M S Ramaiah University of Applied Sciences

Program Structure and Course Details

of

B.Tech (Civil Engineering) Degree Programme

Program Code: 001

Batch: 2022 – 2026

Department of Civil Engineering
Faculty of Engineering and Technology
M S Ramaiah University of Applied Sciences

Registrar
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean-Academics
M.S. Ramaiah University of Applied Sciences
Bangalore-560054

Dean
Faculty of Engineering and Technology
M.S. Ramaiah University of Applied Sciences
Bangalore-560058

Nayana N. Patil
Dept. of Civil Engineering
Faculty of Engineering & Technology
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Bangalore - 560 058. Ph: 080-49065555

University's Vision, Mission and Objectives

The M. S. Ramaiah University of Applied Sciences (MSRUAS) will focus on student-centric professional education and motivates its staff and students to contribute significantly to the growth of technology, science, economy and society through their imaginative, creative and innovative pursuits. Hence, the University has articulated the following vision and objectives.

Vision

MSRUAS aspires to be the premier university of choice in Asia for student centric professional education and services with a strong focus on applied research whilst maintaining the highest academic and ethical standards in a creative and innovative environment

Mission

Our purpose is the creation and dissemination of knowledge. We are committed to creativity, innovation and excellence in our teaching and research. We value integrity, quality and teamwork in all our endeavors. We inspire critical thinking, personal development and a passion for lifelong learning. We serve the technical, scientific and economic needs of our Society.

Objectives

1. To disseminate knowledge and skills through instructions, teaching, training, seminars, workshops and symposia in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to equip students and scholars to meet the needs of industries, business and society
2. To generate knowledge through research in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to meet the challenges that arise in industry, business and society
3. To promote health, human well-being and provide holistic healthcare
4. To provide technical and scientific solutions to real life problems posed by industry, business and society in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences
5. To instill the spirit of entrepreneurship in our youth to help create more career opportunities in the society by incubating and nurturing technology product ideas and supporting technology backed business
6. To identify and nurture leadership skills in students and help in the development of our future leaders to enrich the society we live in
7. To develop partnership with universities, industries, businesses, research establishments, NGOs, international organizations, governmental organizations in India and abroad to enrich the experiences of faculties and students through research and developmental programmes

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Programme Specifications: B. Tech. (Civil Engineering)

Faculty	Engineering and Technology
Department	Civil Engineering
Programme Code	001
Programme Name	B.Tech. in Civil Engineering
Dean of the Faculty	Dr. Dilip Kumar Mahanty
Head of the Department	Dr. Nayana N. Patil

1. **Title of the Award:** B.Tech. (Civil Engineering)
2. **Mode of Study:** Full-Time
3. **Awarding Institution /Body:** M. S. Ramaiah University of Applied Sciences, Bengaluru
4. **Joint Award:** Not Applicable
5. **Teaching Institution:** Faculty of Engineering and Technology, M. S. Ramaiah University of Applied Sciences, Bengaluru
6. **Date of Programme Specifications:** June 2022
7. **Date of Programme Approval by the Academic Council of MSRUAS:** 14 July 2022
8. **Next Review Date:** June 2026
9. **Programme Approving Regulating Body and Date of Approval:** All India Council for Technical Education, New Delhi, 30-Jun-2020
10. **Programme Accredited Body and Date of Accreditation:** Not Applicable
11. **Grade Awarded by the Accreditation Body:** Not Applicable
12. **Programme Accreditation Validity:** Not Applicable
13. **Programme Benchmark:** Not Applicable
14. **Rationale for the Programme**

Civil Engineering is primarily infrastructure development involving planning, design, construction, and operation of facilities essential to modern life, ranging from transit systems to offshore structures to space satellites. Major disciplines within Civil Engineering that are closely interrelated are Structural, Environmental, Geotechnical, Water Resources, Transportation, Construction and Urban planning.

Until recently Civil Engineering teaching was limited to planning, analysis, design and execution of different types of infrastructure like buildings, roads, bridges, dams and power plants. However, increasing technological sophistication and demand for higher living standards fuelled by economic growth and concerns about environmental impact have changed the scope of Civil Engineering curriculum. The challenges of today's Civil Engineering infrastructure are much more complex including reducing carbon emission and interdependencies between resources.

Even though there are a large number of institutions world over which are producing Civil

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Engineers, there is a shortage of quality Civil Engineering graduates. The FET at RUAS would like to offer Civil Engineering programme to produce imaginative, creative and innovative Civil Engineers who are effective and efficient problem solvers providing economical and sustainable infrastructural solutions.

15. Programme Mission

The purpose of the programme is creation of innovative problem solvers in multi-disciplinary settings, entrepreneurs and leaders applying the knowledge, understanding, cognitive abilities, practical skills and transferrable skills gained through systematic, flexible and rigorous learning in the chosen academic domain.

16. Graduate Attributes (GAs)

GA-1. Engineering knowledge: Ability to apply knowledge of mathematics, science, and Engineering fundamentals to solve complex problems in engineering

GA-2. Problem Analysis: Ability to analyse engineering problems, interpret data and arrive at meaningful conclusions involving mathematical inferences

GA-3. Design and Development of Solutions: Ability to design an engineering system, component, or process to meet desired needs considering public health and safety, and the cultural, societal, and environmental considerations

GA-4. Conduct Instigations of Complex Problems: Ability to understand and solve complex engineering problems by conducting experimental investigations

GA-5. Modern Tool Usage: Ability to apply appropriate tools and techniques and understand utilization of resources appropriately to complex engineering activities

GA-6. The Engineer and Society: Ability to understand the effect of engineering solutions on legal, cultural, social, and public health and safety aspects

GA-7. Environment and Sustainability: Ability to develop sustainable solutions and understand their effect on society and environment

GA-8. Ethics: Ability to apply ethical principles to engineering practices and professional responsibilities

GA-9. Individual and Teamwork: Ability to work as a member of a team, to plan and to integrate knowledge of various engineering disciplines and to lead teams in multidisciplinary settings

GA-10. Communication: Ability to make effective oral presentations and communicate technical ideas to a broad audience using written and oral means

GA-11. Project Management and Finance: Ability to lead and manage multidisciplinary teams by applying engineering and management principles

GA-12. Life-long learning: Ability to adapt to the changes and advancements in technology and engage in independent and life-long learning

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17. Programme Outcomes (POs)

B.Tech. graduates will be able to:

PO-1. Apply knowledge of mathematics, science, basic engineering fundamentals and engineering specialization concerned for the solution of complex engineering problems

PO-2. Identify, formulate and analyze engineering problems using first principles of mathematics, science and engineering to interpret data and reach substantiated conclusions

PO-3. Provide solutions to engineering problems by designing systems, components or processes to meet the specified needs considering public health, safety, societal and the environmental considerations

PO-4. Apply the knowledge of laboratory techniques and research methods to solve complex engineering problems through experimental investigations, analysis and interpretation of results

PO-5. Gain proficiency in modelling complex engineering activities by selecting appropriate techniques and IT Tools and utilize available resources effectively

PO-6. Understand the effect of engineering solutions on legal, cultural, social, public health and safety aspects and the consequent responsibilities

PO-7. Develop sustainable engineering solutions and assess their effect on society and environment

PO-8. Understand and apply ethical principles to engineering practices and professional responsibilities

PO-9. Function effectively as an individual or a team player to handle diverse problems in multi-disciplinary settings

PO-10. Make oral and written presentations to communicate technical ideas effectively to engineering community and society at large

PO-11. Apply the knowledge of engineering and management principles to manage projects in multi-disciplinary environments with consideration to cost and time

PO-12. Recognize and engage in lifelong learning to adapt to changing needs and advancements in technology

18. Programme Goal

The programme goal is to produce graduates having critical, analytical and problem-solving skills, and ability to think independently, and to pursue a career in Civil Engineering.

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19. Program Educational Objectives (PEOs)

The Programme educational objectives of the B.Tech. (Civil Engineering) Programme are:

PEO-1. To Provide students with knowledge in mathematics, science and core engineering area to enable them to deliver efficient solutions for complex engineering problems using analytical and cognitive skills

PEO-2. To enable students to design and develop the sustainable innovative solutions for industry and societal requirements by conducting engineering investigations through experimentation and usage of modern tools.

PEO-3. To inculcate ethics, communication, leadership, soft, managerial and entrepreneurial skills for successful career in industries and to engage in lifelong learning

20. Programme Specific Outcomes (PSOs)

At the end of the B.Tech.(Civil Engineering) program, the graduate will be able to:

PSO-1. Apply the knowledge of Civil engineering Analysis and Design in to develop efficient solutions for complex problems in Civil engineering and allied areas using analytical and cognitive skills.

PSO-2. Design and develop sustainable solutions using Civil engineering principles, concepts, experimentation and appropriate tools to address industry and societal requirements

PSO-3. Demonstrate ethics, leadership qualities, communication, entrepreneurial skills and involvement in lifelong learning for the betterment of organization, environment and society

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21. Programme Structure:

Semester 1 (Physics Cycle)							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	MTB101A	Engineering Mathematics-1	3	1	0	4	100
2	PYB102A	Engineering Physics and Laboratory	3	0	2	4	100
3	CEF101A	Engineering Mechanics	3	0	0	3	100
4	ECF102A	Elements of Electronics Engineering and Laboratory	3	0	2	4	100
5	MEF103A	Engineering Drawing	2	0	2	3	100
6	LAN101A	Constitution, Human Rights and Law	2	0	0	2	50
		Total	16	1	6	20	550
		Total number of contact hours per week	23				

Semester 1 (Chemistry Cycle)							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	MTB101A	Engineering Mathematics - 1	3	1	0	4	100
2	CYB104A	Engineering Chemistry and Laboratory	3	0	2	4	100
3	MEF104A	Elements of Mechanical Engineering and Workshop Practice	2	0	2	3	100
4	EEF105A	Elements of Electrical Engineering and Laboratory	3	0	2	4	100
5	CSF106A	Elements of Computer Science and Engineering and Laboratory	3	0	2	4	100
6	TSN102A	Professional Communication	2	0	0	2	50
		Total	16	1	8	21	550
		Total number of contact hours per week	25				

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Semester 2 (Physics Cycle)							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	MTB102A	Engineering Mathematics-2	3	1	0	4	100
2	PYB102A	Engineering Physics and Laboratory	3	0	2	4	100
3	CEF101A	Engineering Mechanics	3	0	0	3	100
4	ECF102A	Elements of Electronics Engineering and Laboratory	3	0	2	4	100
5	MEF103A	Engineering Drawing	2	0	2	3	100
6	LAN101A	Constitution, Human Rights and Law	2	0	0	2	50
		Total	16	1	6	20	550
		Total number of contact hours per week	23				

