation, Harvesting & Artificial
8. Recharge, New Age International Publishers.
9. Punmia and Pando, Lal, B.B., Irrigation and Water Engineering, Standard Publishers Distributors, New Delhi.
10. Michael, A.M., Irrigation - Theory and Practice, Vikas Publishing House, New Delhi.
11. Arora, K.R. Irrigation, Water Power and Water Resources Engineering, Standard Publishers Distributors, New Delhi.

Web Materials:

1. http://nptel.iitm.ac.in
2. http://www.groundwatermanagement.org/module2_000.pps
3. http://www.uiowa.edu/~c012003a/14.%20Groundwater.pdf
4. http://www.authorstream.com/presentation/brod-17752-lect-18-groundwater-
5. http://www.ngwa.org/public/gwbasics/index.aspx

Credits and Hours:

Teaching Scheme	Theory	Practical	Tutorial	Total	Credit
Hours/week	4	2	1	7	5
Marks	100	50	0	150	

A. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction	04
2	Traffic Engineering	10
3	Highway Geometric Design	10
4	Highway Materials and Construction	09
5	Highway Pavement Design	13
6	Highway Drainage, Maintenance, Economics and Arboriculture	10
7	Overlay Design and Construction	04

Total Hours (Theory): 60

Total Hours (Lab): 30

Total Hours: 90

B. Detailed Syllabus:

1 Introduction **04 Hours 06%**

1.1 Role and modes of Transportation, Scope of Transportation Engineering

1.2 Highway Planning and Development in India

1.3 Classification of Roads, Highway Alignment and Surveys: Introduction, Ideal Requirement of Alignment, Factors controlling Alignment, Engineering Surveys, Drawing and Reports, Highway Project

2	**Traffic Engineering**	**10 Hours**	**18%**
2.1	Introduction to Traffic Engineering		
2.2	Traffic Surveys: Traffic Volume Studies, Speed Studies, Traffic Density & Capacity, Relations between traffic parameters, Level of service, Passenger car unit, Parking studies, Accident Studies		
2.3	Traffic Operations: Traffic Regulations, Traffic Control Devices (Signs, Signals and Markings) with its design		
2.4	Highway Intersection: At grade & Grade separated intersections, Rotary intersection, IRC Recommendations , Highway Lightning		
3	**Highway Geometric Design**	**10 Hours**	**16%**
3.1	Introduction		
3.2	Highway Cross-section Elements		
3.3	Sight Distance		
3.4	Design of Horizontal Alignment		
3.5	Design of Vertical Alignment		
4	**Highway Materials and Construction**	**04 Hours**	**14%**
4.1	Introduction		
4.2	Aggregates and Test on Aggregates		
4.3	Bitumen and Test on Bitumen		
4.4	Test on Soil: CBR Test		
4.5	Bituminous Materials: conventional and modified binders, production, types and grade , physical and chemical properties and uses Modified bitumen: Crumb Rubber Modified bitumen, Natural rubber modified bitumen, polymer modified bitumen Introduction to emulsified bitumen and its characterization; Long term and short term ageing and its effect on bitumen performance		
4.6	Bituminous Mix design ,Desirable properties of bituminous mixes, Modified Marshall"s specifications, Introduction to super pave mix design procedure		
4.7	Highway Construction: Construction of Earth Roads, Gravel Roads, Water Bound Macadam Roads, Bituminous Pavement and Cement		

	Concrete Pavement		
5	**Highway Pavement Design**	**13 Hours**	**22%**
5.1	Introduction		
5.2	Types of Highway Pavement: Flexible pavement & rigid pavement, their components & its functions.		
5.3	Design Factors		
5.4	Design of Flexible Pavement: CBR Method, IRC Guidelines		
5.5	Design of Rigid Pavement: IRC method, Westergaard theory, loads & temperature stresses.		
6	**Highway Drainage, Maintenance, Economics and Arboriculture**	**10 Hours**	**16%**
6.1	Highway Drainage: Introduction, Importance of Highway Drainage, Surface Drainage, Sub-surface Drainage, Drainage of slopes and erosion controls		
6.2	Highway Maintenance: Pavement Failures, Maintenance Techniques, Strengthening of existing pavements.		
6.3	Highway Economics and Finance: Introduction, Methods of Economic Evaluation of highway projects: Annual cost method, Rate of return method & benefit- cost ratio method, Highway Project administration and Finance: Public Private Partnership		
6.4	Highway Arboriculture: Environmental Factors affecting highway planning, Road Side Development, Planning Plantation of trees, Species and their selection, Care of trees		
7	**Overlay Design and Construction**	**04 Hours**	**08%**
7.1	Need, Types, Overlay design methods for flexible pavements by conventional design method, Benkelman beam method, Falling Weight Deflection Method, I.R.C. Guidelines &Asphalt Institute Method.		
7.2	Overlay Design Methods for Rigid Pavements, Flexible overlays over rigid slabs		

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	To design highway pavement geometrics
CO2	To understand the procedure to collect the traffic data for design and the need of traffic management
CO3	Test the highway material as per IS recommendations
CO4	Carryout preliminary design of flexible and rigid pavement as per IRC
CO5	To understand the concept for providing highway drainage, maintenance and arboriculture.

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	PS O1	PS O2	PS O3
CO1	3	1	2	2	2	1	-	-	2	1	-	-	2	1	1
CO2	2	1	1	3	2	1	-	-	2	2	1	-	2	1	2
CO3	1	-	-	3	1	1	1	1	2	2	-	-	1	1	1
CO 4	3	1	1	3	2	-	1	1	2	1	-	1	2	1	3
CO5	-	-	1	1	-	1	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.

Reference Books:

1. Sharma, S.K., Principles, Practice and Design of Highway Engineering, S. Chand & Co., New Delhi.

Web Materials:

1. http://www.cdeep.iitb.ac.in/nptel/Civil%20Engineering/Transportation%20Engg%20I/TOC.htm

Other Materials:

1. IRC – 37 "Guidelines for Design of flexible Pavements", IRC, New Delhi, 2001.
2. IRC – 67 "Code of Practice for Road Signs", IRC, New Delhi – 2001.
3. IRC: 58, 2002: "Guidelines for the Design of Plain Jointed Rigid Pavements for Highways", IRC, N. Delhi, December, 2002.
4. IRC:70, 1977: "Guidelines on Regulation and Control of Mixed Traffic in Urban Areas"
5. IRC:106, 1990: "Guidelines for Capacity of Urban Roads in Plain Areas"
6. IRC SP 30: "Manual of Economic Evaluation of Highway Projects in India", IRC, New Delhi, 2009.
7. IRC SP 41: "Guidelines for the Design of At-Grade Intersections in Rural and Urban Areas", IRC, New Delhi, 1994.
8. Khanna S. K. & Justo C. E. G., "Highway Material Testing (Laboratory Manual), Nem Chand & Bros, Roorkee
9. IRC 81: Guidelines for strengthing of flexible Road Pavement using Benkleman Beam Deflection Technique.

