B.Tech.

IN

Civil Engineering

Curriculum and Syllabus

(Applicable from 2024 onwards)

Department of Civil Engineering

NATIONAL INSTITUTE OF TECHNOLOGY MANIPUR

Langol Road, Lamphelpat, Imphal, Manipur - 795004

Preface

It is with great satisfaction that I present the updated *Curriculum Book for the B.Tech Program in Civil Engineering* offered by the Department of Civil Engineering, National Institute of Technology Manipur. This document reflects our continued commitment to excellence in engineering education and our alignment with Outcome-Based Education (OBE) principles as per the guidelines of the National Board of Accreditation (NBA).

The curriculum has been thoughtfully structured to impart a strong foundation in core areas of Civil Engineering while incorporating emerging technologies, sustainability, and interdisciplinary approaches. Through a balance of theoretical knowledge, practical exposure, and skill development, this program aims to produce competent, socially responsible, and industry-ready civil engineers.

In addition to the core courses, the curriculum integrates program-specific outcomes (PSOs), program educational objectives (PEOs), and course outcomes (COs) mapped to program outcomes (POs). This alignment ensures that our graduates are not only technically proficient but also capable of contributing meaningfully to infrastructure development, sustainable practices, and innovation in the profession.

I sincerely thank all faculty members, curriculum committee members, industry experts, alumni, and students who contributed their insights in revising and refining this curriculum. I am confident that this academic framework will serve as a guiding document for both students and faculty in achieving academic excellence and professional relevance.

Let us collectively strive to uphold the vision and values of the department and the institute in nurturing engineers who will shape a better and sustainable future.

Dated Imphal: 28th July 2025

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Associate Professor and Head
Department of Civil Engineering
National Institute of Technology Manipur
Imphal, Manipur

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Vision and Mission of the Department

Vision

To be a centre of excellence in Civil Engineering education, research, and innovation, producing professional leaders committed to sustainable development, infrastructural advancement, and societal well-being.

Mission

1. **Excellence in Education & Innovation:** Deliver high-quality technical education that nurtures creativity, problem-solving, and research in sustainable civil engineering.
2. **Industry Integration & Societal Impact:** Foster strong industry linkages for practical exposure and develop engineering solutions addressing societal and global challenges.
3. **Ethics & Sustainability:** Promote eco-friendly practices, ethical values, and leadership for building resilient infrastructure and enhancing quality of life.

About Department of Civil Engineering

The Department of Civil Engineering at National Institute of Technology (NIT) Manipur) was established in the year 2013 as a full-fledged academic department dedicated to nurturing emerging civil engineers. With a commitment to academic excellence, innovation, and research, the department provides an outstanding teaching and research environment that fosters technical expertise and problem-solving skills.

The department currently offers:

- Bachelor of Technology (B.Tech.) in Civil Engineering – a 4-year program with an intake capacity of 30 students per year.
- Master of Technology (M.Tech.) in Environmental and Water Resources Engineering and Structural Engineering, providing advanced knowledge and research opportunities in these critical domains.
- Doctor of Philosophy (Ph.D.) in cross-disciplinary areas of Civil Engineering, focusing on cutting-edge research and innovation in fields such as structural systems, sustainable infrastructure, water resource management, geotechnical advancements, and environmental engineering solutions.

With the objective of producing quality engineers to meet the ever-growing demand for technical manpower in the field of civil engineering, the department continuously enhances its academic and research capabilities. It is recognized and funded by the Ministry of Human Resource Development (MHRD), Government of India, ensuring access to state-of-the-art laboratories, modern computational facilities, and cutting-edge research opportunities.

The department actively collaborates with industry, government agencies, and research organizations to provide practical exposure and real-world problem-solving experience to students. Through interdisciplinary research, sustainable engineering practices, and community-driven initiatives, the Department of Civil Engineering at NIT Manipur aims to contribute significantly to national development and infrastructural advancement.

Program Educational Objectives (PEOs) – B.Tech. in Civil Engineering

The **Undergraduate (B.Tech.) program in Civil Engineering** at **NIT Manipur** is designed to equip students with the necessary knowledge, skills, and ethical values to excel in their professional careers and contribute to society. The **Program Educational Objectives (PEOs)** are as follows:

1. **Technical Expertise & Continuous Learning:** Graduates will have a strong foundation in Civil Engineering, pursue lifelong learning, and be able to apply knowledge to create sustainable and economically viable solutions.

2. **Innovation, Collaboration & Professional Excellence:** Graduates will posses problem-solving skills, engage in research and innovation, and collaborate with industry and academia to advance Civil Engineering practices.

3. **Leadership, Ethics & Social Responsibility:** Exhibit leadership, teamwork, and communication skills while upholding ethical values and contributing to environmental sustainability and societal well-being.

These PEOs are aligned with the department's mission to produce competent civil engineers who can address infrastructural challenges, drive technological innovations, and contribute to national and global development.

Program Outcomes (POs) – B.Tech. in Civil Engineering

The **B.Tech. in Civil Engineering** program at **NIT Manipur** is designed to equip students with the necessary technical knowledge, problem-solving abilities, and professional skills required to excel in the field of civil engineering. Upon successful completion of the program, graduates will be able to:

1. **Engineering Knowledge:** Apply the principles of mathematics, science, and engineering fundamentals to solve complex civil engineering problems.
2. **Problem Analysis:** Identify, formulate, and analyze engineering challenges using research-based knowledge and methodologies.
3. **Design & Development of Solutions:** Design sustainable and safe structures, systems, and processes that meet societal, environmental, and economic constraints.
4. **Investigation of Complex Problems:** Conduct experiments, analyze data, and apply research-based knowledge to address real-world civil engineering challenges.
5. **Modern Tool Usage:** Utilize state-of-the-art engineering tools, software, and techniques for modeling, analysis, and design in civil engineering applications.
6. **The Engineer & Society:** Assess the societal, health, safety, legal, and cultural implications of engineering solutions and their impact on sustainable development.
7. **Ethics & Professionalism:** Uphold ethical principles and commit to professional responsibilities in civil engineering practice.
8. **Teamwork & Leadership:** Work effectively as an individual and as part of multidisciplinary teams, demonstrating leadership and collaboration in diverse professional settings.
9. **Effective Communication:** Communicate effectively with engineering professionals and society at large through reports, presentations, and documentation.
10. **Project Management & Finance:** Apply engineering and management principles to effectively plan, execute, and oversee infrastructure projects within budget and time constraints.
11. **Lifelong Learning:** Recognize the importance of lifelong learning and adaptability to evolving technologies and industry trends.

Program Specific Outcomes (PSOs)

Upon successful completion of the B. Tech degree in Civil Engineering, graduates will be able to:

PSO 1: Core Competency in Civil Engineering Design and Analysis: apply the knowledge of civil engineering fundamentals in the planning, analysis, design, and execution of infrastructure projects such as buildings, roads, bridges, water supply and wastewater systems, and geotechnical structures.

PSO 3: Problem-Solving in Real-world and Interdisciplinary Contexts: identify, analyse, and propose innovative and feasible engineering solutions to complex civil engineering problems through field investigations, data interpretation, and integration of interdisciplinary knowledge, considering safety, ethics, and professional standards.

COURSE STRUCTURE OF B.Tech. in CIVIL ENGINEERING

Sl. No.	Course Components	No. of Course	Credits
1.	Basic Science Courses (BSC)	04	14
2.	Engineering Science Courses (ESC)	09	32
3.	Departmental Core Courses (DCC)	27	80
4.	Departmental Elective Courses (DEC)	04	12
5.	Open Elective Courses (OEC)	02	06
6.	Skill Enhancement Courses (SEC)	02	06
7.	Ability Enhancement Mandatory Course (AEMC)	04	14+8[1]*
8.	Value Addition Courses (VAC)	04	03
	Total	60	162+8*

PROGRAMME STRUCTURE

Semester I

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	CH 1101	Engineering Chemistry	BSC-1	3	0	2	4
2.	ME 1101	Engineering Mechanics	ESC-1	3	1	0	4
3.	MA 1101	Engineering Mathematics-I	BSC-2	3	0	0	3
4.	PH 1101	Engineering Physics-I	BSC-3	3	0	2	4
5.	HS 1101	Professional Communication Skills	SEC-1	3	0	0	3
6.	ME 1149	Engineering Drawing	ESC-2	1	2	0	3
7.	IC 1191	Induction Programme*	VAC-1	0	0	0	0
8.	IC 1192	Extra Academic Activity-I*	VAC-2	0	0	0	0
		Total		**16**	**3**	**4**	**21**

Semester II

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	CS 1201	Introduction to Computing	ESC-3	3	0	4	5
2.	EE 1201	Basic Electrical Engineering	ESC-4	3	0	2	4
3.	MA 1201	Engineering Mathematics-II	BSC-4	3	0	0	3
4.	EC 1201	Basic Electronics Circuit	ESC-5	3	0	2	4
5.	CE 1201	Environmental Sustainability	ESC-6	3	0	0	3
6.	ME 1249	Engineering Workshop	ESC-7	1	0	4	3
7.	IC 1291	Extra Academic Activity-II*	VAC-3	0	0	0	0
		Total		**16**	**0**	**12**	**22**

[1] ***Value Addition Courses (VAC) will be floated by Department of Humanities and Social Sciences (HSS).**

Semester III

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	MA 2301	Engineering Mathematics III	ESC-8	3	0	0	3
2.	CE2301	Solid Mechanics	DCC-1	3	1	0	4
3.	CE2302	Civil Engineering Materials and Geology	DCC-2	3	1	0	4
4.	CE2303	Engineering Fluid Mechanics	DCC-3	3	1	0	4
5.	CE2304	Environmental Engineering	DCC-4	3	1	0	4
6.	CE2341	Civil Engineering Materials Lab	DCC-5	0	0	3	1.5
7	CE2342	Environmental Engineering Lab	DCC-6	0	0	3	1.5
8.	CE2343	Engineering Fluid Mechanics Laboratory	DCC-7	0	0	3	1.5
		Total		**15**	**4**	**9**	**23.5**

Semester IV

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	MA2402	Numerical Methods	ESC-9	3	0	0	3
2.	CE2401	Structural Analysis I	DCC-8	3	1	0	4
3.	CE2402	Surveying	DCC-9	3	1	0	4
4.	CE2403	Soil Mechanics	DCC-10	3	1	0	4
5.	CE2404	Hydrology and Water Resources Engineering	DCC-11	3	1	0	4
6.	CE2441	Surveying Laboratory	DCC-12	0	0	3	1.5
7.	CE2442	Soil Mechanics Lab	DCC-13	0	0	3	1.5
8.	CE2443	Building Drawing and CAD lab.	DCC-14	0	0	3	1.5
9	CE2439[2]*	Minor Project*	AEMC-1	0	0	16*	8*
		Total		**15**	**4**	**9+16***	**23.5+8***

[2] ***NOTE:** Minor Project (CE2439) is to be opted by the students who wants to leave the program after IV Semester with UG Diploma in Civil Engineering.