Semester 2 (Chemistry Cycle)							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	MTB102A	Engineering Mathematics - 2	3	1	0	4	100
2	CYB104A	Engineering Chemistry and Laboratory	3	0	2	4	100
3	MEF104A	Elements of Mechanical Engineering and Work shop Practice	2	0	2	3	100
4	EEF105A	Elements of Electrical Engineering and Laboratory	3	0	2	4	100
5	CSF106A	Elements of Computer Science and Engineering and Laboratory	3	0	2	4	100
6	TSN102A	Professional Communication	2	0	0	2	50
		Total	16	1	8	21	550
		Total number of contact hours per week	25				

Semester 3							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	MTF201A	Engineering Mathematics -3	3	1	0	4	100
2	CEC202A	Mechanics of Solids	2	2	0	4	100
3	CEC203A	Mechanics of Fluids	2	2	0	4	100
4	CEC204A	Engineering Survey	3	1	0	4	100
5	CEC205A	Engineering Geology and Properties of Soils	3	0	0	3	100
6	CEC206A	Building Materials, Concrete and Construction Technology	3	0	0	3	100
7	CEL207A	Material Testing Laboratory	0	0	2	1	50
8	CEL208A	Survey Practice	0	0	2	1	50
9	CEL209A	Applied Engineering Geology Laboratory	0	0	2	1	50
10	BTN101A	Environmental Studies	2	0	0	2	50
		Total	**18**	**06**	**06**	**27**	**800**
		Total number of contact hours per week	30				

Semester 4							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	MTF202A	Engineering Mathematics - 4	3	1	0	4	100
2	CEC212A	Transportation Engineering - 1	3	0	0	3	100
3	CEC213A	Structural Analysis - 1	2	2	0	4	100
4	CEC214A	Hydraulics and Hydraulic Machines	3	0	0	3	100
5	CEC215A	Environmental Engineering	3	0	0	3	100
6	CEC216A	Building Planning and Computer Aided Drafting	1	0	4	3	100
7	CEL217A	Hydraulics and Hydraulic Machines Laboratory	0	0	2	1	50
8	CEL218A	Environmental Engineering Laboratory	0	0	2	1	50
9	CEL219A	Concrete and Highway Materials Laboratory	0	0	2	1	50
10	BAU201A	Innovation and Entrepreneurship	1	1	2	3	100
		Total	**16**	**04**	**12**	**26**	**850**
		Total number of contact hours per week	32				

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Semester 5							
Sl. No	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	CEC301A	Design of RCC Elements	2	1	0	3	100
2	CEC302A	Structural Analysis - 2	2	2	0	4	100
3	CEC303A	Geotechnical Engineering - 1	3	0	0	3	100
4	CEC304A	Hydrology and Irrigation Engineering	3	0	0	3	100
5	CEC305A	Transportation Engineering - 2	3	0	0	3	100
6	CEC306A	Drawing of RCC Structures	0	0	4	2	100
7	CEL307A	Geotechnical Engineering Laboratory	0	0	2	1	50
8	CEL308A	Extensive Survey Viva Voce	0	0	2	1	50
9	CES301A	Seminar	0	0	2	1	50
		Total	**13**	**03**	**10**	**21**	**750**
		Total number of contact hours per week	**26**				

Semester 6							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	CEC311A	Geotechnical Engineering - 2	3	0	0	3	100
2	CEC312A	Design of Steel Element	2	1	0	3	100
3	CEC313A	Estimation–Costing and Engineering Economics	2	0	2	3	100
4	CEC314A	DSM & Finite Element Analysis	2	0	2	3	100
5	CEC315A	Design & Drawing of Transportation & Irrigation Structures	0	0	4	2	100
6	CEC316A	Design & Drawing of Geotechnical & Environmental Structures	0	0	4	2	100
7	CEC317A	Design and Drawing of Steel Structures	1	0	2	2	100
8	CEL318A	CAE Laboratory	0	0	2	1	50
9	CEE31XA	Professional Core Elective- 1	4	0	0	4	100
		Total	**14**	**01**	**16**	**23**	**850**
		Total number of contact hours per week	**31 hours**				

Semester 7							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	CEE41XA	Professional Core Elective - 2	4	0	0	4	100
2	CEE42XA	Professional Core Elective - 3	4	0	0	4	100
3	OEE41XA	Open Elective-1	3	0	0	3	100
4	CEP401A CEI401A	I] Project Work – 1 II] Internship (Choose one)	0	0	12	6	100
		Total	**11**	**00**	**12**	**17**	**400**
		Total number of contact hours per week	**23 Hours**				

Semester 8							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	CEP402A	Project Work - 2	0	0	24	12	100
		Total	**0**	**0**	**24**	**12**	**100**
		Total number of contact hours per week	**24 Hours**				

Professional Core Elective Courses:

Group	VI Sem	
	Course code	PCE-1 Course Title
Group 1 - Transportation	CEE311A	Traffic Engineering
Group 2 - Structures	CEE312A	Advance Structural Analysis
Group 3 – Water Resources	CEE313A	Advanced Surveying -Remote Sensing and GIS
Group 4 – Construction Materials	CEE314A	Advanced Concrete Technology
Group 5 - Environmental	CEE315A	Solid Waste Management
Group 6 - Geotechnical	CEE316A	Ground Improvement Techniques
Group 7 - Data Sciences and Analytics	MTE301A	Probability and Statistics

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Group	VII Sem			
	Course code	PCE-2 Course Title	Course code	PCE-3 Course Title
Group 1 - Transportation	CEE411A	Pavement Materials, Equipment and Construction	CEE421A	Urban Transportation and Planning
Group 2 - Structures	CEE412A	Pre-stressed Concrete Technology	CEE422A	Advanced Design of Reinforced Concrete Structures
Group 3 – Water Resources	CEE413A	Advanced Hydrology	CEE423A	Water Shed Management
Group 4 – Construction Materials	CEE414A	Green Construction and Alternate Building Materials	CEE424A	Construction Management and Engineering Economics
Group 5 - Environmental	CEE415A	Air Pollution and Control	CEE425A	Environmental Impact Assessment
Group 6 - Geotechnical	CEE416A	Advanced Foundation Engineering	CEE426A	Reinforced Soil Structures
Group 7 - Data Sciences and Analytics	CSE411A	Data Science Foundation	CSE431A	Data Analytics

Note:

1. Students are required to select **one** Professional Core Elective Course during the 6th Semester from any one of the streams.
2. Students are required to select two Professional Core Elective courses during the 7th Semester, one each from PCE-2 and PCE-3 Groups.

22. Open Elective Courses

A number of Open Elective Courses from various Faculties of RUAS are offered as mentioned in the University's website. Students can choose the Open Electives of their choice. The students are permitted to choose online electives from the list approved by the respective HoD and Dean.

- **Innovation Courses in Lieu of Open Elective Courses**

  Students can earn 3-credits by participating in innovation activities as per the approved guidelines in lieu of Open Elective Courses. The activities could be related to any of the following:

  a) Design Thinking and Innovation (RAU250A)
  b) Skill Development (RAU251A)
  c) Industrial Problem Solving and Hackathons (RAU252A)

23.Course Delivery: As per the Timetable

24. Teaching and Learning Methods

1. Face to Face Lectures using Audio-Visuals
2. Workshops, Group Discussions, Debates, Presentations
3. Demonstrations
4. Guest Lectures
5. Laboratory work/Field work/Workshop
6. Industry Visit
7. Seminars
8. Group Exercises

9. Project Work
10. Project
11. Exhibitions
12. Technical Festivals

25. Assessment and Grading

25.1. Components of Grading

There shall be **two components** of grading in the assessment of each course:

Component 1, Continuous Evaluation (CE): This component involves multiple subcomponents (SC1, SC2, etc.) of learning assessment. The assessment of the subcomponents of CE is conducted during the semester at regular intervals. This subcomponent represents the formative assessment of students' learning.

Component 2, Semester-end Examination (SEE): This component represents the summative assessment carried out in the form an examination conducted at the end of the semester.

Marks obtained CE and SEE components have a weightage of 60:40 (CE: 60% and SEE: 40%) indetermining the final marks obtained by a student in a Course.

The complete details of Grading are given in the Academic Regulations.

25.1. Continuous Evaluation Policies

Continuous evaluation depends on the type of the course as discussed below:

25.1.1 Theory Courses

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

- CE components should have a mix of term tests, quiz and assignments
- Two Tests (15 each), Two Assignments (20 marks). (One written and another to be MCQs)
- Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

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25.1.2 Laboratory Course

For a laboratory course, the scheme for determining the CE marks is as under:

For Laboratory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Conduct of Experiments	Laboratory Report + Viva	Laboratory SEE
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The subcomponents can be of any of the following types:

a) Laboratory / Clinical Work Record
b) Experiments
c) Computer Simulations
d) Creative Submission
e) Virtual Labs
f) Viva / Oral Exam
g) Lab Manual Report
h) Any other (e.g. combinations)

Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

25.1.3 Course Having a Combination of Theory and Laboratory

For a course that contains the combination of theory and laboratory sessions, the scheme for determining the CE marks is as under:

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For Combined Courses (Theory + Laboratory)					
Focus of COs on each Component or Subcomponent of Evaluation					
Course Outcome	CE (Weightage: 60 %) Four components including one Lab component			SEE (Weightage: 25 %)	Lab (Weightage: 15 %)
	Tests (30 %)	Written Assignments+ Lab (20 %)	Assignment +Lab CE (10%)	Written exam	LSEE: SEE
CO-1					
CO-2					
CO-3					
CO-4					
CO-5					
CO-6					
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.					

- CE components should have a mix of term tests, quiz and assignments
- Two Tests (15 each), Two Assignments (20 marks). (One written and another to be MCQs)
- In case of courses where laboratory is combined with theory, laboratory components to be assessed in both CE and SEE
- Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

25.1.4 Ability Enhancement courses

For AECC Only		
Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: CE (60% Weightage)	Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests or Assignments	
CO-1		
CO-2		
CO-3		
CO-4		
CO-5		
CO-6		
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.		

- Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

Schedule of CE Components in a Semester

Week 6	Week 8	Week 10	Week 12	Week 13
Test -1 for 25 marks reduced to 15	Multiple Choice Questions Tests on the topics covered – reduced to 10 marks		Test -2 for 25 marks reduced to 15	Written Assignment for 40 marks reduced to 20 marks

SEE

- **For Non –NEP SEE for 100 marks reduced to 40 marks**
- **For NEP Programmes - SEE for 50 marks reduced to 40**

26. Minor Programme

The details of the following aspects of the minor programmes are presented in the **Academic Regulations** for the B. Tech. Degree Programme:

1. Programme Structure
2. Eligibility to Minor Programme
3. Registration to Minor Programme
4. Certification for Minor Programme

27. Student Support for Learning

1. Course Notes
2. Reference Books in the Library
3. Magazines and Journals
4. Internet Facility
5. Computing Facility
6. Laboratory Facility
7. Workshop Facility
8. Staff Support
9. Lounges for Discussions
10. Any other support that enhances their learning

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28. Quality Control Measures

1. Review of Course Notes
2. Review of Question Papers and Assignment Questions
3. Student Feedback
4. Moderation of Assessed Work
5. Opportunities for students to see their assessed work
6. Review by external examiners and external examiners reports
7. Staff Student Consultative Committee meetings
8. Student exit feedback
9. Subject Assessment Board (SAB)
10. Programme Assessment Board (PAB)

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29. Programme Map (Course-PO-PSO Map)

Sem.	Course Title	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
1	Engineering Mathematics-1	3	3	2	3						2			3	3	2
1	Engineering Physics	3	3	3	3	1	1	1						3	3	
1	Engineering Mechanics	3	3	3										3		
1	Elements of Electronics Engineering	3	3											3		
1	Engineering Drawing	3	2			2					1			3	2	1
1	Engineering Physics Laboratory	3	2		3			2		1	2			3	3	2
1	Basic Electronics Laboratory	3	3			3					3			3	3	3
1	Constitution, Human Rights and Law	2	2	3				3						3	3	
2	Engineering Mathematics-2	3	3	2	2	2					1			3	2	1
2	Engineering Chemistry	3	3	3	2		3	3			3			3	3	3
2	Elements of Mechanical Engineering and Work shop Practice	3	3											3		
2	Elements of Electrical Engineering	3	3	3	2	2	2	2		1	1	1	1	3	2	1
2	Elements of Computer Science and Engineering	2	1	3	2	2	2		1			1	2	3	2	2
2	Engineering Chemistry Laboratory	3	2		3			2		1	3			3	3	3
2	Computer Programming Laboratory	2	1	3	2	2	2		1			1	2	3	2	2
2	Basic Electrical Engineering Laboratory	3	3	3	2	2				1	1			3	2	1
2	Professional Communication									3	3					3
3	Engineering Mathematics-3	3	3	2	2						2			3	3	2
3	Mechanics of Solids	3.	3	3	3	1				1	1			3	3	1
3	Mechanics of fluid	3	3	3	2	1				1	1			3	2	1
3	Engineering Survey	3	3	2										3		
3	Engineering Geology and Properties of Soils	3		3										3		
3	Building Materials, Concrete and Construction Technology	3	3	3	2	3								3	3	
3	Material Testing Laboratory	3			3					1				3	3	1
3	Survey Practice	3	3	3	3					1				3	3	1
3	Applied Engineering Geology Laboratory	3	1		2									3		
3	Environmental Studies	1					3		1					1	3	1
4	Engineering Mathematics – 4	3	3	2		2				1	1			3	2	1
4	Transportation Engineering – 1	3	2	2										3		
4	Structural Analysis – 1	3	3											3		
4	Hydraulics and Hydraulic Machines	3	3	3										3		
4	Environmental Engineering	3	2	3	3	3	3	3	2			3		3	3	3
4	Building Planning and Computer Aided Drafting	3		3				3						3	3	3

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Sem.	Course Title	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
4	Hydraulics and Hydraulic Machines Laboratory	2	3		3					1				3	3	1
4	Environmental Engineering Laboratory	3	3		3	3		3		1				3	3	3
4	Concrete and Highway Materials Laboratory	3	3	3	2					1				3	2	1
4	Innovation and Entrepreneurship	2	3	2	2	3	3			3	3	3		2	2	3
5	Design of RCC Elements	3	3	3	2	3								3	3	
5	Structural Analysis - 2	3	3											3		
5	Geotechnical Engineering - 1	3	3	3		2					1		1	3	2	1
5	Hydrology and Irrigation Engineering	3	3	3			1							3	1	
5	Transportation Engineering - 2	3	3	2	1		1							3	1	
5	Drawing of RCC Structures	3	3	3		3			1		2	2		3	3	2
5	Geotechnical Engineering Laboratory	3	3	2	2	2				1				3	2	1
5	Extensive Survey Viva Voce	3	2	3	3							2	1	3	3	2
6	Geotechnical Engineering - 2	3	3	3		2				1	1			3	2	1
6	Design of Steel Element	3	3	3										3		
6	Estimation–Costing and Engineering Economics	3	3			3	3		2					3	3	2
6	DSM & Finite Element Analysis	3	3	3	3	1				1	1			3	3	1
6	Design & Drawing of Transportation & Irrigation Structures	3	3	3	2	3		1		2	2			3	3	2
6	Design & Drawing of Geotechnical & Environmental Structures		3	3	2		3							3	3	
6	Design and Drawing of Steel Structures	3	3	2	2	3		1	2	2	2	1		3	3	2
6	CAE Laboratory	3	3	2	3	3				1	1			3	3	1
6	Traffic Engineering	3	3	3	2	3								3	3	
6	Advance Structural Analysis	3	3	3		3	1			2	2			3	3	2
6	Advanced Surveying -Remote Sensing and GIS	3	2	3	1	3	1						1	3	3	
6	Advanced Concrete Technology	3	3	3	2	1				1	1			3	2	1
6	Solid Waste Management	3				2	3	3						3	3	
6	Ground Improvement Techniques	3	3	3	2	3								3	3	
7	Pavement Materials, Equipment and Construction	3	3	3	2		3	2						3	2	
7	Pre-stressed Concrete Technology	2	3	3	1									3	1	
7	Advanced Hydrology	3	3	3			1	1						3	1	
7	Green Construction and Alternate Building Materials	2		3	3	2				1				3	3	1

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Sem.	Course Title	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
7	Air Pollution and Control	3	2				3	2						3	3	
7	Advanced Foundation Engineering	3	3	3										3		
7	Project Work - 1	3	3	2	3	2	2		2	3	3	3	3	3	3	3
7	Internship											3	3			3
7	Seminar										2	3				3
7	Urban Transportation and Planning	3	3	2	2	2						1		3	2	1
7	Advanced Design of Reinforced Concrete Structures	2	3	3	2	1	1							3	2	
7	Water Shed Management	3	3	3	2	2	3	3						3	2	
7	Construction Management and Engineering Economics	3	3	2		3	3							3	3	
7	Environmental Impact Assessment	3	3					3	3			3		3	3	3
7	Reinforced Soil Structures	2	3	3	3		3						2	3	3	
8	Project Work - 2	3	3		3	2	2			1	3	1	3	3	3	3

30. Co-curricular Activities

Students are encouraged to take part in co-curricular activities like seminars, conferences, symposia, paper writing, attending industry exhibitions, project competitions and related activities for enhancing their knowledge and networking.

31. Cultural and Literary Activities

Annual cultural festivals are held to showcase the creative talents in students. They are involved in planning and organizing the activities.

32. Sports and Athletics

Students are encouraged to take part in sports and athletic events regularly. Annual sports meet will be held to demonstrate sportsmanship and competitive spirit.

Course Specifications
(1st and 2nd Semesters)

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Course Specifications: Engineering Mathematics - 1

Course Title	Engineering Mathematics - 1
Course Code	MTB101A
Course Type	Core Theory
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

The course introduces students to the basic concepts in real analysis and matrix algebra. Students are taught the concepts of limits, continuity, and differentiation, series expansion for the functions of one and two variables, sequence and series, convergence of series. The mathematical operations in Matrix theory, Eigen value and Eigen vector, Inversion and diagonalization of matrix and matrix solution for linear system of equations.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mathematics and Statistics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** State and discuss basic concepts related to single, two variable calculus and matrix algebra
- **CO-2.** Perform basic operations of matrix algebra and apply them to solve systems of linear equations
- **CO-3.** Solve simple mathematical problems associated with linear algebra, single and two variable calculus
- **CO-4.** Demonstrate competence with the basic ideas of linear systems, independence, bases and dimension, linear transformations, eigenvalues, eigenvectors and diagonalization
- **CO-5.** Solve complex real-world problems associated with linear algebra, single and two variable calculus

4. Course Contents

Unit 1 (Single Variable Calculus): Functions of single real variable, limit, continuity and differentiation. Rolle's Theorem and Lagrange's mean value theorem and their applications. Fundamental theorem of integral calculus. Improper integrals - classification and convergence, gamma and beta functions. Sequence of real numbers, Series, Tests for convergence of series: integral test, comparison test, ratio test and root test. Power series, Taylor and Maclaurin series.

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Unit 2 (Two Variable Calculus): Functions of two variables, limits, continuity and partial differentiation. Total differential, errors and approximations, tangent plane approximation of a surface. Partial differentiation of composite and implicit functions, Taylor's theorem. Unconstrained and constrained extrema.