LIST OF EXPERIMENTS

Experiment No.	Name of Experiment
Test on Subgrade Soil	
1	California Bearing Ratio Test
Tests on Aggregates	
2	Aggregate Crushing Test
3	Aggregate Impact Test
4	Los Angeles Abrasion Test
5	Shape Tests
6	Specific Gravity & Water Absorption Test

Tests on Bitumen	
7	Penetration Test
8	Ductility Test
9	Flash & Fire Point Test
10	Softening Point Test
11	Specific Gravity Test
12	Viscosity Test

HS132.02 A: CONTRIBUTORY PERSONALITY DEVELOPMENT

B.TECH 6th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

Teaching Scheme	Theory	Practical	Tutorial	Total	Credit
Hours/week	--	30/15	--	30/15	02
Marks	--	100	--	100	

Pre-requisite courses:

- Communication and Soft Skills

A. Outline of the Course:

Sr. No.	Title of the unit	Minimum number of hours
1.	Concept of Personality	06
2.	Soft Skills and Personality Development	08
3.	Developing Contributory Personality	06
4.	Life skills and Personality Development	06
5.	Contemporary Issues in CPD	04
	Total hours (Theory) :	--
	Total hours (Practical) :	30
	Total hours :	30

B. Detailed Syllabus:

1. Concept of Personality **06 Hours** **20%**

1.1 Meaning of Personality, Types of Personality, Factors contributing to Personality, Personality Traits, Personality Profiling

2. Soft Skills and Personality Development **08 Hours** **26%**

2.1 Positive Thinking and Mind Set, Leadership, Assertiveness and Negotiation Skills, Self-Management, Interpersonal Skills, Being a Team Player

3.	**Developing Contributory Personality**	**06 Hours**	**20%**
3.1	Concept of Contributory Personality, Characteristics of a Contributor, The Contributor's Vision of Success & Career, The Scope of Contribution in a field, Embarking on the Journey to Contributor ship, Developing Contributor Personality, Reviewing Some Contributors Personalities		
4.	**Life skills and Personality Development**	**06 Hours**	**20%**
4.1	Concept of life skills, Self-awareness, Empathy, Decision Making, Problem Solving		
5.	**Contemporary Issues in CPD**	**04 Hours**	**14%**
5.1	Contemporary Trends and Practices in Contributory Personality Development, Case Study & Presentations		

C. Course Outcome (COs):

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

CO1 Identify one's individual personality strengths and challenges.

CO2 Develop more assertive and optimist attitude towards work and life.

CO3 Develop quintessential soft skills to groom one's personality.

CO4 Identify traits of contributor personality.

CO5 Contribute to self, society, nation, and globe.

CO6 Develop skills of global citizenship to perform societal responsibilities.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CO3	-	-	-	-	-	1	-	-	3	1	2	1	1	-
CO4	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO5	-	-	2	-	-	2	2	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	2	2	-	-	-	-	-	3

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

D. Recommended Study Material:

Text book:

1. Personality Development & Soft Skills, Oxford University Press
2. Soft Skills, Bookboon
3. Personality Development, Swami Vivekananda; Advaita Ashrama

Reference book:

1. Contributor Personality Program Workbook (Volume 1,2),
2. Contributor Personality Program ActivGuide, Illumine Knowledge Pvt. Ltd

Web material:

1. https://www.coursera.org/learn/wharton-succcess
2. https://www.coursera.org/learn/personality-types-at-work
3. https://www.coursera.org/learn/self-awareness

CL376: BUILDING REPAIR AND REHABILITATION

B. TECH 6th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - II

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	Maintenance of Building	04
2	Deterioration and Durability Aspects	10
3	Conditional/damage assessment & Evaluation of structures	08
4	Materials and Techniques for Repair	08
5	Rehabilitation and Retrofitting Methods	10
6	Demolition and Dismantling Techniques	05

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1 Maintenance of Building **04 Hours** **09%**

1.1 Introduction

1.2 Objectives

1.3 Phases of Maintenance

1.4 Common Defects In Buildings And Measures To Prevent And Control The Same

1.5 Building Failures- Causes And Effects

1.6 Cracks In Buildings

2	**Deterioration and Durability Aspects**	**10 Hours**	**22%**
2.1	**Deterioration:** Types of deterioration – Signs, causes & symptoms, Mechanism of deterioration, contributing factors like permeability, inadequate durability & micro-structure of concrete		
2.2	Physical deterioration due to moisture, temperature, shrinkage, freeze-thaw, abrasion, erosion, cavitation, crystallization of salts, Efflorescence, exposure to severe environment like marine exposure		
2.3	Chemical deterioration due to corrosion of reinforcement (chloride induced, carbonation induced), Alkali-silica reaction, sulphate attack, Acid attack		
2.4	Deterioration due to water leakage, fire – detection & mitigation of the same. Deterioration due to ageing, inadequate maintenance, Design & construction deficiencies, overloading etc.		
2.5	Visual deterioration of structures- Types of cracks, causes & characteristics of cracking in various structural components like beam, column, slab, masonry walls. Measurement of cracks, interpretation of the cause of particular type of crack		
2.6	**Durability:** Life Expectancy of Different Types of Buildings – Influence of Environmental Elements Such as Heat, Moisture, Precipitation and Frost on Buildings- Design and Construction Errors, Corrosion Mechanism		
2.7	Effect of Biological Agents like fungus, moss, plants, trees, algae, - Termite Control and Prevention		
2.8	Chemical Attack on Building Materials and Components		
2.9	Aspects of Fire and Fire Prevention on Buildings		
2.10	Impact of Pollution on Buildings		
3	**Conditional/damage assessment & Evaluation**	**08 Hours**	**18%**
3.1	Conditional evaluation – Importance, objective & stages, Conditional/damage assessment procedure, Preliminary & Detailed investigation – Scope, Objectives, Methodology & Rapid visual inspection of structures		

3.2	Damage Assessment allied Tests (Destructive, Semi-destructive, Non-destructive)		
3.3	Non-destructive Evaluation Tests - Concrete Strength Assessment Chemical Tests, Fire Damage Assessment, Structural Integrity/Soundness Assessment		
3.4	Interpretation & Evaluation of Test Result Data		
4	**Materials and Techniques for Repair**	**08 Hours**	**18%**
4.1	Essential Parameters for Repair Materials		
4.2	Materials for Repair		
	4.2.1 Premixed cement concrete/mortars		
	4.2.2 Polymer Modified Mortars and Concrete (PMM/PMC)		
	4.2.3 Epoxies and Epoxy Mortars/Concretes		
	4.2.4 Polyester Resins		
	4.2.5 Sulphur infiltrated concrete		
	4.2.6 Ferro cement		
	4.2.7 Fibre reinforced concrete		
	4.2.8 Foamed concrete		
	4.2.9 Dry pack		
	4.2.10 Vacuum concrete		
	4.2.11 Surface Coatings		
4.3	Gunniting, Grouting, Shotcrete and Epoxy injection		
5	**Rehabilitation and Retrofitting Methods**	**10 Hours**	**22%**
5.1	Important factors to be considered for selection of repair methods.		
5.2	Repair Stages		
5.3	Repair Methods		
5.4	Repair of stone, brick and block masonry (Cracks, dampness, efflorescence, joint separation, etc.), Flooring, Roofs (sloping, flat, pitched, etc.)		
5.5	Repair of Concrete members due to (i) Steel Corrosion (ii) Lack of Bond (iii) shear, tension, torsion, compression failure		
5.6	Repair of leakage due to rain water		