Semester V

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	CE3501	Structural Analysis II	DCC-15	3	1	0	4
2.	CE3502	Water and Wastewater Engineering	DCC-16	3	1	0	4
3.	CE3503	Foundation Engineering	DCC-17	3	1	0	4
4.	CE3504	Reinforced Concrete Design	DCC-18	3	1	0	4
5.	CE3541	Foundation Engineering Laboratory	DCC-19	0	0	3	1.5
6	CE35XX	Department Elective I	DEC-1	3	0	0	3
		Total		**15**	**4**	**3**	**20.5**

Semester VI

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	CE3601	Transportation Engineering	DCC-20	3	1	0	4
2.	CE3602	Construction Technology and Project Management	DCC-21	3	1	0	4
3.	CE3603	Design of Steel Structures	DCC-22	3	1	0	4
4.	CE3604	Hydraulics and Hydraulic Structures	DCC-23	3	1	0	4
5.	CE3641	Transportation Engineering Laboratory	DCC-24	0	0	3	1.5
6.	CE3642	Hydraulics and Hydraulic Structures Lab	DCC-25	0	0	3	1.5
7.	HS3601	Managerial Economics and Financial Accountancy	SEC-2	3	0	0	3
		Total		**15**	**4**	**6**	21

Semester VII

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	CE36xx	Departmental Elective II	DEC-2	3	0	0	3
2.	CE4701	Remote Sensing and GIS	DCC-26	3	0	0	3
3.	CE47xx	Departmental Elective-III	DEC-3	3	0	0	3
4.	CE4741	Computational Lab.	DCC-27	0	0	3	1.5
5	CE4791	Project work -I	AEMC-2	0	0	8	4
6	CE47xx	Open Elective-I	OEC-1	3	0	0	3
7	CE4738	Internship/Summer course	AEMC-3	0	0	6	3
		Total		**12**	**0**	**17**	**20.5**

Semester VIII

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1	CE48xx	Departmental Elective-IV	DEC-4	3	0	0	3
2	CE48xx	Open Elective-II	OEC-2	3	0	0	3
3	CE492	Seminar	AEMC-4	0	0	2	1
4	CE4894	Project Work-II	AEMC-5	0	0	12	6
		Total		**6**	**0**	**14**	**13**

For those students carrying out project work in industries/organisations

	L	T	P	C
Industrial project	**1**	**0**	**6**	**4**
Project Seminar	**0**	**0**	**10**	**5**
Comprehensive viva	**0**	**0**	**8**	**4**
Total	**1**	**0**	**24**	**13**

Note: Online courses through NPTEL, SWAYAM etc. can be taken up in lieu of the open electives with the prior approval of DUPC through the Faculty Adviser. However, at least one open elective (3 credits) should be taken from within the Institute.

List of Basic Science Courses

Sl. No.	Course Code	Course Name	L	T	P	Credits
1.	MA1101	Engineering Mathematics-I	3	0	0	3
2.	CH1101	Engineering Chemistry	3	0	2	4
3.	PH1101	Engineering Physics-I	3	0	2	4
4.	MA1201	Engineering Mathematics-II	3	0	0	3
		Total				**14**

List of Engineering Science Courses

Sl. No.	Course Code	Course Name	L	T	P	Credits
1.	ME1101	Engineering Mechanics	3	1	0	4
2.	ME1149	Engineering Drawing	1	2	0	3
3.	CS1201	Introduction to Computing	3	0	4	5
4.	EE1201	Basic Electrical Engineering	3	0	2	4
5.	EC1201	Basic Electronics Circuit	3	0	2	4
6.	CE1201	Environmental Sustainability	3	0	0	3
7.	ME1249	Engineering Workshop	1	0	4	3
8.	MA2301	Engineering Mathematics III	3	0	0	3
9.	MA2402	Numerical Methods	3	0	0	3
		Total				**32**

List of Skill Enhancement Courses

Sl. No.	Course Code	Course Name	L	T	P	Credits
1.	HS1101	Professional Communication Skills	3	0	0	3
2.	HS3601	Managerial Economics & Financial Accountancy	3	0	0	3
		Total	9	0	0	**06**

List of Ability Enhancement Mandatory Course

Sl. No.	Course Code	Course Name	L	T	P	Credits
1.	CE2439	Minor Project	0	0	16	8*
2.	CE4791	Project work-I	0	0	8	4
3.	CE492	Seminar	0	0	2	1
4	CE4894	Project Work-II	0	0	12	**6**
5	CE4740	Internship/Summer course	0	0	6	3
		Total	0	0	38	**14+8***

***For UG Diploma in Civil Engineering**

List of Value Addition Courses

Sl. No.	Course Code	Course Name	L	T	P	Credits
1.	IC1191	Induction Programme	0	0	0	0
2.	IC1192	Extra Academic Activity-I	0	0	0	0
3.	IC1291	Extra Academic Activity-II	0	0	0	0
		Total				**00**

List of Departmental Cores Courses (DCC)

Sl. No.	Course Code	Course Name	L	T	P	Credits
1	CE2301	Solid Mechanics	3	1	0	4
2	CE2302	Civil Engineering Materials and Geology	3	1	0	4
3	CE2303	Engineering Fluid Mechanics	3	1	0	4
4	CE2304	Environmental Engineering	3	1	0	4
5	CE2341	Civil Engineering Materials Lab	0	0	3	1.5
6	CE2342	Environmental Engineering Lab	0	0	3	1.5
7	CE2343	Engineering Fluid Mechanics Laboratory	0	0	3	1.5
8	CE2401	Structural Analysis I	3	1	0	4
9	CE2402	Surveying	3	1	0	4
10	CE2403	Soil Mechanics	3	1	0	4
11	CE2404	Hydrology and Water Resources Engineering	3	1	0	4
12	CE2441	Surveying Laboratory	0	0	3	1.5
13	CE2442	Soil Mechanics Lab	0	0	3	1.5
14	CE2443	Building Drawing and CAD lab.	0	0	3	1.5
15	CE3501	Structural Analysis II	3	1	0	4
16	CE3502	Water and Wastewater Engineering	3	1	0	4
17	CE3503	Foundation Engineering	3	1	0	4
18	CE3504	Reinforced Concrete Design	3	1	0	4
19	CE3541	Foundation Engineering Laboratory	0	0	3	1.5
20	CE3601	Transportation Engineering	3	1	0	4
21	CE3602	Construction Technology and Project Management	3	1	0	4
22	CE3603	Design of Steel Structures	3	1	0	4
23	CE3604	Hydraulics and Hydraulic Structures	3	1	0	4
24	CE3641	Transportation Engineering Laboratory	0	0	3	1.5
25	CE3642	Hydraulics and Hydraulic Structures Lab	0	0	3	1.5
26	CE4701	Remote Sensing and GIS	3	0	0	3
27	CE4741	Computational Lab.	0	0	3	1.5
Total credits						82

List of Department Elective Courses (DEC) subjects

Sl. No.	Course Code	Course Name	L	T	P	Credits
DEC I (5th Semester)						
1	CE3571	COMPUTER AIDED DESIGN	3	0	0	3
2	CE3572	MECHANICS OF COMPOSITE MATERIALS	3	0	0	3
3	CE3573	ADVANCED STRUCTURAL MECHANICS	3	0	0	3
4	CE3574	PRESTRESSED CONCRETE AND INDUSTRIAL STRUCTURES	3	0	0	3
5	CE3575	BRIDGE ENGINEERING	3	0	0	3
6	CE3576	EXPERIMENTAL STRESS ANALYSIS	3	0	0	3
DEC II (6th Semester)						
7	CE3671	PAVEMENT MANAGEMENT SYSTEMS	3	0	0	3
8	CE3672	INFORMATION TECHNOLOGY IN CONSTRUCTION ENGINEERING	3	0	0	3
9	CE3673	DESIGN OF FOUNDATIONS AND RETAINING STRUCTURES	3	0	0	3
10	CE3674	GROUND IMPROVEMENT AND GROUND ENGINEERING	3	0	0	3
11	CE3675	QUANTITATIVE METHODS IN CONSTRUCTION MANAGEMENT	3	0	0	3
12	CE3676	HYDRAULIC MACHINES	3	0	0	3
DEC III (7th Semester)						
13	CE4771	GROUNDWATER HYDROLOGY AND MANAGEMENT	3	0	0	3
14	CE4772	RAILWAY & AIRPORT ENGINEERING	3	0	0	3
15	CE4773	AIR POLLUTION AND INDUSTRIAL WASTE MANAGEMENT	3	0	0	3
16	CE4774	PAVEMENT DESIGN	3	0	0	3
17	CE4775	DYNAMICS OF STRUCTURES	3	0	0	3
18	CE4776	ENVIRONMENTAL MANAGEMENT	3	0	0	3
		DEC IV (8th Semester)				
19	CE4871	SOLID WASTE ENGINEERING	3	0	0	3
20	CE4872	FINITE ELEMENT METHODS IN ENGINEERING	3	0	0	3
21	CE4873	HYDROPOWER ENGINEERING	3	0	0	3
22	CE4874	EARTHQUAKE RESISTANT STRUCTURES	3	0	0	3
23	CE4875	DISASTER MANAGEMENT	3	0	0	3
24	CE4876	CLIMATE CHANGE	3	0	0	3

Note: Undergraduate students can take postgraduate courses in lieu of the above list of Departmental Electives subject to approval of Faculty Adviser and specific Course Instructor.

List of Open Elective Subjects

Sl. No.	Course Code	Course Name	L	T	P	Credits
1.	CE4751	Design Thinking in Engineering	3	0	0	3
2.	CE4752	Sustainability Engineering	3	0	0	3
3.	CE4851	Climate Science	3	0	0	3
4.	CE4852	Municipal Solid Waste Management	3	0	0	3

Credits for 1st year	**43**
Credits for CE (III to VIII Semester)	**122**
Total Credits	**165**

Course Title: Environmental Sustainability			
Course Code: CE1201	**Credits:** 3	**L:T:P:** 3-0-0	**Learning hours:** 42(L) + 48(SL)
Pre-requisite Course Code and title (if any): Nil			
Department: Department of Civil Engineering			**Program**: B.Tech
Course Category: BSE			**Course offered in:** I Semester

Course Objectives:

1. To explain the basis of human well-being and the role of ecosystems in supporting life.
2. To understand the concept of sustainability, its definitions, principles, and challenges.
3. To analyze reasons for unsustainability in economics, business, science, engineering, and society.
4. To introduce sustainable development goals (SDGs) and the role of engineers in achieving them.
5. To impart basic design skills for sustainable processes and products in engineering applications.

Course Outcome:

Upon successful completion of this course, students will be able to

1. Explain the basis of human well-being and the dependence on ecosystem goods and services.
2. Interpret sustainability concepts, definitions, and challenges in engineering contexts.
3. Analyze the interlinkages between economics, business, and environmental sustainability.
4. Examine the role of science, engineering, and society in creating or solving sustainability issues.
5. Apply principles of sustainable design to propose processes and products aligned with SDGs.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	2	1	2	1	1	2	2	2	2	2
CO2	2	2	2	1	2	2	2	1	1	2	1	2	2
CO3	2	2	1	1	2	2	1	1	1	2	1	2	2
CO4	1	2	1	1	2	2	1	2	1	2	1	2	2

	CO5	2	2	2	2	2	3	1	2	1	2	2	2	2	

Course Content:

Module	Topic	L	T	P
1.	The Basis of Human Well-Being: CO1	4	0	0
2.	Status of Ecosystem Goods and Services: CO1	4	0	0
3.	Sustainability: Definitions and Challenges: CO2	4	0	0
4.	Economics and the Environment: CO3	4	0	0
5.	Business and the Environment: CO3	4	0	0
6.	Science, Engineering, and the Environment: CO4	4	0	0
7.	Society and the Environment:CO4	**4**	0	0
8.	Designing Sustainable Processes and Products: CO5	**6**	0	0
9.	Sustainable Development Goals: CO2, CO4, CO5	**8**	0	0
	Total (Contact Hours)	**42**	0	0

Recommended Books or Textbook(s) for self-learning:

1. Bhavik R. Bakshi, *Sustainable Engineering: Principles and Practice*, Cambridge University Press.
2. Allen, D., Shonnard, D., *Sustainable Engineering: Concepts, Design and Case Studies*
3. Peet, J., *Energy and the Ecological Economics of Sustainability*

E Resources for self-learning:

Course Title: Solid Mechanics			
Course Code: CE2301	**No. of Credits:** 04	**L-T-P:** 3-1-0	**Learning hours:**42 (L)+ 14 (T)+ 64 (SL)
Pre-requisite Course Code and title (if any):			
Department: Department of Civil Engineering		Programme: **BTech**	
Course Category: DCC-01		**Course offered in:** Semester III	

Course Objectives:

1. To understand the fundamental concepts of simple stresses and strains, including stress-strain relationships, elastic constants, and deformation under axial and thermal loading.
2. To develop the ability to analyze shear force and bending moment distributions in beams subjected to various loading conditions, and construct corresponding diagrams.
3. To understand and analyze compound stresses and strains using graphical methods like Mohr's Circle, and determine principal stresses and strains in two-dimensional systems.
4. To comprehend the theory of bending and calculate flexural stresses and section moduli for different cross-sectional geometries of beams.
5. To analyze shear stress distribution in various beam sections and evaluate stresses in thin-walled pressure vessels such as thin cylinders and spheres.