Unit 3 (Linear Algebra): Matrix algebra, elementary row operations, row and reduced row echelon forms. Linear system of equations, existence and uniqueness of solution. Vector spaces, subspaces, linear independence, basis and dimension. Row, column and null space of a matrix. Linear transformations. Eigenvalues, eigenvectors and diagonalization.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2							1			3		1
CO-2	3	3	1							1			3		1
CO-3	3	3	2	3						2			3	3	2
CO-4	3	3	2	2						2			3	2	2
CO-5	3	3	2	2						2			3	2	2
		3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

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7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	×	×	×
CO-2	×	×	×
CO-3	×	×	×
CO-4		×	×
CO-5		×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

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9. **Course Resources**

a. **Essential Reading**

1. James Stewart, 2015, Calculus: Early Transcendentals, 8th edition, Boston, Cengage Learning
2. Steven Leon, 2014, Linear Algebra with Application, 9th edition, New Jersey, Pearson

b. **Recommended Reading**

1. Maurice D. Weir and Joel Hass, 2017, Thomas Calculus, 13th edition, New Jersey, Pearson
2. Gilbert Strang, 2016, Introduction to Linear Algebra, 5th edition, Massachusetts, Cambridge Press

c. **Magazines and Journals**

d. **Websites**

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. **Other Electronic Resources**

1. https://ocw.mit.edu/index.htm
2. https://www.khanacademy.org/
3. tutorial.math.lamar.edu/

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Course Specifications: Engineering Physics and Laboratory

Course Title	Engineering Physics and Laboratory
Course Code	PYB102A
Course Type	Core Theory and Laboratory
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary:

The aim of this course is to impart concepts of Physics and its application to solve engineering problems. The students are taught the basic topics in modern physics which include wave particle duality, uncertainty principle, Schrodinger's wave equation, lasers and fiber optics. Electrical and mechanical properties of materials will be discussed in relation to the crystal structure. This course also intends to expose the students to the challenges and rewards related to experimental physics. Students gain hands-on experience by conducting experiments in a controlled laboratory environment. Students are trained to conduct experiments related to mechanics, optics and electric circuits. They are trained to analyze the measurements, results and infer appropriate conclusions based on fundamental concepts of physics

2. Course Size and Credits:

Number of credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
Total hours of interaction	75
Number of Weeks in a Semester	15
Department responsible	Physics
Total Course Marks	100
Pass requirement	As per the Academic Regulations
Attendance requirement	As per the Academic Regulations

3. Course Objectives (CO)

After the successful completion of this course, the student will be able to:

CO - 1	State, explain the concepts of mechanics, electrical conductivity, quantum mechanics, crystal structure and material science, laser and fiber optics
CO - 2	Derive standard relationships in mechanics, electrical conductivity, quantum mechanics, crystal structure and material science, laser & fiber optics, and interpret them
CO - 3	Discuss the applications of mechanics, electrical conductivity, quantum mechanics, crystal structure and material science, laser and fiber optics
CO - 4	Solve problems in mechanics, electrical conductivity, quantum mechanics, crystal structure, material science, laser and fiber optics
CO - 5	Plan the experimental set-up, conduct experiments, calculate and plot the graphs to obtain the results and write a laboratory report as per the prescribed format.

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4. Course Contents

Unit 1 – (Elasticity): Review of Elasticity — Expression for Y, h and K in terms of linear and lateral strains (Deformation of a cube)—Poisson's ratio—Twisting couple on a cylinder—Expression for couple per unit twist—Torsion Pendulum -- determination of rigidity modulus of a wire using torsion pendulum—Bending of beams— Geometrical moment of inertia of circular and rectangular cross sections—Single cantilever—Expression for Young's modulus of a cantilever beam

Unit 2 – (Rigid body dynamics): Review of Rigid body dynamics — Expressions for moments of inertia of a circular disc and rectangular plate about different axes—MI of Flywheel

Unit 3 – (Quantum theory of radiation): Blackbody spectrum—Wien's law—Raleigh-Jeans law—Stefan-Boltzmann law—Planck's quantum theory—Reduction of Planck's formula to Raleigh Jeans and Wien's formulae—Compton effect—Wave particle dualism—de Broglie hypothesis and matter waves—Phase velocity and group velocity of matter waves

Unit 4 – (Quantum Mechanics): Heisenberg's uncertainty principle—Applications of Heisenberg's uncertainty principle—wave function and its properties - Setting up of Schrodinger's one-dimensional time independent wave equation—Application of Schrodinger's equation to a particle in an infinite potential well to determine eigen values and eigen functions

Unit 5 – (Lasers): Interaction of radiation with matter - Absorption, spontaneous emission and stimulated emission - Characteristics of laser light - Expression for the energy density of electromagnetic radiation – Requisite conditions for production of a laser beam—Helium-Neon laser—Semiconductor laser—Applications of lasers—Lidar—laser isotope separation—laser fusion

Unit 6 – (Optical Fibers): Principle-- Angle of acceptance—Expression for Numerical aperture--condition for propagation—Intermodal dispersion-- material dispersion—Refractive index profiles of step index and graded index fibers(GRIN)—Modal propagation in step index and GRIN fibers –Attenuation—Different types of loss mechanisms--Fiber optic communication system

Unit 7 – (Crystal structure): Space lattice—Bravais lattice—Lattice parameters—unit cell and primitive cell—Crystal systems - Miller indices - Indexing directions and planes in a crystal - Atomic packing fraction and coordination number for simple, body centered and face centered cubic Crystals - Expression for inter planar Spacing - Structures of NaCl and diamond crystals—Bragg's law—Identification of cubic crystals using Bragg's law

Unit 8 – (Electrical conductivity of metals): Review of Classical free electron theory - Failure of classical free electron - Quantum free electron theory—Density of States (Qualitative) – Fermi energy – Fermi factor - Effect of temperature on Fermi-Dirac Distribution functio

Unit 9 – (Lab Experiments)

1. Determination of the relationship between the torque and angular acceleration of a flywheel
2. Determination of the (i) the moment of inertia of the given disc and (ii) the rigidity modulus of the material of a wire by torsional oscillations
3. Analysis of Powder X-ray diffraction pattern.
4. Determination of Young's modulus of material of a beam by uniform bending method

5. Determination of radius of curvature of a plano-convex lens by setting up Newton's rings.
6. Determination of the wavelength of prominent spectral lines of Hg source using diffraction grating with minimum deviation method.
7. Determination of thickness of paper by air wedge experiment.
8. Determination of efficiency of Solar cell.
9. Determination of Planck's constant using LED.
10. Study of I-V characteristics of Zener diode
11. Determination of the frequency response of series and parallel resonance circuit and to find the resonant frequency and quality factor.
12. Determination the width of the forbidden energy gap in a semiconductor diode.
13. Determination of dielectric constant of a material by charging and discharging a capacitor.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3		2		1								3	1	0
CO-2	2	1	3	3		1	1						3	2	0
CO-3	3	2											3	0	0
CO-4	3	2	2	1									3	1	0
CO-5	3	2		3			2		1	2			3	3	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		02
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Numeracy		13
1. Solving Numerical Problems	13	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory		
3. Engineering Workshop / Course Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		00
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Tests, Written Examination		10

Total Duration in Hours	85

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment is presented in the Programme Specifications document pertaining to the B.Tech. Programmes. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (TSC1, TSC2, TSC3 or LSC4), COs are assessed as illustrated in the following Table.

For Combined Courses (Theory + Laboratory)					
Focus of COs on each Component or Subcomponent of Evaluation					
Course Outcome	CE (Weightage: 60 %) Four components including one Lab component			SEE (Weightage: 25 %)	Lab (Weightage: 15 %)
	Tests (30 %)	Written Assignments+ Lab (20 %)	Assignment +Lab CE (10%)	Written exam	LSEE: SEE
CO-1	×			×	
CO-2	×	×		×	
CO-3	×	×		×	
CO-4	×	×		×	
CO-5			×		×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8 Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No.	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Class room lectures, and demonstrations
3.	Critical Skills	Assignment
4.	Analytical Skills	Class room, assignment
5.	Problem Solving Skills	Class room, assignment
6.	Practical Skills	Class room, assignment
7.	Group Work	Classroom
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation

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12.	Behavioral Skills	Course
13.	Information Management	Assignment, examination
14.	Personal Management	Assignment, examination
15.	Leadership Skills	Effective management of learning, time management, achieving the learning

9. **Course Resources**

a. **Essential Reading**

1. Class Notes
2. Rajendran, V. (2011) Engineering Physics, TMH
3. Srinivasan M. R. (2011) Physics for Engineers, 3rd Ed, New Age International
4. Gyan Prakash, (2012) Experimental Physics,
5. Michael Sayer, Abhai Mansingh, (1999) Measurement, Instrumentation and Experiment Design in Physics and Engineering, PHI

b. **Recommended Reading**

1. Halliday, I.D., Resnick, R and Walker, J (2010) Fundamentals of Physics, 9th Ed, Wiley
2. Richtmeyer, F. K., Kennard, E.H. and Cooper, J.N (2007) Modern Physics, 6th Ed, TMH
3. Beisser, A. (2009) Concepts of Modern Physics, 6th Ed, TMH
4. Kittel, C. (2010) Introduction to Solid State Physics, 8th Ed, Wiley
5. S.O. Pillai (2011), A Textbook of Solid State Physics, 6th Ed, New Age International
6. Srinivasan M.R. (2011) Applied Solid State Physics, 1st Ed, New Age International
7. Giri, P.K., (2005) Physics Laboratory Manual for Engineering Undergraduates, Department of Physics, Indian Institute of Technology Guwahati

c. **Magazines and Journals**

d. **Websites**

1. http://nptel.ac.in/
2. Other Electronic Resources

e. **Electronic resources on the subject area are available on MSRUAS library**

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Course Specifications: Engineering Mechanics

Course Title	Engineering Mechanics
Course Code	CEF101A
Course Type	Core Theory Course
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This subject deals with laws of engineering mechanics for static and dynamics equilibrium of rigid bodies. The students will be trained on application of engineering mechanics to solve practical problems pertaining to various force systems and static and dynamic equilibrium of rigid bodies.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture:Tutorial:Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** State and describe the laws of Statics, Friction and Dynamics and their contexts of application.
- **CO-2.** Interpret standard mathematical relationships and apply for solving problems when rigid bodies are subjected to different force systems
- **CO-3.** Apply the concepts of equilibrium for solving the problems on rigid bodies
- **CO-4.** Determine centroid/centre of gravity for various plane shapes and calculate moment of inertia for the structural members
- **CO-5.** Apply the laws of statics for the analysis of rigid bodies with and without friction

4. Course Contents

Unit 1 (Engineering Mechanics): Branches of mechanics and its importance: Engineering Design , Mechanics in engineering, Introduction to SI units , Basic idealisations - Particle, Continuum, Rigid body and Point force with examples, principles of mechanics with examples- laws of parallelogram, law of transmissibility, gravitation, Classification of force and force systems; Principle of physical independence of forces, Principle of superposition of forces; constraints on rigid bodies and corresponding reactions, Moment of a force, couple, moment of a couple, characteristics of couple, Equivalent force - couple system; Resolution of forces, composition of forces; Numerical problems on moment of forces and couples, equivalent force and couples.

Unit 2 (Analysis of Coplanar Concurrent and Non-Concurrent System of Forces): Varignon's theorem, resultant of Concurrent and non-concurrent force systems. Equilibrium of Structural Systems: Types of forces acting on a body, Free Body diagram Analysis, Lami's Theorem, Equilibrium of connected bodies, types of supports in beams, determination of support reactions, Applications to engineering problems.