5.7 Strengthening of Earthquake Damage Buildings

6 Demolition and Dismantling techniques 05 Hours 11%

6.1 Engineered demolition techniques for Dilapidated structures

6.2 Safety measures during demolition operation

6.3 Dismantling of buildings and reuse of materials/fittings from environmental and financial point of view

6.4 Case studies

C. Course Outcomes (COs):

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

CO1 Understand the types of requirement of maintenance in building and able to assess the quality aspects of existing building.

CO2 Identify and define concepts associated with deterioration of concrete structures, damage assessment or inspection of a building showing signs of deterioration and should be able to detect the possible cause/source of deterioration with appropriate techniques.

CO3 Develop a knowledge of the concrete repair process with variety of repair materials and techniques. Understand and apply rehabilitation and retrofitting processes.

CO4 Gain knowledge regarding dismantle and demolish structures which cannot be repaired in an environment friendly, with maximum saving of materials and in a safe way.

Course Articulation Matrix:

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
CO3	-	-	-	2	-	-	-	-	-	-	-	-	1	-	1
CO4	-	-	-	-	-	-	1	-	-	-	-	-	1	-	1

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

D. Recommended Study Material:

Text Books:

1. P.C.Varghese , Maintenance, Repair & Rehabilitation and Minor Works of Buildings, PHI learning.

2. R.T.Allen and S.C.Edwards, " Repair of Concrete Structures ", Blakie and Sons, UK, 1987.
3. A.R. Santhakumar,, “Concrete Technology”, 2012 Oxford University Press ,2006.
4. V. M. Malhotra, Nicholas J. Carino 2004 “Handbook on Nondestructive Testing of Concrete”.
5. Handbook on Repairs and Rehabilitation of RCC buildings – CPWD, Government of India.
6. R.Dodge Woodson., Concrete Structures: Protection, Repair and Rehabilitation, Elsevier, 2009.
7. Xilin Lu ,”Retrofitting Design of Building Structures”,Science Press,2010.
8. Structural Condition assessment by Robert T. Ratay.
9. IS 13935 : 2009, Seismic Evaluation, Repair And Strengthening of Masonry Buildings — Guidelines

Reference Books:

1. A.C. Panchdhari, “Maintenance of Buildings”, New Age International.
2. Santhakumar, A.R., Training Course notes on Damage Assessment and repairs in Low Cost Housing, “RHDC – NBO” Anna University, July 1992.
3. Concrete Technology by M.L.Gambhir, Tata McGraw-Hill Education.
4. R.T.Allen and S.C.Edwards, Repair of Concrete structures, Blakie and Sons, UK, 1987
5. M.S.Shetty, Concrete Technology – Theory and Practice, S.Chand and Company, New Delhi, 1992.
6. Concrete Structures, Protection, Repair and Rehabilitation by R.Dodge Woodson.
7. Repairs and rehabilitation of concrete structures by P. I. Modi & C. N. Patel, PHI Publication.

Web Materials:

1. cpwd.gov.in/Units/handbook.pdf
2. www.bis.org.in/sf/nbc.htm
3. http://www.civilengineeringnews.tk/2014/07/methods%20-of-demolition-of-%20building.html
4. http://www.indianconcreteinstitute.org/repair-and-rehabilitation.html

TERM WORK

1) Study of rehabilitation/retrofitting of RCC/Masonry buildings covering (a) damage assessment by visual inspection and using various techniques including NDT (b) one/two alternatives for rehabilitation/retrofitting (considering strength criteria & serviceability criteria).
2) Case study of construction and design failures.
3) Market survey for material for repairs.
4) Case study of repairing/rehabilitation structures and retrofitting of EQ damage/deficit structure.
5) Presentations / finding engineering applications /preparation of learning material based on the syllabus.

CL377: ADVANCED SURVEY

B. TECH 6th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - II

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	Tacheometric Surveying	09
2	Geodetic Surveying	07
3	Trigonometric Levelling	07
4	Theory of Errors	06
5	Field Astronomy	04
6	Aerial photogrammetry	06
7	Total Station and GPS	06

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1 Tacheometric Surveying : 09 Hours 19%

1.1 Introduction

1.2 Tacheometric Systems – Tangential, Stadia and substense methods

1.3 Stadia systems – horizontal and inclined sights – vertical and normal staff – fixed and movable hair – stadia constants

1.4 Field work in tacheometry, anallatic lens – subtense bar – Self reducing tacheometers

1.5 Errors and precisions

2 Geodetic Surveying 07 Hours 15%

2.1 Principle and Classification of triangulation system

2.2	Selection of base line and stations		
2.3	Orders of triangulation		
2.4	Triangulation figures- Horizontal and vertical control		
2.5	Station marks and signals- marking signals		
2.6	Extension of base, Reduction of Centre, Selection and marking of stations		
3	**Trigonometric Levelling**	**07 Hours**	**15%**
3.1	Introduction		
3.2	Methods of trigonometric levelling: Base of object accessible, base of object inaccessible – same vertical plane, base of object inaccessible – not in same vertical plane		
3.3	Determination of height of elevated object above ground when its base & top are visible but not accessible		
4	**Theory of Errors**	**06 Hours**	**13%**
4.1	Introduction		
4.2	Types and sources of errors & definitions		
4.3	Laws of accidental errors, laws of weights, theory of least squares		
4.4	Rules for giving weights and distribution of errors to the field observations		
5	**Field Astronomy**	**04 Hours**	**10%**
5.1	Introduction & purposes, astronomical terms		
5.2	Determination of azimuth, latitude, longitude and time corrections to the observations		
6	**Aerial photogrammetry**	**06 Hours**	**14%**
6.1	Photogrammetric terms, Applications, Type of photographs, floating marks		
6.2	Scale of a vertical and oblique photographs, heights and tilt distortions		
6.3	Flight planning, Stereoscopy, base lining		
6.4	Developments in photogrammetry, Photomaps and mosaics		
6.5	Photographic interpretations, Parallax bar		
7	**Total Station and GPS**	**06 Hours**	**14%**
7.1	Digital theodolite, Electronic Distance Measurement, Total		

Station: Introduction, principle and uses

7.2 Remote sensing: Principle of Remote sensing, EMR, types, resolutions, types of satellites, type of sensors, visual and digital image processing and its applications

7.3 Global Positioning System: Definition, Principles of GPS and applications.

7.4 Introduction and principle of GIS, Applications of GIS in Civil Engineering

C. Course Outcomes (COs):

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

CO1 Conduct tacheometry and geodetic survey.