Course Outcome:

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

1. Understand fundamental principles of strength of materials.
2. Calculate stresses and deformations of objects under external loadings.
3. Define the characteristics and calculate the magnitude of combined stresses.
4. Apply the knowledge of mechanics of materials on engineering applications and design problems.
5. Analyse various situations involving structural members subjected to flexural and shear stresses.

CO-PO Articulation Matrix

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

COURSE CONTENT:

Module	Topic	L	T	P
1	**Simple stresses and Strains:** Stress, strain, type of stresses, elastic limit, Hooke's law, stress-strain curve, elastic constants, initial stiffness, secant stiffness, elongation of bars of varying sections, elongation of bars of composite sections, elongation due to self-weight, bars of uniform strength, complementary shear stresses, Thermal stress.	8	2	0
2	**Bending moment and Shear Force Diagrams:** Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.	12	4	0

3	**Compound Stresses and Strains**: Two-dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two-dimensional stress-strain system, principal strains and principal axis of strain. Relationship between elastic constants.	6	3	0
4	**Flexural Stresses in beams:** Theory of bending, neutral axis and moment of resistance, bending stresses in symmetrical sections, Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections.	8	3	0
5	**Shear Stresses:** Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections. **Thin Cylinders and Spheres-** Calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.	8	2	0
	Total (Contact Hours)	**42**	**14**	0

Evaluation Criteria: (Weightage: Theory -15%; Practical design problems -85%)

- 3 Unit tests+ Assignment/Project: 20% each (average score)
- Mid Term Examination: 30%
- End Term Examination: 50%

Text Book(s) for self-learning:

1. Mechanics of Materials by Timoshenko and Gere, CBS Publishers, New Delhi, 2004, 2nd Edition.
2. Strength of Materials by S. Ramamrutham, R. Narayanan, Dhanpat Rai Books.

References Book (s) for self-learning:

1. Kazmi, S. M. A., "Solid Mechanics" TMH, Delhi, India.
2. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.

E Resources for self learning:

1. https://archive.nptel.ac.in/courses/105/105/105105108/
2. https://archive.nptel.ac.in/courses/112/107/112107147/

Course Title: Civil Engineering Materials and Geology			
Course Code: CE2302	**No. of Credits:** 03	**L-T-P:** 3-1-0	**Learning hours:**42 (L)+ 48 (SL)
Pre-requisite Course Code and title (if any):			
Department: Department of Civil Engineering		Programme: **BTech**	
Course Category: DCC-02		**Course offered in:** Semester III	

Course Objectives:

1. To understand the properties, classification, and selection criteria of various construction materials such as stones, bricks, timber, lime, and cement used in civil engineering projects.
2. To gain knowledge of manufacturing processes, quality control tests, and IS specifications for construction materials like bricks, cement, and aggregates.
3. To understand the composition, preparation, properties, and behavior of cement mortar and concrete, including factors influencing strength, durability, and workability.
4. To explore concrete mix design methods in accordance with IS codes and understand the influence of materials and admixtures on mix performance.
5. To study Earth's materials and processes—including rocks, minerals, tectonic activity, earthquakes, and landslides—with relevance to geological hazards and geotechnical engineering.

Course Outcome:

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

1. Identify and characterize building materials.
2. Understand the manufacturing process of bricks, cement etc.
3. Comprehend the behaviour of cement and concrete.
4. Identify geological formations and structures for rock mass quality assessment.
5. Address remedial measures required to counter effect of earthquakes and landslides.

CO-PO Articulation Matrix

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

COURSE CONTENT:

Module	Topic	L	T	P
1	**Construction Materials:** Classification of stones- Characteristics of good building stones and their uses; Brick and other Clay Products: Composition of brick-earth, manufacturing process of bricks, characteristics of good building bricks and their uses, testing of bricks. Concrete Making Materials: Cement, Fine and Coarse aggregate. Timber, Seasoning and conversions, properties, tests, defects in timbers.	8	0	0
2	**Lime, and Cement:** IS classification of lime and uses, chemical composition of cement, IS specifications and tests on Portland cement, different types of cements and their uses, Mortar and Concrete: Preparation of cement mortar and concrete for different types of works, Hydration of Cement: Bogue's compounds, Hydration, Gel formation, pore & capillary water.	12	0	0

3	**Concrete:** Factors affecting strength of concrete, durability, types of concrete and their specific use. Fresh Concrete-Batching, Mixing, workability, effect of admixture. Design of concrete mix: IS code recommendation. Different methods of mix design – factors affecting mix design.	12	0	0
4	**The Earth:** Earth Processes and their consequences: Lithosphere, Hydrosphere, Cryosphere, Atmosphere, Biosphere and interconnectedness. **Earth Materials:** Rocks, soils, minerals. Engineering and Genetic classification of rocks, Rock mechanics, Strength Properties of Rocks.	8	0	0
5	**Earthquakes and Landslides:** Structures- Folds, Faults, Joints. Plate Tectonics, Earthquakes: Causes, classification, magnitude, intensity, seismic hazards zoning	8	0	0
	Total (Contact Hours)	**42**	**14**	0

Evaluation Criteria: (Weightage: Theory -15%; Practical design problems -85%)

- 3 Unit tests+ Assignment/Project: 20% each (average score)
- Mid Term Examination: 30%
- End Term Examination: 50%

Text Book(s) for self-learning:

1. S.C. Rangwala. Civil engineering Materials. Charotar Publishing House.
2. B.C. Punmia, Ashok Kumar Jain and Arun K Jain. Building Construction. Lakshmi Publications.
3. D Venkat Reddy, Engineering Geology, Vikas Publishing House Pvt. Ltd., 2017.

References Book (s) for self-learning:

1. R.K. Gupta. Civil engineering Materials and Construction Practices. Jain Brothers.
2. N. Chenna Kesavulu, Text Book of Engineering Geology, Mac Millan Ltd., New Delhi. 2018

E Resources for self learning:

1.https://onlinecourses.nptel.ac.in/noc21_ar11/preview
2.https://nptel.ac.in/courses/105/102/105102088/
3.https://nptel.ac.in/courses/105/106/105106053/
4.https://nptel.ac.in/courses/105/102/105102012/
5.https://nptel.ac.in/courses/105/105/105105106/

Course Title: Civil Engineering Materials Lab			
Course Code: CE2341	**Credits:** 1.5	**L:T:P:** 0-0-3	**Learning hours:**36 (P) + 9 (SL)
Pre-requisite Course Code and title (if any):			
Department: Department of Civil Engineering			**Program**: B.Tech
Course Category: DCC5			**Course offered in:** III Semester

Course Objectives:

1. To identify physical and mechanical properties of building materials in the field and laboratory.
2. To develop an understanding, the relationships between the physical characteristics and mechanical properties of civil engineering materials.
3. To prepare concrete mix designs according to IS Standards.

Course Outcome:

Upon successful completion of this course, students will be able to

1. Identify Quality Control tests on concrete making materials
2. Evaluate the physical properties of different building materials
3. Comprehend the behaviour of fresh and hardened concrete
4. Determine the durability properties of concrete
5. Conduct Laboratory and Field tests according to IS standards.

CO-PO Articulation Matrix

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

Course Content:

Module	Topic	L	T	P
1	Workability of Concrete using Compaction Factor Apparatus.	0	0	3
2	Compressive Strength of Concrete.	0	0	3
3	Consistency of Cement using Flow Table.	0	0	3
4	Water Absorption, Compressive Strength and Efflorescence	0	0	3

	of Bricks.			
5	Flakiness Index & Elongation Index of Aggregate.	0	0	3
6	Toughness of Aggregate using Aggregate Impact Testing Machine.	0	0	3
7	Tensile Strength of Cement Mortar using Universal Testing Machine.	0	0	3
8	Heat of Hydration of Cement.	0	0	3
9	Particle Size Distribution of Fine Aggregate/ Coarse Aggregate	0	0	3
10	Aggregate Abrasion Value using Los Angeles Abrasion Testing Machine	0	0	3
11	Soundness of Cement using Le-Chatlier Apparatus.	0	0	3
12	Fineness of Cement using Blaine's Apparatus.	0	0	3
	Total (Contact Hours)	**0**	0	**36**

Recommended Books or Textbook(s) for self-learning:

1. M. S. Mamlouk and J. P. Zaniewski, Materials for Civil and Construction Engineers, Pearson, Prentice Hall, Second edition, 2006.
2. M., Neville and J. J. Brooks, Concrete Technology, Pearson Education, Fourth Indian reprint, 2004.
3. S. Somayaji, Civil Engineering Materials, Prentice Hall, New Jersey, 2001.
4. M. S. Shetty, Concrete Technology, S. Chand and Company Ltd. 2005.

E Resources for self-learning:

1. https://nptel.ac.in/courses/105/102/105102088/
2. https://nptel.ac.in/courses/105/106/105106053/

Course Title: Environmental Engineering Lab			
Course Code: CE 2342	**No. of Credits:** 1.5	**L:T:P:** 0-0-3	**Learning hours:**36 (P) + 9 (SL)
Pre-requisite Course Code and title (if any):			
Department: Department of Civil Engineering			**Program**: BTech
Course Category: DCC-6			**Course offered in:** III Semester

Course Objectives:

1. To introduce students how the common environmental experiments relating to water quality were performed.
2. To understand the wastewater sampling procedures and sample preservation & to test the sample with appropriate methods for given environmental problems.
3. To interpret laboratorial results and write technical reports, and apply the laboratorial results to problems identification, quantification, and basic environmental design and technical solutions.

Course Outcome:

Upon successful completion of this course, students will be able to

1. To understand the different important water quality parameters and their permissible limits as per standards.
2. Quantify the pollutant concentration in water and wastewater
3. Apply different analysis techniques for the measurement of physical and chemical of waste water and waste water.
4. Assess the microbial contamination in water.
5. Demonstrate the ability to write clear technical laboratorial reports.

CO-PO Articulation Matrix

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

Course Content:

Module	Topic	L	T	P
1	Determination of pH of a Given Water Sample.	0	0	3
2	Determination of Turbidity of a Given Water Sample.	0	0	3
3	Determination of Conductivity of a Given Water Sample.	0	0	3
4	Determination of Alkalinity of a Given Water Sample.	0	0	3
5	Estimation of Suspended solids, Dissolved solids and Total Solids.	0	0	3
6	Determination of Total Hardness	0	0	3
7	Determination of Concentration of Fluoride and Metals	0	0	3
8	Determination of Dissolved Oxygen (DO) present in a Given Water Sample.	0	0	3

9	Determination of Biochemical Oxygen Demand (BOD) & chemical Oxygen Demand (COD)	0	0	3
10	Introduction of advance instrument (Atomic Absorption Spectrophotometer)	0	0	3
11	Determination of Plate count Test	0	0	3
12	Determination of Most Probable Number (MPN)	0	0	3
	Total (Contact Hours)	**0**	0	**36**

Recommended Books or Text Book(s) for self-learning:

1. Kotaiah B. and Kumaraswamy N, "Environmental Engineering manual" Charitor Publishing house, India.
2. Standard Methods for the Examination of Water and Waste Water (IS :3025)
3. Eaton AD Standards Methods for the Examinations of Water and Waste Water

E Resources for self-learning:

1. https://youtube.com/playlist?list=PLkyVnO47pDX9YJglk1o2iYzWgABo5I_xA&feature=shared
2. https://youtube.com/playlist?list=PL1BFC82F3A63B4172&feature=shared

Course Title: Structural Analysis I			
Course Code: CE 2401	**No. of Credits:** 4	**L:T:P:** 3-1-0	**Learning hours:** 42 (L)+ 14 (T) + 64 (SL)
Pre-requisite Course Code and title (if any): CE2301 (Solid Mechanics)			
Department: Department of Civil Engineering		**Programme:** BTech	
Course Co-ordinator/instructor:			
Course Type: DCC-8		**Course offered in :** Semester IV	

Course Description:

This is an elementary course on Structural Analysis. Various methods and their underlying mechanics in determining response of structures when subjected to external agitation will be discussed in this course. This course is comprehensive at the basic level. Journey through this course will help students to build the foundation for more advanced courses related to structural engineering.