Unit 3 (Centroid of planes and Moment of inertia of area): Differences between centre of gravity and Centroid, use of axis of symmetry, Centroid of simple built-up sections by integration, Moment of Inertia of planes, radius of gyration, Theorems of moment of inertia, moments of inertia of standard sections by integration, Numerical Examples.

Unit 4 (Friction in Engineering Systems): Laws of friction, angle of friction, angle of repose, cone of friction, Analysis of blocks resting on horizontal and inclined planes, rolling friction, rope friction, Application to wedge and ladder problems, problems involving non concurrent force systems.

Unit 5 (Introduction to dynamics): General principles and types of motions and D'Alemberts principle with examples, Newton's laws of motion. Linear motions and projectiles -Motion with uniform velocity and acceleration, motion with varying acceleration, motion of bodies projected horizontally, projection on inclined planes.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3												3		
CO-3	3	3											3		
CO-4	3	2	1										2		
CO-5		2	3										3		
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

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6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		10
Demonstrations		0
1.Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		30
1. Solving Numerical Problems	30	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**55**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

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For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	×		×
CO-2	×	×	×
CO-3	×		×
CO-4		×	×
CO-5		×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures, Assignment
2.	Understanding	Classroom lectures, Assignment, Self-study
3.	Critical Skills	Classroom lectures, Assignment
4.	Analytical Skills	Classroom lectures, Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	Assignment, Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, Examination
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

f. Essential Reading

1. Class notes
2. S. S. Bhavikatti, (2021), Engineering Mechanics, New Age International
3. R K Rajput (2011), A Text Book of Applied Mechanics, 3rd Edn, Laxmi Publications

g. Recommended Reading

1. S. Timoshenko, D.H. Young, J.V. Rao, Sukumar Pati (2017), Engineering Mechanics, McGraw-Hill Education

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2. C. Lakshamanarao, J. Lakshinarashiman, Raju Sethuraman, Srinivasan M. Sivakumar (1993), Engineering Mechanics: Statics and Dynamics, PHI, New Delhi

h. Magazines and Journals

1. Journal of Engineering Mechanics
2. International Journal for Theoretical and Applied Mechanics

i. Websites

1. https://ascelibrary.org/journal/jenmdt

j. Other Electronic Resources

1. https://nptel.ac.in/

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Course Specifications: Elements of Electronics Engineering and Laboratory

Course Title	Elements of Electronics Engineering and Laboratory
Course Code	ECF102A
Course Type	Core Theory and Laboratory
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

The aim of this course is to create a strong foundation of Digital Electronics. The students are taught the basic components of digital systems and the process of their implementation. The students are also taught Boolean algebra, logic gates, basics of memories, and implementation of combinational and sequential digital circuits using logic gates. This course also emphasizes on different types of memories and logic designing platforms and their merits and demerits. Students are trained to employ the principles of digital electronics to implement digital design for the given problem. Basic electronics laboratory deals with practical applications of electronic circuits and their theoretical concepts.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:2
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Electronics and Communication Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain working principles of PN junction diode, Zener diode, transistors, amplifier configurations, Op-Amps, power supply, logic gates and electronic displays
- **CO-2.** Derive mathematical relationships for electronic devices and circuits
- **CO-3.** Solve simple numerical and design problems related to analog / digital circuits as well as devices
- **CO-4.** Design and analyse operation of standard analog / digital circuits for a given application
- **CO-5.** Conduct experiments as per the standard procedures and tabulate/calculate/plot the measured values
- **CO-6.** Interpret and compare with standard results, and draw conclusions and Write report as per the prescribed format

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4. Course Contents

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Unit 1 (Basic concepts in Electronics): Semiconductor: p-type, n-type; p-n junction diode, its characteristics, half wave, full wave and bridge type rectifiers, basic filter circuits, Diode as voltage multiplier, clipper and clamper circuit, Zener diode characteristics, Zener diode as a voltage regulator.

Unit 2 (Transistor- BJT): Transistor configurations: CB, CE and CC; Transistor parameters: alpha, beta and gamma, working of transistor as a switch, Amplifier; Transistor biasing – Base, Collector-to-base and Voltage Divider Bias.

Unit 3 (Amplifiers): Differential amplifiers and their transfer characteristics, IC Op-Amps, their ideal and practical characteristics, Op-Amp in different modes as inverting amplifier, non-inverting amplifier, summing amplifier, scale changer, differentiator and integrator.

Unit 4 (Power Supplies): Introduction and working of Switched Mode Power Supply (SMPS), Voltage Regulator, Introduction to Inverters and UPS.

Unit 5 (Digital Electronics): Binary, Octal and Hexadecimal number systems and conversions, Boolean Algebra, Truth table of logic gates- AND, OR, NOT, NAND, NOR; Universal gates; Generation of Integrated Circuits- SSI, MSI, LSI and VLSI.

Unit 6 (Laboratory): List of Experiments

1	Forward and Reverse bias V-I Characteristics of a P-N Junction diode
2	Forward and Reverse bias V-I Characteristics of Zener diode
3	Half wave and Full wave Rectifier circuits: a) Output of half/full wave rectifier with and without capacitor filter.
4	Bridge Rectifier circuits: a) Output of bridge rectifier with and without capacitor filter
5	Clipping circuits (Shunt clippers) Clipping circuits (Series clippers)
6	Clamping circuits
7	Characteristics of Op-amp inverting and non- inverting amplifiers
8	Logic Gates circuits: Verification of the truth tables of AND, OR, NOT, NAND, NOR, and EX-OR gates.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3												3		
CO-3		3	2										3		
CO-4		3	2										3		
CO-5		3											3		
CO-6		3		2									3	2	

3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		33
Demonstrations		02
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		10
1. Solving Numerical Problems	10	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**85**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (TSC1, TSC2, TSC3 and LSC4), COs are assessed as illustrated in the following Table.

For Combined Courses (Theory + Laboratory)					
Focus of COs on each Component or Subcomponent of Evaluation					
Course Outcome	**CE (Weightage: 60 %) Four components including one Lab component**			**SEE (Weightage: 25 %)**	**Lab (Weightage: 15 %)**
	Tests (30 %)	**Written Assignments+ Lab (20 %)**	**Assignment +Lab CE (10%)**	**Written exam**	**LSEE: SEE**
CO-1	×			×	
CO-2	×	×		×	
CO-3	×	×		×	
CO-4	×	×		×	
CO-5			×		×

The details of number of tests and assignments to be conducted are presented in the Academic

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Regulations and Programme Specifications Document.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignments, Laboratory instruction
2.	Understanding	Class room lectures, Assignments, Laboratory instructions and experiments
3.	Critical Skills	Class room lectures, Assignments
4.	Analytical Skills	Class room lectures, Assignments
5.	Problem Solving Skills	Class room lectures, Assignments
6.	Practical Skills	Laboratory Work
7.	Group Work	Laboratory Work
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination, Laboratory work
10.	Verbal Communication Skills	Laboratory work
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, examination, Laboratory
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Millman and Halkias, 2001, Integrated Electronics, Tata McGraw-Hill Education
3. Robert Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 7th Ed. Prentice Hall
4. Dale R. Patrick, 1989, Electricity and Electronics Laboratory, The Goodheart-willcox Company Inc, Illinois

b. Recommended Reading

1. Albert Malvino, 2006, Electronic Principles, Tata McGraw - Hill Education
2. Donald L. Shilling & Charles Belowl, 1968, Electronic Circuits, New York: McGraw-Hill
3. Tocci R J and Widmer N S, 2001, Digital Systems - Principles and Applications, 8th Ed., Pearson Education India, New Delhi

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4. Cooper and Helfrick, 1996, Modern Electronic Instrumentation and Measuring Techniques, 4th print Prentice Hall of India, New Delhi
5. H S Kalsi, 2007, Electronic Instrumentation, TMH, 2nd Edition
6. R A Gaikwad, 2001, Op-Amps and Linear Integrated Circuits, PHI, 4th edition
7. Millman and Grabel, 1999, Microelectronics, 2nd Ed. Tata McGraw-Hill
8. Louis R. Nardizzi, 1973, Basic circuits and electronics experiments, Van Nostrand
9. George B. Rutkowski, 1984, Basic electricity for electronics, Bobbs-Merrill Educational Pub.
10. Russell L. Meade, 2003, Foundations of Electronics: Circuits and Devices, Delmar learning, a division of Thomson learning, Inc.

c. **Magazines and Journals**
   1. Electronics For You
   2. IEEE Transaction on Circuits and System I and II

d. **Websites**
   1. http://www.electronics-lab.com
   2. http://www.labmanager.com
   3. http://electronicsforu.com
   4. http://www.lifescienceleader.com

e. **Other Electronic Resources**
   1. https://ocw.mit.edu/index.htm MultiSim software
   2. Analog trainer kit
   3. Digital trainer kit
   4. Discrete electronic components

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Course Specifications: Engineering Drawing

Course Title	Engineering Drawing
Course Code	MEF103A
Course Type	Core Theory and Laboratory
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

This course deals with graphical representation of geometrical entities in various views for visualization and communication. The students will be taught orthographic and isometric projection of points, lines, planes and solids. The students will be taught sections and development of solids. The students will be equipped to visualize and apply principles of orthographic projection to given application. The students will also be trained to use CAD tool to carry out these geometric projections.

2. Course Size and Credits

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:1
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical and Manufacturing Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the conventions used in projections of geometric entities and interpret the same
- **CO-2.** Draw orthographic projections for the geometric entities in specified positions
- **CO-3.** Develop lateral surfaces of un-sectioned and sectioned regular solids
- **CO-4.** Develop orthographic projections for given applications
- **CO-5.** Draw isometric projections for the solids and their combinations
- **CO-6.** Demonstrate competency in using CAD tool for drawing projections of geometric entities

4. Course Contents

Unit 1 (Introduction to Engineering Drawing and CAD Tool): Drawing Instruments and their uses, BIS conventions and specifications, Dimensioning and Significance of Lettering. Graphical User Interface (GUI), Co-ordinate system and reference planes. Definitions of Horizontal Plane (HP), Vertical Plane (VP), Right Profile Plane (RPP) & Left Profile Plane (LPP). Creation of 2D/3D environment. Selection of drawing size and scale. Creation of geometric entities and text. Modification and editing of geometric entities. Dimensioning, line conventions and material conventions

Unit 2 (Orthographic Projections- Points and Lines): Definitions - Planes of projection, reference line and conventions employed. Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant, first angle projection), True and apparent lengths, True and apparent inclinations to reference planes (simple problems).