CO2 Apply principles of theory of errors for correction of measurements.

CO3 Apply knowledge of astronomy for solving civil engineering problems.

CO4 Explain use of aerial camera, aerial photographs and procedure of aerial survey.

CO5 Utilize stereoscope and parallax bars, total station and other modern survey instruments.

CO6 Apply GIS in solving engineering problems.

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

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

D. Recommended Study Material:

Text Books:

1. Duggal, S. K., Surveying Vol. I & II, Tata McGraw Hill Publication, New Delhi.
2. Subramanian, R., Surveying &Levelling, Oxford University Press, New Delhi.

Reference Books:

1. Surveying Vol. I, II and III by Dr. B.C. Punamia, Laxmi Publishers. New Delhi
2. Surveying and Levelling Vol. I and II by T.P. Kanetkar and S.V. Kulkarni, Pune Vidhyarthi Gruh
3. Surveying Vol. I, II and III by Dr. K.R. Arora, Standard Book House. New Delhi
4. Surveying Vol. I and II by S. K. Duggal, Tata Mcgraw Hill, New Delhi
5. Surveying and Levelling by N.N. Basak, Tata Mcgraw Hill, New Delhi
6. Surveying and Levelling by R. Agor, Khanna Publishers, New Delhi
7. Advanced Surveying by R. Agor, Khanna Publishers, New Delhi
8. Fundamentals of Surveying by Roy, S.K., Prentice Hall India, New Delhi
9. Surveying and Leveling by Subramanian, R., Oxford University Press, New Delhi
10. Remote Sensing and GIS by B Bhatia, Oxford University Press, New Delhi.
11. Remote sensing and Image interpretation by T.M. Lillesand,. R.W. Kiefer,. and J.W. Chipman, 5th edition, John Wiley and Sons India
12. Surveying theory and practice 7th Edition by James M Anderson and Adward M. Mikhail Tata McGraw Hill Publication.
13. Gopi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson Education India, 2007.

Web Materials:

1. http://nptel.iitm.ac.in/courses/Webcourse-contents/IITROORKEE/SURVEYING/home.htm
2. http://nptel.iitm.ac.in/video.php?subjectId=105104101
3. http://en.wikipedia.org/wiki/Geographic_information_system
4. http://www.naicc.org/meeting/2009/GPSRemoteSensing.pdf

LIST OF EXPERIMENTS

Experiment No.	Name of Experiment
1	Introduction to Tacheometry
2	Determination of multiplying and additive constants of a Tacheometer
3	Use of (i) Tacheometer, (ii) Total Station for determination of Reduced levels and Horizontal distances of various points in the field
4	Project: Tacheometric Survey Project
5	Use of different Softwares for surveying
6	Extension of Baseline using Theodolite
7	Remote Sensing
8	Applications of GIS Software's
9	Total Station Surveying – Measurements of Distances and angles, Slope distances, Height, Traversing.
10	Use of Stereoscope for 3-D Viewing, Height determination from a Stereo pair using the Parallax bar

CL378: STRUCTURAL ANALYSIS-III

B TECH 6th SEMESTER (CIVIL ENGINEERING)

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	Beams Curved in Plan	06
2	Cable and Suspension Bridge	04
3	Plastic Theory of Structures	08
4	Column Analogy	06
5	Approximate analysis of Indeterminate Structures	06
6	Matrix Method of Structural Analysis – System Approach	15

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

B. Detailed Syllabus:

1 Beams Curved in Plan **06 Hours** **13 %**

1.1 Uses of curved beam

1.2 Types of internal forces

1.3 Analysis of curved beam fixed at ends for point load, uniformly distributed load

1.4 Analysis of closed circular beam supported symmetrically

2 Cable and Suspension Bridge **04 Hours** **09%**

2.1 Introduction: Cables and cable bridge

2.2 General cable theorem

2.3 Cable under uniformly distributed loads

2.4 Suspension bridge

2.5 Suspension bridge with three-hinged stiffening girder

3	**Plastic Theory of Structures**	**08 Hours**	**18%**
3.1	Concept, assumptions, upper and lower bound theorems		
3.2	Shape factor for different cross sections		
3.3	Collapse load, load factor, plastic modulus of section, plastic moment of resistance		
3.4	Computation of collapse load for fixed beam, continuous beam and plane frame subjected to various load cases		
4	**Column Analogy**	**06 Hours**	**13%**
4.1	introduction		
4.2	Sign convention		
4.3	Analysis of fixed beam and propped cantilever beam		
4.4	Stiffness and carry-over factors for non-prismatic members		
5	**Approximate analysis of Indeterminate Structures**	**06 Hours**	**13%**
5.1	Introduction		
5.2	Portal method		
5.3	Cantilever method		
5.4	Substitute Frame Method		
6	**Matrix Method of Structural Analysis – System Approach**	**15 Hours**	**34 %**
6.1	Introduction to flexibility and stiffness method		
6.2	Flexibility and stiffness coefficient		
6.3	Application of flexibility and stiffness method system approach to analysis of beams, plane frame and plane truss		

C. Course Outcomes:

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

CO1 Recognize the importance of structural analysis and the tools available to determine the response of a structural system to external loads.

CO2 Identify and formulate an engineering problem and to develop a solution.

CO3 Recognize the need for technical updating on a continuing basis, since the course emphasizes on the changing nature of software.

CO4 Use various approximate methods for analysis of indeterminate structures

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

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

A. Recommended Study Material:

Text Books:

1. Junarkar, S.B. & Shah, H.J., Mechanics of Structures Vol-I & II, Charotar Publishing House
2. Negi, L.S. and Jangid, R.S., Structural Analysis, Tata McGraw Hill
3. Vazirani, V.N. and Ratwani, N.M., Analysis of Structures, Khanna Publishers
4. Weaver William and Gere James, Matrix Analysis of Framed Structures, CBS Publishers
5. R.S. Khurmi and N. Khurmi, Theory of structures, S. Chand

Reference Books:

1. Gere & Timoshenko, Mechanics of Materials, CBS Publishers & Distributors, Delhi
2. Hibbler, R.C., Structural Analysis, Pearson Education
3. Wang, C.K., Intermediate Structural Analysis, Tata McGraw Hill
4. Reddy, C.S., Basic Structural Analysis, Tata McGraw Hill
5. Jangid, R.S., Structural Analysis, Tata McGraw Hill
6. Devdas Menon., Structural Analysis, Alpha Science
7. William M.C. McKenzie, Examples in Structural Analysis, Second Edition, CRC Press

Web Materials:

1. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Structural%20Analysis/New_index1.html
2. http://www.nptelvideos.in/2012/11/structural-analysis-ii.html