Course Objectives:

The Course will try to introduce the overall concept of structural analysis of different structures especially determinate and indeterminate beams, frames etc. which will help the student to understand and solve the different structural members of a structure.

Course Outcomes:

1. CO1: The students should understand the fundamentals of static and kinematic indeterminacy and be able to solve various trusses, 3-hinged arches and suspension cable problems using force and/or displacement methods.
2. CO2: The students should be able to determine the deflection of beams using various methods.
3. CO3: The students should be able to solve indeterminate structure problems using force methods and be able to present the fundamentals of various Energy methods.
4. CO4: The students should understand and be able to present various influence line and rolling loads on beams, frames and arches.
5. CO5: The students should understand and be able to apply Muller- Breslau Principles to determinate and indeterminate structures.

Course Content:

UNIT I	Topic	CO	L	T	P
Module 1	Different types of structures, Loads on the structural system, static and kinematic indeterminacy	CO1	6	2	
Module 2	Methods of Analysis: Equilibrium equations, compatibility requirements, Introduction to force and displacement methods		5	2	
Module 3	Analysis of trusses: plane truss, compound truss, complex truss and space truss, Arches and suspension cables, three hinged arches and suspension cables		5	2	
Module 4	Deflection of Beams, various methods for calculation of deflection	CO2	5	2	
UNIT II					
Module 5	Analysis of indeterminate structures by force methods, flexibility coefficients	CO3	6	2	

Module 6	Energy methods: Principle of minimum potential energy, principle of virtual work, Castigliano's theorems		5	2	
Module 7	Reciprocal theorem, unit load method, Influence line and Rolling loads, beam, frames and arches	CO4	5	1	
Module 8	Muller- Breslau Principles and its applications to determinate and indeterminate structures.	CO5:	5	1	
	Total (Contact Hours)		**42**	14	**0**

Evaluation Criteria: (Weightage: Theory -80%; Practical design problems - 20%)

- 3 Unit tests: 20% each (average score)
- Mid Term Examination: 30%
- End Term Examination: 50%

Learning Outcomes:

Student will acquire the knowledge of global structural stability, theory of structural analysis, and methods in structural analysis.

Recommended Books or Text Book(s):

1. C.S. Reddy, *Basic Structural Analysis*, Second Edition, Tata McGraw Hill, 2005.
2. R.C. Hibbeler, *Structural Analysis*, Pearson Education, 6th edition, 2009.
3. D.S. Prakash Rao, *Structural analysis: Unified approach*, Universities Press, 1996.
4. C.H. Norris, J.B. Wilbur, S.Utku, *Elementary Structural Analysis*, Tata McGraw Hill, 4th edition, 2003.
5. L. S. Negi and R. S. Jangjid, *Structural Analysis*, Tata Mc. Graw, New Delhi, 1997.

Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2
CO 1	3	3	3	2	1	2	2	1			1	3	2
CO 2	3	3	3	2	1	2	2	1			1	3	2
CO 3	3	3	3	2	1	2	2	1			1	3	2
CO 4	3	2	3	2	1	2	2	1			1	3	2
CO 5	3	2	3	2	1	2	2	1			1	3	2

Course Title: Structural Analysis I			
Course Code: CE 2401	**No. of Credits:** 4	**L:T:P:** 3-1-0	**Learning hours:** 42 (L)+ 14 (T) + 64 (SL)
Pre-requisite Course Code and title (if any): CE2301 (Solid Mechanics)			
Department: Department of Civil Engineering		**Programme:** BTech	
Course Co-ordinator/instructor:			
Course Type: DCC-8		**Course offered in :** Semester IV	

Course Description:

This is an elementary course on Structural Analysis. Various methods and their underlying mechanics in determining response of structures when subjected to external agitation will be discussed in this course. This course is comprehensive at the basic level. Journey through this course will help students to build the foundation for more advanced courses related to structural engineering.

Course Objectives:

The Course will try to introduce the overall concept of structural analysis of different structures especially determinate and indeterminate beams, frames etc. which will help the student to understand and solve the different structural members of a structure.

Course Outcomes:

1. CO1: The students should understand the fundamentals of static and kinematic indeterminacy and be able to solve various trusses, 3-hinged arches and suspension cable problems using force and/or displacement methods.
2. CO2: The students should be able to determine the deflection of beams using various methods.
3. CO3: The students should be able to solve indeterminate structure problems using force methods and be able to present the fundamentals of various Energy methods.
4. CO4: The students should understand and be able to present various influence line and rolling loads on beams, frames and arches.
5. CO5: The students should understand and be able to apply Muller- Breslau Principles to determinate and indeterminate structures.

Course Content:

UNIT I	**Topic**	**CO**	**L**	**T**	**P**
Module 1	Different types of structures, Loads on the structural system, static and kinematic indeterminacy	CO1	6	2	
Module 2	Methods of Analysis: Equilibrium equations, compatibility requirements, Introduction to force and displacement methods		5	2	
Module 3	Analysis of trusses: plane truss, compound truss, complex truss and space truss, Arches and suspension cables, three hinged arches and suspension cables		5	2	
Module 4	Deflection of Beams, various methods for calculation of deflection	CO2	5	2	
UNIT II					
Module 5	Analysis of indeterminate structures by force methods, flexibility coefficients	CO3	6	2	

Module 6	Energy methods: Principle of minimum potential energy, principle of virtual work, Castigliano's theorems		5	2	
Module 7	Reciprocal theorem, unit load method, Influence line and Rolling loads, beam, frames and arches	CO4	5	1	
Module 8	Muller- Breslau Principles and its applications to determinate and indeterminate structures.	CO5:	5	1	
	Total (Contact Hours)		**42**	14	**0**

Evaluation Criteria: (Weightage: Theory -80%; Practical design problems - 20%)

- 3 Unit tests: 20% each (average score)
- Mid Term Examination: 30%
- End Term Examination: 50%

Learning Outcomes:

Student will acquire the knowledge of global structural stability, theory of structural analysis, and methods in structural analysis.

Recommended Books or Text Book(s):

1. C.S. Reddy, *Basic Structural Analysis*, Second Edition, Tata McGraw Hill, 2005.
2. R.C. Hibbeler, *Structural Analysis*, Pearson Education, 6th edition, 2009.
3. D.S. Prakash Rao, *Structural analysis: Unified approach*, Universities Press, 1996.
4. C.H. Norris, J.B. Wilbur, S.Utku, *Elementary Structural Analysis*, Tata McGraw Hill, 4th edition, 2003.
5. L. S. Negi and R. S. Jangjid, *Structural Analysis*, Tata Mc. Graw, New Delhi, 1997.

Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2
CO 1	3	3	3	2	1	2	2	1			1	3	2
CO 2	3	3	3	2	1	2	2	1			1	3	2
CO 3	3	3	3	2	1	2	2	1			1	3	2
CO 4	3	2	3	2	1	2	2	1			1	3	2
CO 5	3	2	3	2	1	2	2	1			1	3	2

Course Title: Soil Mechanics			
Course Code: CE2403	**No. of Credits:** 04	**L-T-P:** 3-1-0	**Learning hours:**42 (L)+ 14 (T)+ 64 (SL)
Pre-requisite Course Code and title (if any):			
Department: Department of Civil Engineering		Programme: **BTech**	
Course Category: DCC-10		**Course offered in:** Semester IV	

Course Objectives:

1. To understand the basic principles of soil mechanics, properties of soils and knowledge of identifying soil.
2. To understand the flow through soils and their behavior and gain a practical outlook of utilizing soil as construction materials.
3. To understand highly compressible soil settlements and estimate the strength of soil for different loading conditions.
4. To identify shear strength parameters of soil using different laboratory tests.

Course Outcome:

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

1. Identify various types of soils and determine their properties.
2. Estimate coefficient of permeability and stresses in soils under various site conditions.
3. Apply the knowledge of compaction and seepage to understand the soil behavior of a site.
4. Evaluate the consolidation settlement to enhance the soil properties at site.
5. Examine the shear strength of different soils under various loading conditions.

CO-PO Articulation Matrix

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

COURSE CONTENT:

Module	Topic	L	T	P
1	**Physical and Index properties of soils**: Introduction about origin and formation of soils, basic definitions from soil three phase diagram (weight ratios & volume ratio), Inter relationships of preliminary properties. Determination of laboratory tests for water content, field density, specific gravity by various methods, Index properties, sieve analysis, consistency limits, Indian soil classification IS-1498-1970.	8	2	0
2	**Permeability of soils:** Darcy's. law of seepage water through soils- Determination of co-efficient of permeability (constant head and variable head permeability tests) – Field tests (Pumping in and pumping out tests) – Equivalent permeability of stratified soils. **Stress in Soils**: Total, effective and neutral stress for different soil conditions.	8	2	0
3	**Seepage in Soil:** Seepage flow, seepage pressure – Flow nets – Locating phreatic line in a homogeneous earthen dam using Kozeny's parabola – computation of seepage quantity	8	3	0

	Compaction: Compaction Mechanism, factors affecting compaction. Laboratory determination of compaction characteristics- standard and modified Proctor tests – IS Light and Heavy compaction tests; Field surface compaction: compaction equipment, procedure, quality control.			
4	**Consolidation:** Spring Analogy, Laboratory consolidation test, calculation of void ratio, compression characters and settlement equation, differential equation for one dimensional consolidation, co-efficient of consolidation – square root & logarithm time fitting method.	8	3	0
5	**Shear strength:** Significance of Shear strength of soils – Mohr-Coulomb equation – shear parameters –Laboratory tests for determination of shear strength – Direct shear test, Tri-axial compression tests. (UU, CU and CD), Un-confined compression test, Vane shear test. Factors affecting shear strength of cohesion less and cohesive soils.	10	4	0
	Total (Contact Hours)	**42**	**14**	0

Evaluation Criteria: (Weightage: Theory -25%; Practical design problems -75%)

- 3 Unit tests+ Assignment/Project: 20% each (average score)
- Mid Term Examination: 30%
- End Term Examination: 50%

Text Book(s) for self-learning:

1. K. R. Arora, "Soil Mechanics and Foundation Engineering", Standard Publisher Dist.; 7th Edition, 2008
2. Gopal Ranjan and A S R Rao "Basic and Applied Soil Mechanics", New Age International Pvt Ltd; Third Edition 2016.

References Book (s) for self-learning:

1. R. F. Scott, "Principles of Soil Mechanics", Wesley Educational Publishers Inc., 1 st edition, 1963.
2. T. W. Lambe and R. V. Whitman, "Soil Mechanics", Wiley; 17 edition, 2012.
3. C.Venkatramaiah, "Geotechnical Engineering", New Age Publications, revised Fifth edition, 2017.

E Resources for self learning:

1. https://archive.nptel.ac.in/courses/105/101/105101201/
2. https://archive.nptel.ac.in/courses/105/105/105105168/

Course Title: HYDROLOGY AND WATER RESOURCES ENGINEERING			
Course Code: CE2404	**No. of Credits:** 03	**L-T-P:** 3-0-0	**Learning hours:** 42 (L)+ 0 (T)+ 48 (SL)
Pre-requisite Course Code and title (if any):			
Department: Department of Civil Engineering		Programme: **BTech**	
Course Category: DCC-11		**Course offered in:** Semester IV	

Course Objectives:

1. To understand the principles of hydrology, knowledge of the hydrological cycle and interaction between various hydrological components.