Unit 3 (Orthographic Projections - Planes (First Angle Projection): Definitions–projections of plane surfaces–triangle, square, rectangle, pentagon, hexagon and circle. Planes in different positions by change of position method only.

Unit 4 (Orthographic Projections – Solids (First Angle Projection): Definitions – Projections of solids– cube, prisms, cylinder, pyramids, cones and tetrahedron in different positions.

Unit 5 (Orthographic Projections – Section of Solids and Development of Surfaces (First Angle Projection): Section planes, Sections, Section views, Apparent shapes and True shapes of sections of right regular prisms, pyramids, cylinders and cones resting in simple positions.

Unit 6 (Isometric Projections using Isometric Scale) : Section planes, Sections, Section views, Apparent shapes and True shapes of sections of right regular prisms, pyramids, cylinders and cones resting in simple positions. Application of Projection of points and lines to given situation.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3	2								1			3		1
CO-3	3	2								1			3		1
CO-4	3	2								1			3		1
CO-5	3	2								1			3		1
CO-6					2									2	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	00	
2. Computer Laboratory	30	

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3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	×	×	×
CO-2	×	×	×
CO-3			×
CO-4	×	×	×
CO-5			×
CO-6	×		×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

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S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures, Assignments
2.	Understanding	Classroom lectures, Assignments
3.	Critical Skills	Classroom lectures, Assignments
4.	Analytical Skills	Classroom lectures, Assignments
5.	Problem Solving Skills	Classroom lectures, Assignments
6.	Practical Skills	Assignment
7.	Group Work	Assignments
8.	Self-Learning	Assignments
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	Assignment
12.	Behavioral Skills	--
13.	Information Management	Assignment, Examination
14.	Personal Management	Course Work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. K. R. Gopalakrishna, 2005, Engineering Graphics, 32nd Edition, Shubhash Publishers

b. Recommended Reading

1. W. J. Luzadder, 2006, Fundamentals of Engineering Drawing, 11th Edition, Prentice Hall India
2. N. D. Bhatt and V. M. Panchal, 2006, Engineering Drawing, 49th Edition, Charotar Publishing House
3. CAD Tool Users Manuals

c. Magazines and Journals

d. Websites

1. http://nptel.ac.in

e. Other Electronic Resources

1. Electronic resources on the course area are available on MSRUAS library

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Course Specifications: Constitution, Human Rights and Law

Course Title	Constitution, Human Rights and Law
Course Code	LAN101A
Course Type	Ability Enhancement Compulsory Course
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

This course aims at enabling students understand the key principles of Indian Constitution, Human Rights and Law. The course facilitates the understanding of the framework of Indian constitution and the judicial and the legal systems that guides Indian citizens. It aims at building awareness about the application of Human Right principles and Law. It allows students to work towards the formulating realistic solutions for protection of human rights.

2. Course Size and Credits

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	2:0:0
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	School of Law
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the key principles of the Indian Constitution
- **CO-2.** Explain Indian legal system and judicial structure that govern the citizens
- **CO-3.** Discuss UN Declaration of Human Rights
- **CO-4.** Discuss the scope and application of Human Rights Principles and Law
- **CO-5.** Suggest strategies for protection of human rights and resolving legal issues in compliance with applicable laws

4. Course Contents

Unit 1 (Constitution of India): The framework of Constitution of India, Constituent Assembly, The Constitution and the government, The constitution and the judiciary, The constitution and the legislature.

Unit 2 (Introduction to Law): Indian Legal System and Judicial Structure, Liability under the Law, Issues relating to Good Corporate Governance, Company Law.

Unit 3 (Concept of Human Rights and Duties): Inherent, inalienable, universal, indivisible, values, dignity, liberty, equality, justice, unity in diversity, classification of rights, classification of duties, correlation of rights and duties, need for balance between rights and duties, freedom and responsibility.

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Unit 4 (International Human Rights Standards and UN): Universal declaration of human rights 1948, international covenant on civil and political rights 1966, international covenant on economic, social and cultural rights 1966, UN system and human rights, convention on elimination of all forms of racial discrimination 1965, convention on elimination of all forms of discrimination against women 1979, convention on the rights of the child 1989, UN declaration and duties and responsibilities of individuals 1997, UN agencies to monitory compliance such as UN high commission for human rights.

Unit 5 (Contract Law and Disputes): Formation of Contract: offer and acceptance, Terms of Contract: avoidance, representation, illegality, Breach of Contract and Remedies, Industrial Disputes Act, Negligence, Trespass and Breach of Statutory Duty, Litigation, Arbitration, Judicial Remedies.

Unit 6 (Intellectual Property Law): Copyright, Protection and Infringement of Copyright, Trade Marks, Protection of Trade Marks and Passing-off, Patents, Ownership and Protection of Patents, Product Liability, Government Schemes for IPR Protection.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3												3		
CO-3	3									2			3		2
CO-4	3	2											3		
CO-5										3					3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		0
1.Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		0
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	

5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2), COs are assessed as illustrated in the following Table.

For AECC Only		
Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: CE (60% Weightage)	**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests or Assignments**	
CO-1	X	X
CO-2	X	X
CO-3	X	X
CO-4	X	X
CO-5	X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.		

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Face to face lectures
2.	Understanding	Face to face lectures, group discussions
3.	Critical Skills	

4.	Analytical Skills	Face to face lectures, activities, group discussions, assignments
5.	Problem Solving Skills	
6.	Practical Skills	Face to face lectures, activities, group discussions, course work
7.	Group Work	Course work, practice, assignment, group discussion
8.	Self-Learning	Course work, practice, assignment, group discussion
9.	Written Communication Skills	Face to face lectures, Course work, practice, assignment, group discussion
10.	Verbal Communication Skills	Face to face lectures, Course work, practice, assignment, group discussion
11.	Presentation Skills	
12.	Behavioral Skills	Course work, practice, assignment, group discussion, presentation practice, role plays
13.	Information Management	Assignment
14.	Personal Management	Face to face lectures
15.	Leadership Skills	Face to face lectures, group discussions

9. Course Resources

a. **Essential Reading**

1. Course notes
2. Tulsian, PC. (2008) Business Law, Tata McGraw Hill, New Delhi
3. Donnelly, J. (1998) International Human Rights, 2nd edn, Westview Press

b. **Recommended Reading**

1. Gulshan , S. S and Kapoor, G. K. (2005) Business Law including Corporate Laws, New Age International (P) Ltd. Publishers, New Delhi
2. Perry, M. (1998) The Idea of Human Rights, Oxford University Press
3. K Swamyraj (2017), Law of Contract (General Principles), God's Grace Publication, New Delhi
4. D D Basu (1983), Constitutional Law of India, Lexis Nexis Butterworths Publication, Nagpur
5. Introduction to Intellectual Property Theory and Practice (1997), World Intellectual Property Organisation, Geneva
6. Smith, R. (2007) Textbook on international human rights 3rd edn, Oxford University Press

c. **Magazines and Journals**

d. **Websites**

1. http://industrialrelations.naukrihub.com/industrial-relation-policy.htm
2. http://labour.nic.in/
3. http://whitepapers.businessweek.com/tlist/Legal-Environment.html
4. http://nptel.ac.in/

e. **Other Electronic Resources**

1. Electronic resources on the course area are available on MSRUAS library

Nayana N. Patil

Course Specifications: Engineering Mathematics - 2

Course Title	Engineering Mathematics - 2
Course Code	MTB102A
Course Type	Core Theory
Department	Applicable for all programmes
Faculty	Engineering and Technology

1. Course Summary

This course deals with analytical solutions of ordinary differential equations and Laplace transform. Students are taught the concepts of fundamentals of ordinary differential equations and Laplace transform. The solution procedures for certain standard forms of ordinary differential equations are illustrated. The role, relevance of ordinary differential equations in modelling some of the real world problems are emphasized and this course also covers the underlying principles and applications of transform techniques in various engineering disciplines.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mathematics and Statistics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- CO-1. Describe the fundamentals of ordinary differential equations and Laplace transform
- CO-2. Solve standard forms of ordinary differential equations
- CO-3. Solve simple problems in ordinary differential equations and Laplace transform
- CO-4. Model real world problems using ordinary differential equations and solve complex problems associated with ordinary differential equations using Laplace transform
- CO-5. Apply Laplace transform in solving complex real world engineering problems

4. Course Contents

Unit 1 (First Order Differential Equation): First order differential equations - Introduction, basic concepts and geometrical meaning. Separable, linear and exact differential equations. Integrating factors and transformations. Applications of first order ordinary differential equations: orthogonal trajectories, growth/decay problems and mixture problems

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Unit 2 (Higher Order Differential Equation): Introduction, initial and boundary value problems. Linear homogenous/nonhomogeneous differential equations with constant coefficients, method of undetermined coefficients and variation of parameters. Cauchy-Euler equations. Application of second order linear differential equations with constant coefficients, mass-spring-dashpot system, electric circuits. System of linear differential equations of first order, solutions by matrix method.

Unit 3 (Laplace Transform): Definition, properties and theorems, transform of derivatives, integrals, periodic functions, unit step function, Dirac's delta function and time shifting property. Inverse Laplace transform, convolution theorem, solution of initial value problems

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2							1			3		1
CO-2	2	3	2							1			3		1
CO-3	3	3	1							1			3		1
CO-4	3	3	2	2	2					1			3	2	1
CO-5	3	3	2	2	2					1			3	2	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		70

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7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	×	×	×
CO-2	×	×	×
CO-3	×	×	×
CO-4		×	×
CO-5		×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

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9. Course Resources

a. Essential Reading

5. Glyn James, 2016, Advanced Modern Engineering Mathematics, 4th edition, Pearson Dennis Zill, 2012,
6. A First Course in Differential Equations, 10th edition, Massachusetts, Brooks/Cole
7. Shepley Ross, 2007, Introduction to Ordinary Differential Equations, 4th edition, New York, John Wiley & sons

b. Recommended Reading

1. George Simmons, 2017, Differential Equations with Applications and Historical Notes, 2nd edition, New Jersey, McGraw Hill
2. Dennis Zill and Warren Wright, 2011, Advanced Engineering Mathematics, 4th edition, Jones and Bartlet
3. Erwin Kreyszig, 2015, Advanced Engineering Mathematics, tenth edition, John Wiley & Sons Inc.

c. Magazines and Journals

d. Websites

1. http://nptel.ac.in/
2. https://ocw.mit.edu/index.htm

e. Other Electronic Resources

1. https://www.khanacademy.org/
2. tutorial.math.lamar.edu/

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Course Specifications: Engineering Chemistry and Laboratory

Course Title	Engineering Chemistry and Laboratory
Course Code	CYB104A
Course Type	Core Theory and Laboratory
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

This subject aims at enhancing the basic understanding of chemistry with reference to engineering systems and to train students to perform quantitative analysis related to Engineering Chemistry.