3. http://nptel.ac.in/courses/105106050/2
4. http://nptel.iitg.ernet.in/Civil_Eng/IIT%20Delhi/Structural%20Analysis%201%20(Video).htm
5. http://freevideolectures.com/Subject/Civil-Engineering
6. http://freevideolectures.com/Course/3015/Advanced-Structural-Analysis

LIST OF EXPERIMENTS

Experiment No.	Name of Experiment
1	Simple suspension bridge
2	Plastic bending of beams
3	Plastic bending of portals
4	Redundant truss
5	Beam Apparatus

CL379: TOWN & URBAN PLANNING

B TECH 6th SEMESTER (CIVIL ENGINEERING)

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 Town Planning	06
2	Ancient System of Town Planning	04
3	Surveys	04
4	Zoning	05
5	Housing and Slums	08
6	Development Plan	05
7	Planning Concepts	08
8	Planned Cities of India	05

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

B. Detailed Syllabus:

1 Introduction to Town Planning 06 Hours 13%

1.1 Objects & importance of town planning

1.2 Principles of town planning

1.3 Origin of Towns

1.4 Growth of Towns

1.5 Stages in Town Development

1.6 Distribution of land uses

1.7 Forms of planning

2	**Ancient System of Town Planning**	04 Hours	9%
2.1	Town Planning in Ancient India		
2.2	Planning thought behind Fatehpur Sikri, Shahjahanabad, Jaipur and Delhi		
2.3	Indus Valley Civilization		
3	**Surveys**	04 Hours	9%
3.1	Necessity of surveys		
3.2	Collection of Data and Methods Adopted to Collect Data		
3.3	Types and Uses		
4	**Zoning**	05 Hours	11%
4.1	Objects and Principles of Zoning		
4.2	Advantages and Importance of Zoning		
4.3	Aspects of Zoning, Transition Zone		
4.4	Maps for Zoning		
5	**Housing and Slums**	08 Hours	18%
5.1	Importance of housing, its demand		
5.2	Requirements of residential buildings		
5.3	Design of residential areas		
5.4	Low cost housing, Laurie Baker's work and ideology		
5.5	Slums – Causes, Characteristics, Effects		
5.6	Slum clearance, Works of Improvement, Re-housing		
5.7	Prevention of slum formation		
6	**Development Plan**	05 Hours	11%
6.1	Objects and Necessity of development plan		
6.2	Stages of preparation of development plan, Data to be collected		
6.3	Features of Development Plan		
7	**Planning Concepts**	08 Hours	18%
7.1	Land use planning, Neighbourhood planning		
7.2	Protective strips, green belt		
7.3	Radburn Layout		
7.4	Urban Roads – Requirements, Classification, Types of Street Systems, Ring Roads		
7.5	Geddesian Triad, Ekistics		

8	**Planned Cities of India**	05 Hours	11%
8.1	Chandigarh, Contribution of Le Corbusier to Town Planning		
8.2	Gandhinagar		

C. Course Outcomes:

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

CO1	Have a proper understanding of history of town planning, ideas developed in the past and its relevance in today's world.
CO2	Understand procedure involved in making development plans and various concepts, and issues of town planning.
CO3	Understand the importance of housing and its cost effectiveness.
CO4	Understand the causes of slum formation and measures needed to prevent it.
CO5	Understand the ideology behind different planned cities.

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

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

D. Recommended Study Material:

Text Books:

1. Rangwala, S.C., Town Planning, Charotar Publishing House, Anand.
2. Hiraskar, G.K., Town Planning, Dhanpatrai& Sons, New Delhi.
3. A.Bandopadhyay, Text book of Town Planning, Books and Allied, Calcutta 2000

Reference Books:

1. Mathur, G.C., Low Cost Housing in Developing Countries, South Asia Books
2. K. S. Rame Gowda, Urban and regional planning: principles and case studies, Prasaranga, University of Mysore, 1972

3. John Ratcliffe, An Introduction to Town and Country Planning, Hutchinson 1981
4. Kevin A. Lynch, The Image of the City, MIT Press
5. Alex Krieger and William S. Saunders, Urban Design, University of Minnesota Press

Web Materials:

1. https://townplanning.gujarat.gov.in/
2. http://www.udd.gujarat.gov.in/ctp.php
3. http://hcp.co.in/file_manager/publications/Town-Planning-of-Gujarat_Research-Paper.pdf
4. https://www.planetizen.com/
5. http://www.itpi.org.in/

LIST OF TUTORIALS

Experiment No.	Name of Tutorials
1	Origin and Growth of Towns
2	Ancient System of Town Planning
3	Surveys
4	Zoning
5	Housing and Slums
6	Development Plan – Case study of Different cities
7	Planning Concepts
8	Planned Cities of India
9	City planning case studies from around the world

CL380: CONSTRUCTION TECHNOLOGY

B. TECH 6th 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	Min. No. of Hours
1	Introduction to Construction Equipment & Fundamental of Moving Earth	09
2	Excavating Equipment	06
3	Handling and Hauling Equipment	06
4	Overview of Other Construction Equipment	06
5	Procurement and Planning of Construction Equipment	04
6	Ground Water Control During Excavation	06
7	Latest Building Material and Technology	08

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

B. Detailed Syllabus:

1 Introduction to Construction Equipment & Fundamental of Moving Earth **09 Hours 21%**

1.1 Contribution and Importance of construction equipment

1.2 Classification of Equipment, Selection of construction equipment

1.3 Soil Fundamentals, Weight-Volume Relations of Materials

1.4 Machine power, coefficient of traction, rim pull and available pull and drawbar pull, Effect of grade & altitude on power

2 Excavating Equipment **06 Hours 13%**

2.1 Features of excavating equipment

2.2	Production/Output analysis and Suitability of Power Shovel, Dragline, Backhoe, Clamshells		
3	**Handling and Hauling Equipment**	**06 Hours**	**13%**
3.1	General		
3.2	Tractor, Dumper, Bulldozer, Ripper, Scraper, Truck		
4	**Overview of Other Construction Equipment**	**06 Hours**	**13%**
4.1	Hosting Equipment		
4.2	Conveying Equipment		
4.3	Drilling Equipment		
4.4	Pumping Equipment		
4.5	Compacting Equipment		
5	**Procurement and Planning of Construction Equipment**	**04 Hours**	**09%**
5.1	Procurement criteria		
5.2	Equipment cost		
5.3	Replacement analysis		
6	**Ground Water Control During Excavation**	**06 Hours**	**13%**
6.1	Importance, selection of method for ground water control during excavation		
6.2	Well point system, Dewatering Systems etc.		
6.3	Grouting-preparation of grouting, material and equipment used.		
7	**Latest Building Material and Technology**	**08 Hours**	**18%**
7.1	Introduction		
7.2	Building Material from Waste: Recycle Concrete Aggregates, Paper as building material, Composite: Matrices and Reinforcement		
7.3	Introduction to Advance Techniques used in Construction: Slip		

Formwork, Jump Formwork, Tunnel Formwork, Trenchless Technology for excavation, Shotcreting

C. Course Outcomes (COs):

On the successful completion of this course:

CO1 The students will be able to estimate earthwork for various construction projects.