2. To analyze various component of surface hydrology- water balance equation, estimation of precipitation, evapotranspiration, infiltration losses, hydrograph, flood forecasting, surface runoff estimation, streamflow measurement etc.

3. To formulate and solve engineering problems related to various surface hydrological components

4. To understand the basic principle of subsurface hydrology/groundwater hydrology and to formulate and solve various groundwater hydrological problems.

5. To understand the fundamental of Water Resource Management focusing on the various aspects of Soil-Water-Plant relationships, crop water requirement; Layout of canal system; Types and methods of irrigations etc.

Course Outcome:

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

1. understand the hydrologic cycle, water balance equation and relationships between various hydrological components
2. analyze and solve various surface hydrological problems related to precipitations, runoff, streamflow measurement, evaporation, evapotranspirations, Infiltrations, Hydrographs etc
3. understand the concept of subsurface hydrology/groundwater hydrology and to solve and provide solution to various groundwater hydrological problems.
4. analyze and solve various water resource management problems- calculation of crop water requirements, design and maintenance of various irrigation canals (its types & methods)
5. understand and differentiate between types of drainage systems- various remedial measures of water logging, drainage of land etc.

CO-PO Articulation Matrix

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

COURSE CONTENT:

Module	Topic	L	T	P
1	**Surface water hydrology** - hydrologic cycle; Precipitation and its measurement, Mean Precipitations, Evaporations, Evapotranspiration & its estimation, Runoff estimations; Stream Flow measurements; Infiltration & its losses; Storm hydrology; Hydrograph Theory- Unit and Storm hydrograph	14	0	0
2	Flood estimation and routing, flood forecasting- Estimation of peak discharge, rational method, SCS method and unit hydrograph method, Design flood, return period, flood frequency analysis , Reservoir planning – Investigations, life of reservoir;	6	0	0
3	**Ground water hydrology** –Occurrence of groundwater, types of aquifers, aquifer properties, Groundwater movement, Darcy's law, Conductivity and Transmissivity etc.	10	0	0
4	Concept on **Water Resource Management**, Soil-Water-Plant relationships, crop water requirement; Layout of canal system; Types and methods of irrigation systems	6	0	0
5	Surface and sub-surface drainage, water logging, remedial measures, drainage of land	6	0	0
	Total (Contact Hours)	**42**	**0**	0

Evaluation Criteria: (Weightage: Theory -30%; Numerical problems -70%)

- 3 Unit tests+ Assignments: 20% each (average score)
- Mid Term Examination: 30%
- End Term Examination: 50%

Text Book(s) for self-learning:

1. V.P. Singh, Elementary Hydrology, Prentice Hall, 1993.
2. H.M. Raghunath, Hydrology – Principles, Analysis and Design, Wiley Eastern Ltd., 1986.
3. Subramanya K., Engineering Hydrology, Tata McGraw Hill Publications, 2018, Fifth Edition.
4. Asawa G.L., Irrigation and Water Resources Engineering, New Age International Publishers, 2006, Second Edition.

References Book (s) for self-learning:

1. A.M. Michael, Irrigation – Theory and Practice, Vikas Publishing House, 1987.
2. V.T. Chow, D.R. Maidment, and L.W. Mays, Applied Hydrology, McGraw Hill, 1998.

E Resources for self learning & assignments:

1. https://nptel.ac.in/courses/105103213
2. https://nptel.ac.in/courses/105105214
3. https://nptel.ac.in/courses/126105334
4. https://nihroorkee.gov.in/sites/default/files/uploadfiles/Practicing-Hydrology.pdf
5. https://www.pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/BSE/BSE-191/BSE-191-PDF.pdf
6. https://pubs.usgs.gov/wsp/2220/report.pdf

Course Title: Surveying Laboratory			
Course Code: CE2441	**Credits:** 1.5	**L:T:P:** 0-0-3	**Learning hours:**36 (P) + 9 (SL)
Pre-requisite Course Code and title (if any):			
Department: Department of Civil Engineering		**Program**: B.Tech	
Course Category: DCC-12		**Course offered in:** IV Semester	

Course Objectives:

1. To determine the relative positions of various objects on the surface of the earth
2. To determine the distance, area, volume and other related quantities.
3. To prepare a map or plan to represent an area on a horizontal plan.
4. To solve measurement problems in an optimal way.

Course Outcome:

Upon successful completion of this course, students will be able to

1. Understand working of different types of surveying equipment
2. Gain practical experience in applying various surveying methods to establish control points and collect data.
3. Select appropriate instruments and techniques for collecting data relevant to specific survey objectives
4. Adjust the traverse and calculation of coordinates i.e. latitude and departures
5. Use surveying data for preparation of maps.

CO-PO Articulation Matrix

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

Course Content:

Module	Topic	L	T	P
1	Measurement of Distance by Patching, Ranging And Chaining.	0	0	3
2	To locate Various Objects by Chain & Cross Staff Surveying.	0	0	3
3	Determination of Area of Polygon by Chain and Cross Staff Survey.	0	0	3
4	Measurement of Bearings of Sides of Traverse with Prismatic Compass and Computation of Correct Included Angle.	0	0	3
5	To locate a given Building by Chain and Compass Traversing.	0	0	3
6	Determination of Elevation of Various Points with Dumpy Level by Collimation Plane Method and Rise & Fall Method.	0	0	3
7	To fix Bench Mark with respect to Temporary Bench Mark with Dumpy Level by Fly Leveling and Check Leveling.	0	0	3
9	Measurement of Horizontal Angles and Vertical angles by using Theodolite.	0	0	3
10	Determination of Horizontal Distance between two Inaccessible Points with Theodolite.	0	0	3

11	To locate a given Building by Theodolite Traversing.	0	0	3
12	To locate a given Building by Plain Table Traversing.	0	0	3
	Total (Contact Hours)	**0**	**0**	**36**

Recommended Books or Textbook(s) for self-learning:

1. Surveying and levelling vol 1 & 2 by SS Bhavikatti,Techsar pvt ltd

E Resources for self-learning:

1. https://youtube.com/@theengineeringsurveyor7872?feature=shared
2. https://youtu.be/it8fdS5Axfo?feature=shared

Course Title: Soil Mechanics Lab			
Course Code: CE2442	**Credits:** 1.5	**L:T:P:** 0-0-3	**Learning hours:**36 (P) + 9 (SL)
Pre-requisite Course Code and title (if any):			
Department: Department of Civil Engineering			**Program**: B.Tech
Course Category: DCC			**Course offered in:** IV Semester

Course Objectives:

1. To identify physical and mechanical properties of soil in the field and laboratory.
2. To develop an understanding, the relationships between the physical characteristics and mechanical properties of soil
3. To choose different tests for soils according to IS Standards.

Course Outcome:

Upon successful completion of this course, students will be able to

1. Identify soils with reference to their index properties.
2. Classify soils according to IS classification.
3. Calculate field density and required compaction for a specific site.
4. Examine the moisture content, organic matter presence in a given soil.
5. Conduct Laboratory and Field tests according to IS standards.

CO-PO Articulation Matrix

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

Course Content:

Module	Topic	L	T	P
1	Grain size distribution by Sieve Analysis.	0	0	3
2	Grain size distribution by Hydrometer Analysis.	0	0	3
3	Consistency limits - Liquid limit and Plastic limit using Casagrande's method.	0	0	3
4	Compaction test: Standard Proctor test.	0	0	3

5	Compaction test: Modified Proctor test.	0	0	3
6	Field Density using Sand Replacement method.	0	0	3
7	Field Density using Core Cutter method.	0	0	3
8	Specific gravity of soils.	0	0	3
9	Natural Moisture Content using Calcium Carbide Method.	0	0	3
10	Natural Moisture Content using Oven Drying Method.	0	0	3
11	Natural Moisture Content using Pycnometer Method.	0	0	3
12	Organic matter of soil determination using Muffle Furnace.	0	0	3
	Total (Contact Hours)	**0**	0	**36**

Recommended Books or Textbook(s) for self-learning:

1. Essentials of Soil Mechanics and Foundations – Basic Geotechnics, David F. McCarthy, Pearson Education Ltd., 2014, 7th Edition.
2. Soil Mechanics and Foundations, Muni Budhu, Wiley Publishers, 2016, 3rd Edition.
3. Geotechnical Engineering Lab Manual, William A. Kitch, 2011.
4. IS 2720 (part-3) : 1964 for specific gravity, IS 2720 (Part 17) : 1966 for Sieve analysis IS 2720 (Part- IV) : 1965) for Grain size analysis and other IS codes.

E Resources for self-learning:

1. https://nptel.ac.in/courses/105101160
2. https://archive.nptel.ac.in/courses/105/101/105101160/

Course Title: Building Drawing and CAD lab.			
Course Code: CE2443	**Credits:** 1.5	**L:T:P:** 0-0-3	**Learning hours:**36 (P) + 9 (SL)
Pre-requisite Course Code and title (if any):			
Department: Department of Civil Engineering			**Program**: B.Tech
Course Category: DCC14			**Course offered in:** IV Semester

Course Objectives:

1. To interpret the concepts of drawing plan and elevation of buildings using computer aided graphic tool.
2. To develop an understanding of the concepts of actual sizes of door, windows, ventilators.
3. To develop detailed understanding of the interior design concepts through section view.

Course Outcome:

Upon successful completion of this course, students will be able to

1. Create and draw plan for different buildings in different views using computer aided graphic tool
2. Prepare working drawings to communicate the ideas and information.
3. Read, understand and interpret engineering drawings.
4. Identify various components of the building, and their functionality.
5. Plan various service and safety requirements of the building, and their functionality.

CO-PO Articulation Matrix

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

Course Content:

Module	Topic	L	T	P
1	Drawing of Plan, Section and Elevation of Buildings.	0	0	12
2	Line Diagram - Representation of Doors, Windows, Ventilators and Built in Features.	0	0	6

3	Development of Plans for Single Storied and Multi Storied Buildings.	0	0	12
4	Drawing of several types of footing, bricks work, floor, staircase, masonry, arches and lintels.	0	0	6
	Total (Contact Hours)	**0**	0	**36**

Recommended Books or Textbook(s) for self-learning:

1. Punmia B. C., Jain A.J., and Jain A.J., Building Construction, Laxmi Publication, 2016, 11th Edition.
2. Arora S. P., and Bindra S. P., The Text book for Building Construction, Dhanpat Rai Pubications, 2010

Reference Books:

1. Varghese P.C., Building Construction, PHI Learning Pvt. Ltd., 2017, 2nd Edition.
2. National Building Code of India, Bureau of Indian Standards, 2016.
3. S. Tickoo, Auto CAD 2017 for Engineers & Designers, Dreamtech, 2016, 23rd Edition
4. N. D. Bhatt. and V. M. Panchal, Engineering Graphics, Charotar Publishers, 2016, 53rd Edition
5. B. Agarwal, Engineering Drawing, 2015, McGraw Hill Education, 2015, 2nd Edition
6. AutoCAD Manual. (https://knowledge.autodesk.com/)

E Resources for self-learning:

1. https://nptel.ac.in/courses/105/106/105106197/
2. https://nptel.ac.in/courses/105/102/105102175/

Course Title: Structural Analysis II

Course Code: CE3501	**No. of Credits:** 4	**L:T:P**: 3-1-0	**Learning hours:** 42 (L)+ 14 (T) + 64 (SL)

Pre-requisite Course Code and title (if any): CE2301 (Solid Mechanics) and CE2401 (Structural Analysis I)

Department: Department of Civil Engineering | **Programme:** BTech

Course Co-ordinator/instructor:

Course Type: DCC-15 | **Course offered in :** Semester V

Course Description:

The course provides students with the principles of elastic structural analysis and behaviour of indeterminate structures. Classical and modern analysis techniques are introduced to arm the students with the necessary tools to better appreciate the real behaviour of structures.