This subject deals with topics on electrochemistry, energy stage devices, fuels, chemical kinetics, corrosion science, metal finishing, polymers and nanomaterials.

Students are trained to determine physical and chemical properties of a given sample experimentally. They are trained to analyze the results and infer appropriate conclusions based on concepts of Engineering Chemistry.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Chemistry
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Explain the basic concepts of electrochemistry, conversion of chemical energy into electrical energy, theory of corrosion and principles of metal finishing

CO-2. Differentiate renewable - nonrenewable fuels, primary - secondary electrodes & primary - secondary batteries, batteries - fuel cells, electroplating – electroless plating, thermosetting – thermoplastic polymers and dry corrosion - wet corrosion

CO-3. Discuss the reaction chemistry and stoichiometry of combustion of fuels, remedial measures to control oxides of nitrogen, sulphur and carbon, polymerization – methods, mechanism, preparation, properties and applications of some polymers, concepts of nano science and nanotechnology

CO-4. Identify the types of corrosion and methods to prevent corrosion, suitable polymers and nanocomposite materials for engineering applications

CO-5. Derive kinetic rate equations for various chemical systems and equation for electromotive force

CO-6. Analyze the suitability of polymers & composites for various applications and solve problems related to storage devices, chemical kinetics, electro chemistry, corrosion and metal finishing

CO-7. Plan the experimental set up, conduct experiments, calculate and plot the graphs to obtain results, and write a laboratory report as per the prescribed format

4. Course Contents

Unit 1 Electrochemistry: Electrochemical cell, Electrode Potential and EMF. Construction of Galvanic cell, Types of Electrodes. Numerical on Electrode Potential of cell using Nernst equation. Construction and working of reference electrodes: calomel and silver-silver chloride electrode. Construction, working and application of Ion-selective electrode: Glass electrode. Determination of pH using glass electrode

Unit 2 Storage and Conversion devices – Batteries: Storage devices – Batteries: Primary batteries, Secondary batteries, reserve batteries and super capacitors. Construction, working and application of dry cell, lead acid, Nickel-Cadmiun, Nickel-Metal hydride, Zinc –Air, Lithium-ion batteries, Lithium polymer batteries.
Conversion devices: Fuel cells, Construction, working and application of: Hydrogen-Oxygen, Methanol-Oxygen cells.

Unit 3 Corrosion and its Control: Types of corrosion. Electrochemical theory of corrosion. Factors affecting, Corrosion control: Metal coating, cathodic protection, organic coating, corrosion-inhibitors.

Unit 4 Metal Finishing: Technological importance of metal finishing, Polarization and factors influencing polarization, Principle of electroplating, factors affecting electrodeposition, Electroplating of Chromium and Gold. Electro-less Plating of Copper and Nickel.

Unit 5 Chemical Kinetics: Order of Reactions, Derivation of second, third, consecutive reactions, rate equations, Steady State Concept, numerical problems with suitable examples of different kinds of reactions.

Unit 6 Combustion Chemistry: Introduction to Fuels, types and classification, Sources of Fuels, Characteristics of a good fuel, Proximate and ultimate analysis, Petroleum cracking, Mechanism of Knocking and its effect, Anti-knocking agents, Octane and Cetane numbers, Functioning of Catalytic converter, Introduction to Biofuels, Flue gases and control measures.

Unit 7 Polymers and polymerization: Introduction & Classification of polymers, Addition, condensation and co- ordination polymerizations, mechanism of free radical addition polymerization with ethylene as example, Techniques of polymerization (Bulk, Solution, suspension, emulsion), Tg, factors affecting Tg, effect of structure on properties of polymers, fundamentals of biodegradable polymers, preparation, properties and technical applications of thermoplastics (PVC, PVA, Teflon), thermosets (PF, UF), elastomers (natural rubber, SBR) & adhesives (epoxy and acrylics) Introduction to polymeric composites.

Unit 8 Introduction to nanoscience and nanotechnology: Basic concepts of Nanoscience and Nanotechnology – Graphene – Carbon nanotubes – Material processing by top down and down top synthesis; chemical vapor deposition and physical vapor deposition– Potential uses of nanomaterials in electronics, robotics, computers, sensors, vehicles and transportation – Medical applications of nanomaterials.

Unit 9 – (Lab Experiments)	
1	Determination of Viscosity Coefficient of a given liquid using Ostwald's Viscometer
2	Conductometric estimation of an acid using standard NaOH solution

3	Determination of pKa of the given weak acid using Glass electrode-Ag/AgCl electrode assembly
4	Potentiometric estimation of FAS using standard $K_2Cr_2O_7$ solution
5	Colorimetric estimation of Copper
6	Determination of total hardness of a given water sample
7	Determination of percentage of Cu from the given brass sample
8	Determination of percentage of Fe in the rust solution by external indicator Method
9	Determination of first order reaction constant for acid hydrolysis of ethyl acetate
10	Electroplating of copper*
11	Determination of composition of brass alloy using UV-Vis spectroscope*
12	Measurement of voltage in a hydrogen-oxygen fuel cell*
13	Preparation of printed circuit board*
14	Construction and operation of lead acid battery cell*
15	Determination of empirical formula of a fuel using exhaust gas analyzer*

* Demo experiments

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2						3								3	
CO-3							3							3	
CO-4			3										3		
CO-5							1							1	
CO-6		3		2						3			3	2	3
CO-7	3	2		3			2		1	3			3	3	3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		35
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		10
1. Solving Numerical Problems	10	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	

6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
	Total Duration in Hours	**85**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. Programmes. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (TSC1, TSC2, TSC3, LSC4 or LSC5), COs are assessed as illustrated in the following Table.

For Combined Courses (Theory + Laboratory)					
Focus of COs on each Component or Subcomponent of Evaluation					
Course Outcome	CE (Weightage: 60 %) Four components including one Lab component			SEE (Weightage: 25 %)	Lab (Weightage: 15 %)
	Tests (30 %)	Written Assignments+ Lab (20 %)	Assignment +Lab CE (10%)	Written exam	LSEE: SEE
CO-1	×	×		×	
CO-2	×	×		×	
CO-3	×	×		×	
CO-4	×	×		×	
CO-5	×	×		×	
CO-6		×		×	
CO-7			×		×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course

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1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. **Course Resources**

a. **Essential Reading**

1. Class Notes
2. Gadag, R.V. and Nityananda Shetty A., (2010), Engineering Chemistry, Second Edition, New Delhi, I.K. International Publishing House
3. O.G. Palanna, (2011), Engineering Chemistry, New Delhi, Tata McGraw Hill Education Pvt Ltd.
4. Gurudeep Raj, (2014), Advanced Physical Chemistry, Meerut-Uttar Pradesh, Krishnan Prakashana
5. Pradeep. T, (2012) "A Text Book of Nanoscience and Nanotechnology", New Delhi, Tata McGraw Hill Company Ltd.

b. **Recommended Reading**

1. Pletcher, D. and Walsh, F.C., (1993), Industrial Electrochemistry, Second edition, UK, Blackie Academic and Professional
2. Kuriacose, J.C. & Rajaram, J., (1998), Chemistry in Engineering & Technology (Vol I & II), Third reprint, New Delhi, Tata McGrahill Company
3. C. N. R. Rao, Achim Muller and A.K. Cheetham, (2004), The Chemistry of Nanomaterials, Vol I & II, Weinheim, Wiley VCH.

c. **Magazines and Journals**

d. **Websites**

e. **Other Electronic Resources**

1. http://nptel.ac.in/
2. Electronic resources on the subject area are available on MSRUAS library

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Course Specifications: Elements of Mechanical Engineering and Workshop Practice

Course Title	Elements of Mechanical Engineering and Workshop Practice
Course Code	MEF104A
Course Type	Core Theory
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

This course is aimed at preparing the students to understand the concepts and underlying principles of mechanical engineering. The students are taught various types of energy sources, power generation, energy conversion methods and types of power plants. Students are taught the working of IC engines, refrigeration and air-conditioning and power transmission elements. Students are also exposed to basic operations and applications of machine tools.

2. Course Size and Credits

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:1
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mechanical and Manufacturing Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Demonstrate the understanding on Classification of energy sources, energy conversion systems, mechanical power transmission systems, machine tools and processes

CO-2. Describe various energy conversion systems, mechanical power transmission systems and machine tools

CO-3. Explain the working principle of refrigeration systems, biomass conversion technologies and machining operations

CO-4. Solve numerical problems on IC engines and mechanical power transmission systems

CO-5. Apply principles of energy conversion systems, power transmission systems, machining processes and mechanical joints to practical applications

4. Course Contents

Unit 1 (Energy Sources and its Conversion Devices): Energy sources and their classification, Fuels and their properties. Bio-mass energy, OTEC, Solar energy, Wind energy, Geo-thermal energy, Tidal energy, Nuclear Energy. Demonstration of Gas Turbine

Unit 2 (Boilers and Accessories): Steam boilers – classification, Lancashire boiler, Babcock and Wilcox boiler; working and function of boiler mountings and accessories. Demonstration of

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Steam Turbine

Unit 3 (Hydraulic Pumps and IC engines): Classification, Principles and operations of Reciprocating and rotary types of pumps and compressors.
Internal Combustion Engines: Classification of IC Engines, engines components, 2 and 4–Stroke Petrol and diesel engines, P-V diagrams for Otto and Diesel cycles, IC engine performance-numerical on IC engines, electric and Hybrid vehicles. Demonstration of Pumps, Blower Compressors and Multi-cylinder Engine.