CO2 The students will be able to plan and select suitable construction equipment for different construction activities.

CO3 The students will acquire ability to do planning for construction operations based on equipment productivity.

CO4 The students will be able to analyse various financial aspects involved in the use of construction equipment.

CO5 Students will have an understanding on various systems and techniques used in ground water control during excavation.

CO6 Students will be familiar with some of the latest materials and systems used in 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	3	1	3	3	1	-	-	-	2	3	2	3	3	2	2
CO2	3	-	-	2	-	2	2	1	3	2	2	1	3	1	2
CO3	3	1	2	2	3	2	-	1	3	3	2	1	3	-	3
CO4	3	-	-	2	1	2	-	2	3	3	3	-	3	-	3
CO5	3	3	2	3	3	2	2	-	3	2	3	1	2	1	1
CO6	3	1	-	-	3	-	-	-	3	3	1	-	1	-	1

D. Recommended Study Material:

Text Books:

1. Peurifoy, L., Schexnayder, C.J. and Shapira, A., Construction Planning, Equipment and Methods, McGraw Hill, New Delhi, 8th Edition, 2010.
2. Roy Chudley, Roger Geeno," Advanced Construction Technology" Latest Edition
3. Deodhar, S.V. "Construction Equipment and Job Planning", Khanna Publishers Delhi, 2008

Reference Books:

1. Jha, Kumar Neeraj, "Construction Project Management: Theory and Practice", Pearson Education India, 2011

2. Seetharaman, S., Construction Engineering & Management, Umesh Publications, 2007.
3. Kotadia, A.S., "Construction Management and equipments", Mahajan Publishing House, 8th Edition, 2010
4. Sharma, S.C., Construction Equipment & Management, Khanna Publications, New Delhi, 1988.
5. Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University Press, New Delhi, 2008.
6. Sahu, G.C. and Jena, Joygopal, "Building Materials and Construction", McGraw Hill Education, Latest Edition
7. Punmia, B. C., Jain, Ashok Kumar, "Soil Mechanics and Foundations", Laxmi Publication, 16th edition.

Web Materials:

1. http://nptel.ac.in/courses/105103023/
2. https://www.youtube.com/watch?v=XEAc1lFHzpY
3. https://www.youtube.com/watch?v=pN2Th96poHQ
4. https://www.youtube.com/watch?v=D0DCtN0SXGQ
5. https://www.youtube.com/watch?v=pBJfKHRzDEM

LIST OF PRACTICAL/TUTORIAL

Sr. No.	Name of Tutorials
1.	Estimating Earth Work For Construction Projects
2.	Machine Power
3.	Owning Operating Cost
4.	Output Analysis of Equipment
5.	Replacement Analysis of Equipment
6.	Excavating Equipment-Basic parts, selection and operation
7.	Handling and Hauling Equipment- Basic parts, selection and operation
8.	Conveying Equipment and Drilling Equipment- Basic parts, selection and operation
9.	Ground Water Control During Excavation
10.	Latest Building Material and Technology

CL383: INSTRUMENTATION & SENSOR TECHNOLOGIES FOR CIVIL ENGINEERING APPLICATIONS

B TECH 6th SEMESTER (CIVIL ENGINEERING)

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 (COs):

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

D. Recommended Study Material:

Text Books:

- Alan S Morris (2001), Measurement and Instrumentation Principles, 3rd/e, Butterworth Hienemann
- David A. Bell (2007), Electronic Instrumentation and Measurements 2nd/e, Oxford Press
- S. Tumanski (2006), Principle of Electrical Measurement, Taylor & Francis
- 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

OCCL3001: ADMIXTURES AND SPECIAL CONCRETES

B. TECH 6th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - I

Description:

This course OCCL3001 – Admixtures and Special Concretes is offered from SWAYAM as noc23_ce61- Admixtures and Special Concretes.

Credit and Week:

Teaching Scheme	Week	Marks	Credits
	12	150	4

About The Course:

The course – Admixtures and Special Concretes – builds upon the basics of construction materials and concrete technology to introduce the learner to the mechanisms of action of chemical and mineral admixtures and their impact on the performance of concrete. It goes on to introduce the students to the formulation and properties of special concretes that are increasingly being used nowadays in construction.

Prerequisites: Basic course in Construction Materials and preferably, Concrete Technology

Industry Support: All cement companies, construction chemical manufacturers, and concrete technology experts working in construction industry

Course Layout

Week 1: Cement chemistry and concrete performance - An overview

Week 2: Chemical admixtures: Introduction & Water reducers

Week 3: Chemical admixtures: Set controllers, Standards on chemical admixtures & Air entraining agents

Week 4: Chemical admixtures: Understanding concrete rheology, Viscosity modifying agents, Shrinkage reducing admixtures, & Other specialty admixtures

Week 5: Mineral Admixtures: Introduction, classification and pozzolanic activity

Week 6: Mineral Admixtures: Fly ash and Silica fume

Week 7: Mineral Admixtures: GGBFS, Metakaolin and LC3

Week 8: Mineral Admixtures: Agricultural ashes, characterization techniques Life Cycle Assessment

Week 9: Special Concretes: High strength concrete and ultra-high performance concrete

Week 10: Special Concretes: Self compacting concrete and mass concreting

Week 11: Special Concretes: Mass concreting and lightweight concrete

Week 12: Special Concretes: High density concrete and concrete for 3D printing

Books and references

Textbook:

1. Mehta, P. K., and Monteiro, P. J. M., Concrete: Microstructure, Properties, and Materials, Fourth Edition (Indian Edition), McGraw Hill, 2014.

Reference books:

1. Neville, A. M., Properties of Concrete, Pitman Publishing, Inc., MA, 1981.
2. Thomas M.D.A., Supplementary Cementing Materials in Concrete, CRC Press, Francis & Taylor Group, Florida, USA, 2013.
3. Bentur, A., Diamond, S., and Berke, N.S., Steel Corrosion in Concrete, E&FN Spon, UK, 1997.
4. Taylor, H. W. F., Cement Chemistry, Academic Press, Inc., San Diego, CA, 1990.
5. Lea, F. M., The Chemistry of Cement and Concrete, Chemical Publishing Company, Inc., New York, 1971.
6. Mindess, S., and Young, J. F., Concrete, Prentice Hall, Inc., NJ, 1981.
7. J. Newman and B. S. Choo, Eds., Advanced Concrete Technology, Four Volume Set, Elsevier, 2003

Criteria to Get a Certificate

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

OCCL3002: REMOTE SENSING ESSENTIALS

B. TECH 6th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - I

Description:

This course OCCL3002 – Remote Sensing Essentials is offered from SWAYAM as noc20_ce29 – Remote Sensing Essentials.