Course Objectives:

1. Understand indeterminate structure and methods of analysis.
2. Analysis of indeterminate beams and frames by slope deflection method
3. Analysis of indeterminate beams and frames without and with side sway by using moment distribution method.
4. Calculation the deflection of trusses, beams and frames by using unitload method.
5. Analysis of two pinned arches.
6. Apply influence line for indeterminate beams.
7. Understand matrix method and its application for computer-based analysis of structure.

Course Content:

Module	Topic	CO	L	T	P
	UNIT I				
1	Classical method of analysis of framed Structures: Slope deflection method, Moments distribution methods, effect of symmetry and antisymmetry, sway correction	CO1: The students should understand and be able to apply Slope deflection method, Moments distribution methods, effect of symmetry and antisymmetry, sway correction to framed Structures.	9	4	0
2	Approximate methods: Substitute frame methods for gravity load, Lateral load analysis	CO2: The students should understand and be able to apply Substitute frame methods for gravity load, Lateral load analysis	8	3	0
3	Portal and Cantilever methods, Matrix method of structural analysis	CO3: To learn Portal and Cantilever methods, Matrix method of structural analysis	8	2	0
	UNIT 2				
4	Stiffness method: Local and global stiffness matrices, assembly, band storage, solution of resulting simultaneous algebraic equation, boundary conditions, application to plane and space truss	CO4: The students should understand matrices stiffness method and will be able to apply to plane and space truss	9	3	0
5	Analysis of plane frame, grid and three dimensional frames.	CO5: The students will be able to analysis plane frame, grid and three dimensional frame.	8	2	
	Total (Contact Hours)		**42**	14	**0**

Learning Outcomes: On successful completion of the course, the student is expected to understand static indeterminacy and adopt an appropriate structural analysis technique, possess an understanding of the physical response of structures to various loads and to identify the kinematic indeterminacy of structures, perform basic calculations to determine redundant forces and displacements, appreciate the difference between idealized structures, models and real structures.

Recommended Books or Text Book(s):

1. W. Weaver and J. M. Gere, *Matrix analysis of framed structures*, CBS Publishers, 2nd edition, 2004.
2. C.K. Wang, *Intermediate Structural Analysis*, Tata McGraw Hill, 1984.

References:

1. C.S. Reddy, *Basic Structural Analysis*, Second Edition, Tata McGraw Hill, 2005.
2. G.S. Pandit and S.P. Gupta, *Structural Analysis - A matrix approach*, Tata McGraw Hill, 2nd edition, 2008.
3. C.H. Norris, J.B. Wilbur, S.Utku, *Elementary Structural Analysis*, Tata McGraw Hill, 4th edition, 2003.
4. M.B. Kanchi, *Matrix Methods of Structural analysis*, Enlarged edition, Wiley Eastern Limited, 1993.

Course Articulation Matrix

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

Course Title: Water and Wastewater Engineering			
Course Code: CE3502	**Credits:** 3	**L:T:P:** 3-0-0	**Learning hours:** 42(L) + 48(SL)
Pre-requisite Course Code and title (if any): Environmental Engineering			
Department: Department of Civil Engineering			**Program**: B.Tech
Course Category: DCC			**Course offered in:** V Semester

Course Objectives:

1. To introduce the principles of water supply, treatment, and distribution.
2. To develop knowledge of wastewater collection, treatment, and disposal.
3. To analyze water quality parameters and their impact on public health and the environment.
4. To familiarize students with modern water and wastewater treatment technologies.
5. To emphasize sustainable water management and environmental protection practices.

Course Outcome:

Upon successful completion of this course, students will be able to

1. Understand water demand, sources, and treatment processes.
2. Analyze the quality parameters of water and wastewater.
3. Design and evaluate water treatment and wastewater treatment systems.
4. Apply hydraulic principles to water distribution and sewage collection networks.
5. Implement sustainable practices in water and wastewater management.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	2	1	3	1	1	2	2	2	2	2
CO2	2	2	2	3	2	2	0	1	1	2	1	2	2
CO3	2	2	3	3	2	2	1	1	1	2	1	2	2
CO4	3	2	3	3	2	2	0	2	1	2	1	2	2
CO5	2	2	2	2	2	3	1	2	1	2	2	2	2

Course Content:

Module	Topic	L	T	P
1	**Water Supply and Demand: CO1** Sources of water: Surface water and groundwater. Water demand and	6	0	0

	population forecasting. Factors affecting water consumption. Water intake structures and conveyance systems.			
2	**Water Quality and Treatment: CO2, CO3** Physical, chemical, and biological characteristics of water. Drinking water standards (BIS, WHO). Water treatment processes: Screening, sedimentation, coagulation and flocculation, filtration, disinfection, softening, aeration, and fluoridation. Advanced water treatment techniques: Reverse osmosis, UV treatment, and desalination.	9	0	0
3	**Water Distribution System: CO4** Design and layout of distribution networks. Pipe materials, joints, and appurtenances. Storage reservoirs and their classification. Distribution network analysis: Hardy-Cross method and equivalent pipe method.	6	0	0
4	**Wastewater Characteristics and Collection: CO4** Physical, chemical, and biological characteristics of sewage. Wastewater standards and effluent disposal guidelines. Types of sewerage systems and sewer materials. Design of sewers, sewer appurtenances, and sewage pumping stations.	6	0	0
5	**Wastewater Treatment Systems: CO3** Primary treatment: Screening, grit removal, sedimentation. Secondary treatment: Activated sludge process, trickling filters, oxidation ponds. Tertiary treatment: Advanced filtration, nutrient removal, disinfection. Sludge treatment and disposal: Thickening, digestion, drying, and incineration.	9	0	0
6	**Emerging Trends in Water and Wastewater Management: CO5** Sustainable water management practices. Water reuse and recycling. Smart water management using IoT and AI. Decentralized wastewater treatment systems.	6	0	0
	Total (Contact Hours)	**42**	0	0

Recommended Books or Textbook(s) for self-learning:

1. Garg, S.K., 2010. *Water supply engineering*. 25th ed. New Delhi: Khanna Publishers.
2. Metcalf & Eddy, 2003. *Wastewater engineering: Treatment and reuse*. 4th ed. New York:

McGraw-Hill.

3. Hammer, M.J., 2012. *Water and wastewater technology*. 7th ed. Upper Saddle River, NJ: Prentice Hall.
4. Peavy, H.S., Rowe, D.R. and Tchobanoglous, G., 1985. *Environmental engineering*. New York: McGraw-Hill.
5. Central Public Health and Environmental Engineering Organisation (CPHEEO), 2013. *Manual on sewerage and sewage treatment systems*. Vol. 1. New Delhi: Ministry of Housing and Urban Affairs, Government of India.
6. Goel, S., 2019. *Water and wastewater engineering*. Cambridge: Cambridge University Press.

E Resources for self-learning:

1. https://www.youtube.com/playlist?list=PL1BFC82F3A63B4172
2. https://www.youtube.com/playlist?list=PLLy_2iUCG87AZvtaiuD3r4HATrBKhb90P
3. https://www.youtube.com/playlist?list=PLbRMhDVUMngdeOSgQOe399aBKqdxkxNCp

Course Title: Foundation Engineering			
Course Code: CE3503	**No. of Credits:** 04	**L-T-P:** 3-1-0	**Learning hours:**42 (L)+ 14 (T)+ 64 (SL)
Pre-requisite Course Code and title (if any): Soil Mechanics			
Department: Department of Civil Engineering		Programme: **BTech**	
Course Category: DCC-17		**Course offered in:** Semester V	

Course Objectives:

1. To understand the principle of bearing capacity and settlement analysis.
2. To understand the principles of single and group piles.
3. To select suitable methods for the construction of coffer dams and caissons.
4. To understand the principles of site investigation and sampling techniques.

Course Outcome:

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

1. Compute the stress distribution in the soil deposit and calculate the stability of slope and retaining structures.
2. Estimate the bearing capacity of different soils for shallow foundation.
3. Design the load carrying capacity of deep foundation.
4. Interpret and implement the concepts of Coffer dams and Caissons.
5. Deal with the field investigations and sampling methods.

CO-PO Articulation Matrix

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

COURSE CONTENT:

Module	Topic	L	T	P
1	**Stress distribution in Soils:** Boussinesq's and Westergaards equations for point load. Application of point loadformulae for uniformly distributed load on circular area, Line load, Strip Load, rectangular area. Use of Newmark's chart for different areas using Boussinesq's equation and Contact pressure distribution.	8	2	0
2	**Bearing capacity of soils:** Terzaghi's equation for bearing capacity in soils for square, rectangular and circular footings, general and local shear failure conditions. Plate load test as per IS specification. Allowable bearing capacity. Standard penetration test and use of N values for estimating soil conditions and bearing capacity. **Settlement Analysis:** Computation of pressures before loading and after loading. Estimation of settlement – ultimate and after any given period.	8	2	0
3	**Pile Foundations:** Types of piles–Timber, steel, concrete, cast-in situ, precast piles, bearing piles, friction piles, compaction piles, large diameter piles. Pile capacity – Static formulae, dynamic formulae, pile load test, determination of point resistance and skin friction as per IS code. Bearing capacity of pile groups and negative skin friction.	8	3	0

4	**Caissons:** types of caissons–Open caissons, pneumatic caissons, box caissons (floating caissons). General description and construction methods. Dewatering techniques: sumps, ditches. Well points, deep walls. **Geotextile**: Types and uses. **Coffer dams**: Earth embankments, cantilever sheet piles, braced coffer dams. Double wall cofferdams, cellular coffer dams – circular, diaphragm type, general description and construction methods.	8	3	0
5	**Site investigation:** Principles of exploration, sampling methods, transportation and storage of samples, boring and drilling methods, log of bore holes, sampling tubes and samplers. Sampling records. **Machine foundations:** Types, Basic definitions. Degree of Freedom of a Block foundation, General criteria for design of machine foundation, Free and forced Vibration.	10	4	0
	Total (Contact Hours)	**42**	**14**	0

Evaluation Criteria: (Weightage: Theory -25%; Practical design problems -75%)

- 3 Unit tests+ Assignment/Project: 20% each (average score)
- Mid Term Examination: 30%
- End Term Examination: 50%

Text Book(s) for self-learning:

1. K. R. Arora, "Soil Mechanics and Foundation Engineering", Standard Publisher Dist.; 7th Edition, 2008
2.Gopal Ranjan and A S R Rao "Basic and Applied Soil Mechanics", New Age International Pvt Ltd; Third Edition 2016.

References Book (s) for self-learning:

1. B. M. Das and K. Sobhan, "Principles of Geotechnical Engineering", 9th edition, 2018
2. E. J. Bowles, "Foundation Analysis and Design", Tata Mc Graw Hill, 2017.
3. Handy, Richard L. 2020. Foundation Engineering: Geotechnical Principles and Practical Applications. 1st ed. New York: McGraw-Hill Education

E Resources for self learning:

1. https://archive.nptel.ac.in/courses/105/105/105105176/
2. https://archive.nptel.ac.in/courses/105/107/105107120/

Course Title: Reinforced Concrete Design			
Course Code: CE3504	**No. of Credits:** 04	**L-T-P:** 3-1-0	**Learning hours:**42 (L)+ 14 (T)+ 64 (SL)
Pre-requisite Course Code and title (if any):			
Department: Department of Civil Engineering		Programme: **BTech**	
Course Category: DCC-18		**Course offered in:** Semester V	

Course Objectives:

1. This course provides the fundamental of design of reinforced concrete structures, and its basics.
2. Elaborate the importance of IS codes i.e. IS 456, IS 13920, IS 875.
3. Different methods of design of reinforced concrete structures. via limit state method, working stress methods, ultimate load methods.
4. Design of different structural members and its types viz., beam, column. Slab.
5. Understanding the basics of footing and its design.