URL: https://onlinecourses.nptel.ac.in/noc20_ce29/preview

Credit and Week:

Teaching Scheme	Week	Marks	Credit
	12	150	4

About the course:

The proposed course provides basic understanding about satellite based Remote Sensing and Digital Image Processing technologies. Presently, remote sensing datasets available from various earth orbiting satellites are being used extensively in various domains including in civil engineering, water resources, earth sciences, transportation engineering, navigation etc. Google Earth has further made access to high spatial resolution remote sensing data available to non-experts with great ease. Knowledge of Digital Image Processing of satellite data allows to process raw satellite images for various applications.

Pre-requisites: Remote Sensing / Geoinformatics companies, e.g NIIT, ESRI India, Leica Geoinformatics, MapmyIndia etc

Industry support:

This course will be extremely helpful for anyone who is working in the industry in various capacities. It will be helpful for employees of large companies, Public and Private sector undertakings and SME'S like ONGC, OIL, GSI and others.

Course layout:

Week 1: Rudiments of remote sensing and advantages, Historical Perspective of development of remote sensing technology

Week 2: Laws of Radiation and their relevance in Remote Sensing, Basis of remote sensing image representation

Week 3: Prominent characteristics of IRS, Cartosat, ResourceSat etc.

Week 4: Importance of digital image processing

Week 5: Atmospheric errors and corrections, Geometric transformations / Georeferencing Technique

Week 6: Digital Image Processing Software

Week 7: Supervised image classification techniques and limitations

Week 8: High Spatial Resolution Satellite Images and limitations

Week 9: NDVI and other indices, Image merging techniques, Radar Images interpretation and applications, SAR Interferometry (InSAR) Technique

Week 10: SAR Interferometry (InSAR) Technique-02, Principles of image interpretation

Week 11: Integrated applications of RS and GIS in groundwater studies

Week 12: Different sources of free satellite images, Limitations of Remote Sensing Techniques

Books and references

1. Introduction to Remote Sensing", (5th Ed.), The Guildford Press, New York, 2012.
2. Lillesand, T.M., Kiefer, R.W. and Chapman, J.W., "Remote Sensing and Image Interpretation", (5th Ed.), John Wiley & Sons, 2007.
3. Gupta, R. P., "Remote Sensing Geology", 2nd Ed., Springer, 2003.
4. Drury, S. A., "Image Interpretation in Geology", 2nd Ed, Allen & Unwin, 1993.
5. Cracknell, A.P., "Introduction to Remote Sensing", (2nd Ed.), Tylor & Francis, London, 1991.
6. Gonzalez, Rafael C. and Richard E. Woods "Digital Image Processing", (3rd Edition) Pearson Education, London.

Criteria to get a certificate:

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

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

OCCL3003: INTRODUCTION TO MULTIMODAL URBAN TRANSPORTATION SYSTEMS (MUTS)

B. TECH 6th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - I

Description:

This course OCCL3003 – Introduction to Multimodal Urban Transportation Systems (MUTS) is offered from SWAYAM as noc23_ce75 - Introduction to Multimodal Urban Transportation Systems (MUTS)

URL: https://onlinecourses.nptel.ac.in/noc23_ce75/preview

Credit and Week:

Teaching Scheme	Week	Marks	Credit
	12	150	4

About The Course:

This course is refined version of the Post-Graduate course (ID6004) "Planning, Operation and Management of Transportation Facilities" which is being currently taught to the students of Infrastructure Design and Management at IIT Kharagpur. The course's primary objectives are to:

1. Identify the sustainability principles in transportation
2. Introduce the concept of Travel Demand Management (TDM)
3. Disseminate the techniques of urban public transit planning, operations and management
4. Imbibe the concepts of non-motorized urban transport
5. Demonstrate the applications in intelligent transportation systems (ITS)

Prerequisites: None

Industry support: Urban Local Bodies, Transport Network Companies (TNCs), Public transportation operating companies and administrators

Course Layout

- Week 1: Module 1: Overview of urban transportation
  - Lec. 1: Urbanization and Transport
  - Lec. 2: Key issues in urban transportation
  - Lec. 3: Challenges in urban transportation
  - Lec. 4: Travel demand modelling overview
  - Lec. 5: Vehicular Level of Service (LOS) overview
- Week 2: Module 2: Public Transportation
  - Lec. 6: Introduction to public transportation
  - Lec. 7: Basic operating elements of public transportation
  - Lec. 8: Basic operating elements of public transportation (contd.)
  - Lec. 9: Bus Transportation
  - Lec. 10: Bus Transportation (contd.)
- Week 3: Module 2: Public Transportation
  - Lec. 11: Financing public transportation
  - Lec. 12: Transit marketing
  - Lec. 13: Rail transportation
  - Lec. 14: Intermediate Public Transportation
  - Lec. 15: Measuring performance of transit systems
- Week 4: Module 2: Public Transportation
  - Lec. 16: Advanced operation concepts of public transportation
  - Lec. 17: Bus; Rail Transit Capacity
  - Lec. 18: Bus; Rail Transit Capacity (contd.)
  - Lec. 19: Station Capacity
  - Lec. 20: Transit Stop Location
- Week 5: Module 3: Non-Motorised Transportation (NMT) Planning
  - Lec. 21: Introduction to NMT Systems
  - Lec. 22: Assessing existing NMT scenario
  - Lec. 23: Data collection and analysis in NMT Planning
  - Lec. 24: Complementarity and Selection of Interventions
  - Lec. 25: Alternative Selection through Economic; Financial Analysis

- Week 6: Module 3: Non-Motorised Transportation (NMT) Planning
  - Lec. 26: Introduction to NMT systems
  - Lec. 27: Basic NMT Characteristics
  - Lec. 28: Pedestrian Data Collection and Flow Characteristics
  - Lec. 29: PTS Case Studies Pedestrian flow characteristics on facilities
  - Lec. 30: Pedestrian Level of Service (PLOS) based on Flow models
- Week 7: Module 3: Non-Motorised Transportation (NMT) Planning
  - Lec. 31: Other types of Pedestrian Level of Service (PLOS)
  - Lec. 32: HCM 2010 Methodology for PLOS
  - Lec. 33: HCM 2010 Methodology for PLOS (contd.)
  - Lec. 34: Bicycle Facilities and Level of Service (BLOS)
  - Lec. 35: BLOS and Bicycle Compatibility Index (BCI)
- Week 8: Module 3: Non-Motorised Transportation (NMT) Planning
  - Lec. 36: NMT Design Principles
  - Lec. 37: Design of Pedestrian Infrastructure
  - Lec. 38: Design of Pedestrian Infrastructure (contd.)
  - Lec. 39: Design of Cycling Infrastructure
  - Lec. 40: Design of Cycling Infrastructure (contd.)
- Week 9: Module 4: Urban Transport; Sustainability
  - Lec. 41: Travel Demand Management (TDM) overview
  - Lec. 42: Push measures cases
  - Lec. 43: Pull measure cases
  - Lec. 44: Parking Studies
  - Lec. 45: Transit Oriented Development (TOD)
- Week 10: Module 4: Urban Transport; Sustainability
  - Lec. 46: Introduction to Intelligent Transportation Systems (ITS)
  - Lec 47: ITS components, applications and communication
  - Lec. 48: ITS Architecture
  - Lec. 49: Electronic Toll Collection (ETC)
  - Lec. 50: Public Bicycle Sharing (PBS) System with ITS
- Week 11: Module 4: Urban Transport; Sustainability
  - Lec. 51: Multimodal transportation (MMT) environment
  - Lec. 52: Multimodal Level of Service (MMLOS)

- Lec. 53: Multimodal Level of Service (MMLOS) (contd.)
- Lec. 54: Design of multimodal transfer facilities
- Lec. 55: Park & Ride (P&R) Facility Planning

- Week 12: Module 4: Urban Transport; Sustainability
  - Lec. 56: An Introduction to Pedestrian Road Safety and associated Risk Factors
  - Lec. 57: Road crash estimation and elements of predictive methods
  - Lec. 58: Predicting Vehicle-Pedestrian and Vehicle-Bicycle conflicts
  - Lec. 59: Environmental Concerns of Urban Transport
  - Lec. 60: Sustainable strategies for Urban Transportation

Books and References

Books:

1. Travel Demand Management and Road User Pricing: Success, Failure and Feasibility, edited by Gerd Sammer; Wafaa Saleh (2009), AshGate
2. The Implementation and Effectiveness of Transport Demand Management Measures -An International Perspective, edited by Stephen Ison, Tom Rye, (2008), Ashgate
3. Sustainable Transport: Planning for Walking and Cycling in Urban Environments, edited by Rodney Tolley (2003) Woodhead Publishing Ltd.
4. Fruin, J.J. Pedestrian Planning and Design, McGraw Hill Publication, 1987
5. Hudson, M. The Bicycle Planning, Open Books, 1982
6. Fundamentals of Intelligent Transportation Systems Planning, by Mashrur A. Chowdhury, Adel Wadid Sadek, (2003) Artech House, Inc. Boston
7. http://local.iteris.com/itsarch/index.htm
8. Perspectives on Intelligent Transportation Systems (ITS), by Joseph M. Sussman, (2008) MIT, Springer.
9. Ceder, A., 2016. Public Transit Planning and Operation: Modeling, Practice and Behavior, 2nd Ed., CRC Press.
10. Traffic; Highway Engineering, Garber, N.J., and Hoel, L.A., 5th Edition, Cengage Learning, 2015

Standards and Government Reports:

1. IRC 103:2012, Design of Pedestrian Facilities. Indian Road Congress
2. IRC 11: 2015 Design & Layout of Cycle Tracks. Indian Road Congress
3. Indo-Highway Capacity Manual (HCM), CSIR-CRRI, 2018.
4. TOD Guidance Document. Ministry of Housing and Urban Affairs, GoI

5. NMT Guidance Document. Ministry of Housing and Urban Affairs, GoI
6. PBS Guidance Document. Ministry of Housing and Urban Affairs, GoI

Reference links:

1. http://www.vtpi.org/tdm/index.php
2. https://www.fhwa.dot.gov/environment/climate_change/mitigation/publications/refer ence_sourcebook/page05.cfm
3. TDM Training Document: https://www.sutp.org/files/contents/documents/resources/H_Training-Material/GIZ_SUTP_TM_Transportation-Demand-Management_EN.pdf

Criteria to Get a Certificate

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

OCCL3004: ENVIRONMENTAL REMEDIATION OF CONTAMINATED SITES

B. TECH 6th SEMESTER (CIVIL ENGINEERING)

PROGRAMME ELECTIVE - I

Description:

This course OCCL3004: Environmental Remediation of Contaminated Sites is offered fromSWAYAM as noc21_ce36 Environmental Remediation of Contaminated Sites.

URL: https://onlinecourses.nptel.ac.in/noc21_ce36/preview

Credit and Week:

Teaching Scheme	Week	Marks	Credit
	12	150	4

About the course:

The course details the usual remediation techniques practiced worldwide and provide an understanding of the relevant theoretical concepts. The current course will enable a student to:

- Develop understanding of integrated approaches to remediating contaminated sites.
- Develop the ability to screen, choose and design appropriate technologies for remediation.

Intended Audience: Environmental engineering professionals and students pursuing a degree with emphasis in Environmental engineering.

Industry support: CPCB, SPCB, Degremont, ERM, Ramky Enviro Engineers, Veolia Water, SFC Environmental Technologies Pvt. Ltd., Nalco Water, VA Tech Wabag, Thermax.

Prerequisites: Entry level chemistry course, and understanding of chemical, physical and biological processes on Environmental Engineering.

Course layout:

Week 1: Introduction, Laws, Regulations and Remediation, Legal Concepts, Types of Law, Regulations, Federal

Week 2: Laws/Regulations, History, Objectives, Remediation Process, Definition of hazardous waste, Waste Classification, Corrective Action

Week 3: Risk Assessment Introduction, Terminology, History, Steps in Human Health Risk Assessment, Data Collection and Evaluation, Exposure Assessment, Toxicity Assessment, Risk Characterization, Risk Management, Risk Communication, Ecological Risk Assessment, Risk-based Corrective Action

Week 4: Remedial Options, Introduction, Administrative Options, Groundwater, Plume Containment, introduction, extraction wells, extraction trenches, injection wells/trenches, wells/barriers, Pump and Treat, Introduction, Contaminant behavior, Design considerations

Week 5: Source Control, Philosophy, Options, Permeable Reactive Barriers, Introduction, Redox reactions, Kinetics, Design considerations

Week 6: Monitored Natural Attenuation, Introduction, Evaluation, Monitoring, Mechanisms, Plume Types, Lines of Evidence, Case Study

Week 7: Soils/Sediments, Excavation, Use, Techniques, Control of contaminant transport, Typical costs, Landfill, Hazardous waste landfill, Solid waste landfill

Week 8: Containment characteristics of barrier materials, alternatives, Solidification/Stabilization, Introduction, Fundamentals, Chemical, physical, Leaching, single-component, multi-component, Design Considerations, TCLP-based approach, Risk-based approach

Week 9: Chemical Treatment, Non-redox reactions, Reductive processes, Oxidative processes (ISCO), Surfactant extraction, Introduction, Surfactant properties, Configurations, Soil Vapor Extraction, Introduction, Fundamentals, Design considerations

Week 10: Bioremediation, Introduction, Fundamentals, Important processes, Examples

Week 11: Phytoremediation, Mechanisms, Examples

Week 12: Thermal Processes, Introduction, Incineration, Thermal Desorption, Aqueous Oxidation, Soil Washing, Introduction, Process Description, Design Considerations

Books and References

1. LaGrega, M.D., Buckingham, P.L., Evans, J.C., Hazardous Waste Management, McGraw-Hill, 1994.
2. Haas, C.N., Vamos, R.J., Hazardous and Industrial Waste Treatment, Prentice Hall, Englewood Cliffs, NJ, 1995.

Criteria to get a certificate:

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