Course Outcome:

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

1. Know the importance of reinforced concrete structures in construction.
2. Understanding the importance of IS codes and its contents.
3. Different design concepts of reinforced concrete.
4. Design of different structural members in reinforced concrete structures.
5. Different footing types and its design.

CO-PO Articulation Matrix

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

COURSE CONTENT:

Module	**Topic**	**L**	**T**	**P**
1	Working stress, limit state method and ultimate load design of R.C. Structures	4	1	0
2	Design of Beam: Singly reinforced, Doubly reinforced beam, Flanged beam, Shear and bond, development length, detailing of reinforcement, Torsion, Serviceability criteria: Deflection	8	2	0

3	Design of Slab: One way and two way slab, detailing, redistribution of moments	10	4	0
4	Design of Column: Axial loading, Uniaxial bending, Biaxial bending, Slender column	10	4	0
5	Foundation: Isolated and Combined footing	10	3	0
	Total (Contact Hours)	**42**	**14**	0

Evaluation Criteria: (Weightage: Theory -25%; Practical design problems -75%)

- 3 Unit tests+ Assignment/Project: 20% each (average score)
- Mid Term Examination: 30%
- End Term Examination: 50%

Text Book(s) for self-learning:

1. S. U. Pillai and D. Menon, *Reinforced Concrete Design*, Tata McGraw-Hill 3rd edition, v 2009.
2. P.C. Varghese, *Limit State Design of Reinforced Concrete*, Prentice Hall India, 2008.

References Book (s) for self-learning:

1. 1. S.N. Sinha, *Reinforced Concrete Design*, Tata McGraw-Hill, 2nd Edition, 2002.
2. M.L. Gambhir*, Fundamentals of Reinforced Concrete Design*, Prentice Hall India, 2006.
3. A. K. Jain, *Reinforced concrete: Limit state design*, Nem Chand and Bros. 1999.
4. J. Macgregor and J. K. Wight, *Reinforced Concrete: Mechanics and Design*, Prentice Hall, 5th edition, 2008.

E Resources for self learning: (SL)

1. https://nptel.ac.in/courses/105105105
2. https://www.udemy.com/course/reinforced-concrete-design/?srsltid

Course Title: Foundation Engineering Lab			
Course Code: CE3541	**Credits:** 1.5	**L:T:P:** 0-0-3	**Learning hours:**36 (P) + 9 (SL)
Pre-requisite Course Code and title (if any): Soil Mechanics Lab			
Department: Department of Civil Engineering			**Program**: B.Tech
Course Category: DCC			**Course offered in:** V Semester

Course Objectives:

1. To determine the geotechnical behaviour of soil which are required for suitable design of foundations for any structures.
2. By numerical modelling of soil behaviour, students will be able to relate the concepts studied in the relevant theory course.

Course Outcome:

Upon successful completion of this course, students will be able to

1. Determine soil shear strength parameters for different types of soil
2. Calculate soil compressibility characteristics for different types of soil
3. Perform various tests related to sub-soil explorations.
4. Apply the concepts of slope stability, earth pressure & retaining structures.
5. Conduct Laboratory and Field tests according to IS standards.

CO-PO Articulation Matrix

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

Course Content:

Module	Topic	L	T	P
1	Direct Shear Test to determine the shear strength parameters of soils	0	0	3
2	Vane Shear Test for determining the undrained shear strength of cohesive soils.	0	0	3
3	Unconfined Compression Test to evaluate the compressive	0	0	3

	strength of cohesive soils.			
4	Triaxial Compression Tests—Unconsolidated Undrained (UU), Consolidated Undrained (CU), and Consolidated Drained (CD)—to assess soil strength under various drainage and consolidation conditions.	0	0	9
5	Consolidation Test	0	0	3
6	Permeability test using Falling-head and Constant-head method.	0	0	3
7	Determination of Free swell Index and Swelling Pressure of soil in the Laboratory	0	0	3
8	Relative Density of soil	0	0	3
9	Numerical Modelling of Soil Behaviour	0	0	9
	Total (Contact Hours)	**0**	0	**36**

Recommended Books or Textbook(s) for self-learning:

1. Essentials of Soil Mechanics and Foundations – Basic Geotechnics, David F. McCarthy, Pearson Education Ltd., 2014, 7th Edition.
2. Soil Mechanics and Foundations, Muni Budhu, Wiley Publishers, 2016, 3rd Edition.
3. Geotechnical Engineering Lab Manual, William A. Kitch, 2011.
4. IS 2720 (part-3) : 1964 for specific gravity, IS 2720 (Part 17) : 1966 for Sieve analysis IS 2720 (Part- IV) : 1965) for Grain size analysis and other IS codes.

E Resources for self-learning:

1. https://nptel.ac.in/courses/105101160
2. https://archive.nptel.ac.in/courses/105/101/105101160/

Course Title: Transportation Engineering			
Course Code: CE3601	**No. of Credits:** 04	**L-T-P:** 3-1-0	**Learning hours:**42 (L)+ 14 (T)+ 64 (SL)
Pre-requisite Course Code and title (if any):			
Department: Department of Civil Engineering		Programme: **BTech**	
Course Category: DCC-20		**Course offered in:** Semester VI	

Course Objectives:

1. To understand the design concepts of the highways, the quality of the materials required for the construction of highways and different techniques used in construction of pavements.
2. To know how to collect the field data for the evaluation of traffic patterns.
3. To get an idea about the concepts of designing flexible and rigid pavements.
4. To know the construction techniques of pavements.
5. To Know about pavement failures and maintenance of pavements.

Course Outcome:

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

1.Outline the components of highway alignment.
2.Design various geometric components of highway as per design standards.
3.Illustrate critical aspects of traffic engineering for efficient road traffic operations.
4.Design flexible pavements as per IRC standards.
5.Design rigid pavements as per IRC standards.

CO-PO Articulation Matrix

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

COURSE CONTENT:

Module	Topic	L	T	P
1	**Highway Alignment:** Objectives and phases of highway engineering, history of highway engineering, factors to be considered for highway alignment, engineering surveys, concepts of master plan, road patterns, highway project preparation, and classification as per IRC.	8	2	0
2	**Geometric Design:** Highway standards (IRC) - carriageway, shoulders, medians, camber, right of way, footpaths, cycle tracks, service roads, frontage roads, sight distance - stopping sight distance, overtaking sight distance, horizontal curves, super-elevation, transition curve, extra widening, gradient, and grade compensation.	8	2	0
3	**Traffic Engineering:** Objectives of traffic studies, traffic characteristics, volume, speed, density, headways and relationship among them. Traffic volume studies, speed and delay studies, origin and destination studies,	8	3	0

	intersection delay studies, parking and accident studies, highway capacity and level of service concept as per HCM 2010, intersection improvement studies at grade, and types of grade separated intersections, channelization, rotary planning and design, concept of signal design – Webster's method.			
4	**Design of Flexible Pavement**: Variables considered in pavement design; classification of axle types, standard and legal axle loads, tyre pressure, contact pressure, ESWL, concepts; traffic analysis: ADT, AADT, truck factor, growth factor, lane distribution factor, directional distribution factor, and vehicle damage factor; IRC method of flexible pavement design.	8	3	0
5	**Design of Rigid Pavement:** Types of Rigid Pavements; Layers in rigid pavement; Stresses in rigid pavement; Factors governing design - Axle load characteristics; wheel base characteristics; Traffic considerations; Design lane; Critical stresses conditions; IRC method of design for plain jointed cement concrete pavement.	10	4	0
	Total (Contact Hours)	**42**	**14**	0

Evaluation Criteria: (Weightage: Theory -25%; Practical design problems -75%)

- 3 Unit tests+ Assignment/Project: 20% each (average score)
- Mid Term Examination: 30%
- End Term Examination: 50%

Text Book(s) for self-learning:

1. S. K. Khanna, C. E. G. Justo, and A. Veeraraghavan, "Highway Engineering", revised 10th Edition, Nem Chand & Bros., 2017.
2. S.K. Sharma, "Principles, Practice and Design of Highway Engineering", S. Chand Publishers, 2015.

References Book (s) for self-learning:

1. R. Srinivas Kumar," Pavement Evaluation, Maintenance and Management systems", Universities Press, 2014.
2. L. A. Garber and N. J. Hoel, K. RamachandraRao, "Traffic and Highway Engineering, 5th Edition, 2017. Cengage learning India Pvt. Ltd., New Delhi
3. Dr. L.R. Kadiyali and Dr. N.B. Lal, "Principles and Practices of Highway Engineering", Khanna Publishers, 2018.
4. IRC 37:2018, "Flexible pavement design".
5. IRC 58:2015, "Rigid pavement design".

E Resources for self learning:

1. https://archive.nptel.ac.in/courses/105/105/105105107/

Course Title: Construction Technology and Project Management			
Course Code: CE3602	**Credits:** 3	**L:T:P:** 3-0-0	**Learning hours:** 42(L) + 48(SL)
Pre-requisite Course Code and title (if any): CE2302: Civil Engineering Materials and Geology CE2443: Building Drawing and CAD lab			
Department: Department of Civil Engineering			**Program**: B.Tech
Course Category: DCC			**Course offered in:** VI Semester

Course Objectives:

1. To introduce construction as an industry and its challenges.
2. To provide knowledge on construction management principles and estimation techniques.
3. To familiarize students with network-based project management techniques.
4. To develop skills in project scheduling, monitoring, and control.
5. To introduce concepts of quality management, construction safety, and automation in the industry.

Course Outcome:

Upon successful completion of this course, students will be able to

1. Understand the challenges in the construction industry and the role of construction management.
2. Apply fundamental principles of construction estimation and specifications.
3. Utilize network-based project management techniques for scheduling and monitoring.
4. Implement quality management and safety practices in construction projects.
5. Analyze the role of information technology and automation in modern construction projects.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	2	1	3	1	1	2	2	2	2	2
CO2	2	2	2	3	2	2	0	1	1	2	1	2	2
CO3	2	2	3	3	2	2	1	1	1	2	1	2	2

	CO4	3	2	3	3	2	2	0	2	1	2	1	2	2	
	CO5	1	1	1	1	1	1	1	1	1	1	1	1	1	

Course Content:

Module	Topic	L	T	P
1	**Introduction to Construction Industry and Management:** Overview of the construction industry and its significance. Challenges in the construction sector. Role and objectives of construction management. Basic requirements and methods of construction management.	6	0	0
2	**Principles of Estimation and Specifications:** Fundamental principles of construction estimation. Types of estimates – preliminary, detailed, and cost estimation. General and detailed specifications for construction works.	6	0	0
3	**Network-Based Project Management Techniques:** Basics of project management and scheduling techniques. Activity definition and interdependence in project networks. Network diagram representation: CPM (Critical Path Method) and PERT (Program Evaluation and Review Technique). Estimation of time and resources in network scheduling.	9	0	0
4	**Project Monitoring and Control:** Use of network techniques for project control. Project progress tracking and monitoring methods. Importance of project scheduling in cost and time management.	9	0	0
5	**Quality Management and Construction Safety:** Principles of quality control and assurance in construction projects. Standard practices and quality certifications. Construction site safety: regulations, risk assessment, and hazard prevention.	6	0	0
6	**Information Technology and Automation in Construction:** Role of IT in construction project management. Digital tools for construction scheduling and monitoring. Automation in the construction industry: robotics, AI, and BIM (Building Information Modeling).	6	0	0
	Total (Contact Hours)	**42**	0	0

Recommended Books or Textbook(s) for self-learning:
1. Chitkara, K.K., *Construction Project Management: Planning, Scheduling and Controlling*. 2. Jha, K.N., *Construction Project Management: Theory and Practice*. 3. Hendrickson, C., *Project Management for Construction*. 4. Sengupta, B. and Guha, H., *Construction Management and Planning*. 5. Issa, R. and Flood, I., *Building Information Modeling (BIM) in Construction*.
E Resources for self-learning:
1. https://nptel.ac.in/courses/105104161
2. https://nptel.ac.in/courses/105103093
3. https://nptel.ac.in/courses/105102206

Course Title: Design of Steel Structures			
Course Code: CE3603	**No. of Credits:** 04	**L-T-P:** 3-1-0	**Learning hours:**42 (L)+ 14 (T)+ 64 (SL)
Pre-requisite Course Code and title (if any):			
Department: Department of Civil Engineering		Programme: **BTech**	
Course Category: DCC-22		**Course offered in:** Semester VI	

Course Objectives:

1. This course provides the fundamental of design of steel structures, and its basics
2. Different methods of design of steel structures. via limit state method, working stress methods.
3. Different connection types i.e. welding, bolting shall be taught and explain their uses.
4. To make it understanding the different steel structural members viz, tension, beam, column based on IS 800 2007
5. To understand the idea of foundation of steel structures

Course Outcome:

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

1. Know the importance of steel structures in construction
2. Different design concepts of steel as per IS code i.e. limit state & working stress method
3. Design of different connections in steel structures.
4. Design of steel structural members viz tension, compression , bending members.
5. Examine the design of foundation in steel structures.

CO-PO Articulation Matrix

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

COURSE CONTENT:

Module	**Topic**	**L**	**T**	**P**
1	Steel structures - advantages, design loads, structural steel sections, material properties.	5	1	0
2	Design Concepts: Working stress design, limit state design, plastic design (plastic analysis of frame members), LRFD, Classification of sections.	5	2	

3	Forms of constructions, Design of connections, types of connections, Bolt connections: ordinary black bolts, HSFG bolts and their design in shear, bearing, bending, tension; prying force, slip resistance, block shear failure. Welded connections: different types of weld connections and design, detailing of connections. Design of eccentric connections	10	4	0
4	Design of tension members: design criteria, net and gross area, examples. Design of compression members: concept of stability and buckling, failure modes, effective lengths, local and global buckling, design of compression members of various types. Design of flexural members: moment curvature relations, stability and lateral-torsional buckling, design against shear, serviceability requirements, beam column design.	12	4	0
5	Design of base plates, load transfer mechanism, design of slab base, gusseted base and anchorage. Steel structural systems.	10	3	0
	Total (Contact Hours)	**42**	**14**	0

Evaluation Criteria: (Weightage: Theory -25%; Practical design problems -75%)

- 3 Unit tests+ Assignment/Project: 20% each (average score)
- Mid Term Examination: 30%
- End Term Examination: 50%

Text Book(s) for self-learning:

1. N. Subramanian, *Design of Steel Structures*, Oxford University Press, 2008.
2. L. S. Negi, *Design of Steel Structures*, Tata McGraw Hill, 1997.

References Book (s) for self-learning:

1. P. Dayaratnam, *Design of Steel Structures*, S. Chand & Co., 2003.
2. S. M. A. Kazimi and R. S. Jindal, *Design of Steel Structures*, Prentice Hall of India Pvt Ltd, 1988.

E Resources for self learning: (SL)

1. https://nptel.ac.in/courses/105105162
2. https://onlinecourses.swayam2.ac.in/ntr25_ed56/preview

Course Title: Transportation Engineering Lab			
Course Code: CE3641	**Credits:** 1.5	**L:T:P:** 0-0-3	**Learning hours:**36 (P) + 9 (SL)
Pre-requisite Course Code and title (if any):			
Department: Department of Civil Engineering			**Program**: B.Tech
Course Category: DCC			**Course offered in:** VI Semester

Course Objectives:

1. To assess the quality of the materials used in pavement construction.
2. To compare the characteristics of pavement materials as per IRC design standards.
3. To identify and collect the field data required for the traffic parameters.

Course Outcome:

Upon successful completion of this course, students will be able to

1. Evaluate the properties of bitumen for its suitability in pavement construction.
2. Determine the mechanical properties of aggregates for its use in road construction.
3. Analyze the traffic data obtained from various traffic studies.
4. Apply the data from various traffic studies for design the pavement.
5. Prepare technical report based on laboratory and field studies.

CO-PO Articulation Matrix

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

Course Content:

Module	Topic	L	T	P
1	**Tests on bitumen** 1. Penetration test 2. Ductility test 3. Specific gravity test 4. Viscosity test	0	0	12
2	**Tests on road aggregates** 1. Aggregate crushing value test 2. Los Angeles abrasion test 3. Aggregate impact value test	0	0	12

	4. Aggregate shape test (flakiness & elongation) 5. Water Absorption test			
3	**Traffic Studies** 1. Traffic volume study 2. Spot Speed study 3. Design using IITPAVE software	0	0	10
4	**Miscellaneous Tests (demonstration only)** 1. Determination of CBR. 2. Bitumen extraction test 3. Marshall Stability concepts and tests.	0	0	2
	Total (Contact Hours)	**0**	0	**36**

Recommended Books or Textbook(s) for self-learning:

1. Khanna and Justo, "Highway materials and Pavement Testing", Nem Chand & Bros. 2013.
2. R. Srinivasa Kumar, "Highway Engineering", Universities Press, 2011.
3. IRC codes and specifications.

E Resources for self-learning:

1. https://nptel.ac.in/courses/105105107
2. https://www.vlab.co.in/ba-nptel-labs-civil-engineering

Course Title: REMOTE SENSING & GIS			
Course Code: CE4701	**No. of Credits:** 03	**L-T-P:** 3-0-0	**Learning hours:** 42 (L)+ 0 (T)+ 48 (SL)
Pre-requisite Course Code and title (if any):			
Department: Department of Civil Engineering		Programme: **BTech**	
Course Category: DCC-26		**Course offered in:** Semester VII	

Course Objectives:

1. Understanding the basic fundamental aspects of Remote Sensing, GIS and their applications in various domain and sub domain areas of Civil Engineering field.
2. To introduce to the basic fundamental aspects on the Digital Image Processing (DIP) and its associated tools for the analysis of satellite images for image interpretation.
3. Knowledge on the concepts of Geographical Information System (GIS) and its association with Remote Sensing data processing and Analysis.
4. To develop the skills and ability to understand, process, interpret and analyze satellite remote sensing datasets
5. To develop the knowledge and skills for GIS models development and the integration of various spatial database in a GIS framework.

Course Outcome:

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

1. Understand the process of Remote sensing data acquisition, analyze the energy interaction with our earth atmosphere and earth surface features
2. Identify and analyze various earth surface features using the surface reflectance properties, colour composites, sensor resolutions, visual and digital image interpretation techniques.
3. Understand various LULC classification techniques, accuracy assessment and generation of thematic maps
4. Understand the underlying GIS data structures, model setup, concept of our earth coordinate system- for the accurate representation of geospatial data in GIS framework
5. Apply the knowledge on integrating the Remote Sensing and GIS in solving various real world problems

CO-PO Articulation Matrix

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

COURSE CONTENT:

Module	Topic	L	T	P
1	**Remote Sensing**- Definition of Remote Sensing, History and scope of remote sensing, applications example; **Electromagnetic Radiation** (EMR) and atmospheric windows- Sources of EMR, Types of remote sensing. Thermal Emission of Radiation, Black body radiation, Radiation Laws, Spectral signatures, Reflectance characteristics of Earth cover types.	9	0	0
2	**Satellite Orbits, platforms and Sensors**: Platforms: Airborne and Space borne, Sensors: Passive and Active, Across track and Along track scanning, Optical sensors, and Thermal scanners. Resolutions-Image characteristics: Image resolution: Spatial (IFOV), Spectral, Radiometric and Temporal; Aerial Photography- basic concepts & geometric errors, Examples of Earth Observation Satellite (EOS)	6	0	0
3	**Image Interpretation and processing**: Elements of Image Interpretation, Visual Interpretation; Image Pre-processing: radiometric, atmospheric and geometric corrections, Remote sensing data format	6	0	0
4	**Image analysis**: Geometric corrections, Enhancement techniques, Filtering; Land use/ Land Cover (LULC) Classification techniques- Supervised and Unsupervised; Accuracy assessment	7	0	0
5	**Fundamental on GIS**- Definition, GIS and its History, GIS Database (types, structures) and data models, Geographic information and spatial data types. Raster and Vector data formats, Data acquisition, Data entry & preparations. Map scanning and digitizing, data conversion, linking of spatial and non-spatial data. Applications of RS and GIS in Civil Engineering domain and sub domain areas	14	0	0
	Total (Contact Hours)	**42**	**0**	0

Evaluation Criteria: (Weightage: Theory -40%; Application problems -60%)

- 3 Unit tests+ Assignments: 20% each (average score)
- Mid Term Examination: 30%
- End Term Examination: 50%

Text Book(s) for self-learning:

1. Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press.
2. Duggal, S. K. (2013), "Surveying" Vol 2, Tata, McGraw Hill.
3. Basudeb Bhatta (2011) Remote Sensing and GIS, 2nd ed., Oxford University Press.
4. Thomas. M. Lillesand and Ralph. W. Kiefer, Remote Sensing and Image Interpretation, John Wiley and Sons, Inc.
5. Burrough P.A., Principles of GIS for Land Resources Assessment, Oxford Publication, 1980.

References Book (s) for self-learning:

1. Lillesand T.M., Kiefer R.W. and Chipman J.W. (2003) Remote Sensing and Image Interpretation, 5th ed., Wiley.
2. Jensen J.R. (2007) Remote Sensing of the Environment: An Earth Resource Perspective, 2nd ed., Prentice Hall.
3. Michael N. Demers, "Fundamentals of geographic information system", Wiley student edition, 2012.

E Resources for self learning & assignments:

1. https://nptel.ac.in/courses/105103193
2. https://nptel.ac.in/courses/105101206
3. https://annamalaiuniversity.ac.in/studport/download/engg/civil/resources/Remote%20Sensing%20and%20GIS.pdf
4. https://appliedsciences.nasa.gov/sites/default/files/2022-11/Fundamentals_of_RS_Edited_SC.pdf
5. https://www.nateko.lu.se/sites/nateko.lu.se.sv/files/remote_sensing_and_gis_20111212.pdf
6. https://natural-resources.canada.ca/sites/nrcan/files/earthsciences/pdf/resource/tutor/fundam/pdf/fundamentals_e.pdf

Course Title: Computational lab.			
Course Code: CE4739	**Credits:** 1.5	**L:T:P:** 0-0-3	**Learning hours:**36 (P) + 9 (SL)
Pre-requisite Course Code and title (if any):			
Department: Department of Civil Engineering			**Program**: B.Tech
Course Category: DCC27			**Course offered in:** VII Semester

Course Objectives:

1. To interpret the concepts of different soft-computing techniques for solving civil engineering problems.
2. To develop an understanding of multi-disciplinary applicability of various software primarily used in Civil Engineering.

Course Outcome:

Upon successful completion of this course, students will be able to

1. Identify software tools in analysis and design of Civil Engineering Systems.
2. Apply the available open-source software tools used for analyzing specific problems in Civil Engineering.
3. Apply latest software tools for Advanced Modelling and Design of Civil Engineering Systems.
4. Understand the requirement of computer aided analysis and design for large scale engineering problems.
5. Get familiar with various software for computer aided design problems across the Civil Engineering discipline.

CO-PO Articulation Matrix

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

Course Content:

Module	**Topic**	**L**	**T**	**P**

1	Solving of Civil Engineering Problems in MATLAB.	0	0	6
2	Analysis of large three-dimensional building structures to find out shear force diagram, bending moment diagram and axial force diagram (Software: SAP2000 / STAAD.Pro).	0	0	12
3	Analysis and design of concrete beam/frame member (Software: SAP2000 / STAAD.Pro).	0	0	12
4	Time history analysis (following its theoretical background) (Software: SAP2000).	0	0	6
	Total (Contact Hours)	**0**	0	**36**

Recommended Books or Textbook(s) for self-learning:

1. A.K. Chopra. Dynamics of Structures. Pearson
2. Software Manuals of all related softwares.

E Resources for self-learning:

1. https://nptel.ac.in/courses/103106118
2. https://www.youtube.com/@computersNstructures