Unit 4 (Refrigeration and Air Conditioning): Properties of refrigerants, Performance of Refrigeration System - Refrigerating effect, Ton of Refrigeration, Ice making capacity, COP, Relative COP, Unit of Refrigeration, Energy Efficiency Ratio (EER). Principle and working of vapour compression refrigeration, vapour absorption refrigeration, comparison of vapour compression and vapour absorption refrigeration. Principles and applications of air conditioners, Room air conditioner, automotive air conditioning system

Unit 5 (Mechanical Power Transmission): Belt Drives - Classification and applications, Length of belt, Velocity ratio, Creep and slip, Idler pulley, stepped pulley and fast and loose pulley, belt and pulley construction. Demonstration of Open and Cross Belt drive. Applications of chain drive and rope drives. Gear Drives: Definitions, Terminology, types and uses, Gear Drives and Gear Trains – Simple problems on gear drives. Demonstration of Simple and Compound Gear Trains. Importance of machining and machine tools

Unit 6 (Machine Tools and Mechanical Joints): Lathe - Principle of working of a Centre Lathe, Parts of a lathe, Lathe Operations. Drilling Machine – Principle of working and classification of drilling machines, types of drilling machines, drilling operations. Demonstration of working of Lathe and drilling machines along with different operations performed. Mechanical Joints: Temporary and permanent fasteners- Threaded fasteners, Riveted joints, welded joints, Knuckle joint, cotter and pin joints, couplings. Demonstration of Fitting operations, Sheet Metal operations, Arc Welding, Fasteners and Couplings.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3												3		
CO-3	3												3		
CO-4		3											3		
CO-5		3											3		
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		00
1. Demonstration using Videos	00	

2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	30	20
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	×		×
CO-2	×	×	×
CO-3	×	×	×
CO-4	×	×	×
CO-5	×	×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

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Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. V. K. Manglik, 2013, Elements of Mechanical Engineering, PHI Learning
3. K. R. Gopalakrishna, 2008, Elements of Mechanical Engineering, Subhash Publishers

b. Recommended Reading

1. G.D. Gokak, J.K. Kittur, 2014, Elements of Mechanical Engineering, Wiley publications
2. G. S. Sawhney, 2003, Fundamental of Mechanical Engineering, Prentice Hall of India Publication
3. S. Trymbaka Murthy, 2006, A Text Book of Elements of Mechanical Engineering, 3rd Revised Edition, I .K. International Publishing House Pvt. Ltd.
4. K. P. Roy and S. K. Hajra Chaudhary, 2005, Elements of Mechanical Engineering, Media Promoters and Publishers Pvt. Ltd.

c. Magazines and Journals

1. ASME Mechanical Engineering Magazine
2. Machine Tools

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/
3. www.asme.org

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e. Other Electronic Resources
   1. Electronic resources on the course area are available on RUAS library

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Course Specifications: Elements of Electrical Engineering and Laboratory

Course Title	Elements of Electrical Engineering and Laboratory
Course Code	EEF105A
Course Type	Core Theory and Laboratory
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

This course deals with basic principles and concepts of electric and magnetic circuits. Students are taught construction, principle of operation, working, characteristics of DC machines, transformers and AC rotating machines. They are introduced to fractional-kW motors, special purpose machines and facilitated to understand measuring instruments, domestic wiring and earthing techniques. Basic electrical laboratory deals with practical applications of circuits and their theoretical concepts.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Electrical Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. State and explain various laws of electric circuits, magnetic circuits and their significance, phasor diagrams for electrical elements

CO-2. Explain construction, principle of operation, working and characteristics of DC machines, transformers, AC rotating machines and their applications

CO-3. Derive equations for electrical circuits, magnetic circuits and performance of various AC and DC machines

CO-4. Solve problems on electric circuits, magnetic circuits, DC machines, transformers and AC rotating machines

CO-5. Conduct experiments as per the standard procedures and tabulate/calculate/plot the measured values

CO-6. Interpret and compare with standard results, and draw conclusions and Write report as per the prescribed format

4. Course Contents

Unit 1 (Circuit Analysis Technique-I): DC Fundamentals: Circuit elements, voltage and current division, Ohm's law and Kirchhoff's laws, mesh analysis, nodal analysis, source transformations, application of star delta transformation, Thevenin's theorem, maximum power transfer theorem, superposition theorem.

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Unit 2 (Circuit Analysis Technique-II): A.C. Fundamentals: Sinusoidal voltage and currents, period, frequency, instantaneous, peak, average, r.m.s. values, peak factor and form factor, phase difference, lagging, leading and in phase quantities. Simple R, L and C circuits.

Unit 3 (Magnetic Circuits): Magnetic effect of electrical current, cross and dot convention, right hand thumb rule and cork screw rule, Fleming's right hand rule, Fleming's left hand rule, Faraday's law of electromagnetic induction, statically and dynamically induced EMF's, concepts of m.m.f, flux, flux density, reluctance, permeability and field strength, basic analogy between electric and magnetic circuits.

Unit 4 (DC Machines): Constructional details, working principle and methods of excitation of DC machine as a generator and a motor. EMF equation of generator, relation between induced EMF and terminal voltage with brush contact drop, back EMF, torque equation of a DC motor.

Unit 5 (Transformers and AC Rotating Machines): Single Phase Transformers: Necessity of transformer, Constructional Details (core and shell types), Principle of operation, Ideal Transformer and Practical Transformer. EMF equation, Losses, Transformer Test, Circuit Model of Transformer, Determination of Parameters of Circuit Model of Transformer, Impedance shifting, Efficiency and Regulation Calculations
Three phase induction machine: Constructional details, principle of operation, slip and rotor frequency.

Unit 6 (Domestic Wiring): Domestic wiring, concealed conduit wiring, two-way and three-way control

Unit 7 (Laboratory): List of Experiments

No.	Course Content for Laboratory
1	Verification of KVL and KCL for DC circuits
2	Verification of superposition theorem
3	Verification of Thevnin's theorem
4	Verification of maximum power transfer theorem
5	Verification of mesh analysis
6	Verification of node analysis
7	Determination of relationship between phase and line voltages; Phase and line currents in a three phase system
8	Determination of efficiency of a single phase transformer
9	Analysis of load characteristics of DC shunt motor
10	Wiring of two-way and three-way switching of lamp

5. **Course Map (CO-PO-PSO Map)**

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2				2	2			1		1	3	2	1
CO-2	3	2				2	2					1	3	2	1
CO-3	3	2	2									1	3		1
CO-4	3	3	2		2				1	1		1	3	2	1
CO-5	3	3	3	2	2	2			1	1	1	1	3	2	1

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3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	30	
Practical Work		30
1. Course Laboratory	20	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**85**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (TSC1, TSC2, TSC3 and LSC4), COs are assessed as illustrated in the following Table.

For Combined Courses (Theory + Laboratory)					
Focus of COs on each Component or Subcomponent of Evaluation					
Course Outcome	CE (Weightage: 60 %) Four components including one Lab component			SEE (Weightage: 25 %)	Lab (Weightage: 15 %)
	Tests (30 %)	Written Assignments+ Lab (20 %)	Assignment +Lab CE (10%)	Written exam	LSEE: SEE
CO-1	×			×	
CO-2	×	×		×	
CO-3	×	×		×	

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CO-4	×	×		×	
CO-5			×		×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Edward Hughes, 2011, Electrical and Electronics Technology, 10th edition, Dorling Kindersley India Pvt. Ltd.
3. Del Toro V. 2008, Electrical Engineering Fundamentals, PHI

b. Recommended Reading

1. Mittle V. and Arvind Mittle, 2007, Basic Electrical and Electronics Engineering, Tata McGraw Hill, New Delhi
2. Delton Horn T. 1993, Basic Electricity and Electronics, McGraw-Hill Limited, Europe

c. Magazines and Journals

1. IEEE Circuits and Designs magazine

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

1. MULTISIM/ PROTEUS

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Course Specifications: Elements of Computer Science and Engineering

Course Title	Elements of Computer Science and Engineering and Laboratory
Course Code	CSF106A
Course Type	Core Theory and laboratory
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

This course is intended to provide an understanding of the elements of computer science and engineering and development of computer programs using algorithmic and programming constructs, for students across streams. Elements and methods of computer science and engineering and their applications to engineering computational problems are discussed using illustrative examples. Students are taught the methodology of solving computational problems algorithmically, programming concepts and constructs, basic algorithms and data structures. They are also exposed to the practice of software development, modern computing systems and their scope for engineering applications.

2. Course Size and Credits

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the elements and methodology of Computer Science and Engineering
- **CO-2.** Explain the basic principles and techniques of algorithms and programming
- **CO-3.** Select appropriate approach to solve a computational problem
- **CO-4.** Design an algorithmic solution and draw a flow chart of the solution
- **CO-5.** Develop computer programs for moderately complex problems
- **CO-6.** Test and validate developed computer programs

4. Course Contents

Unit 1 (Introduction): Computers and other computing devices, interface between Computer Science and Engineering (CSE) and other disciplines, idea of computing, nature and purpose of CSE, software and computer programs, practice of CSE. Relationship between data, information and knowledge.

Unit 2 (Problem Solving using Computers): Algorithmic problem solving. Flowcharts: symbols and meaning. Drawing flowcharts for simple problems. Fundamental algorithms, efficiency. Example of algorithms in practice: Illustration of algorithms for numerical computation, simulation and data

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processing in engineering domains. Lab Exercises on Problem Solving Using Computers.

Unit 3 (Building Blocks of Computer Programs): Programming languages and process of compiling and program execution. Data representation and storage. Python programming language, IDEs and Workbooks. Data types, variables and keywords. Program structure. Simple data manipulation and logical statements, lists, tuples, sets and dictionaries, conditional and looping control statements, functions, nested expressions, recursion. Plotting and other utility libraries. Lab Exercises on Building Blocks of Computers.

Unit 4 (Elements of Computer Programming): Elements of good programming style, decomposing problems, moving from algorithm to code, random number generation, testing and validation of programs. Lab Exercises on Problem Solving Using random number generation.

Unit 5 (Basic Algorithms and Data Structures): Iterative and recursive algorithms, algorithms for search, sorting algorithms, idea of a data structure, basic data structures and algorithms, and their use. Lab Exercises on Problem Solving Using Iterative and recursive algorithms.

Unit 6 (Algorithm Design): Recursion, Brute force, Divide and conquer, Greedy approaches. Introduction to Backtracking and Dynamic programming.

Unit 7 (Modern Computing Systems): Software development process, operating systems, network of computers, distributed computing, high performance computing, Internet and Web technology, cloud computing.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	1	3	2	2	2		1			1	2	3	2	2
CO-2	2	1	3	2	2	2		1			1	2	3	2	2
CO-3	2	1	3	2	2	2		1			1	2	3	2	2
CO-4	2	1	3	2	2	2		1			1	2	3	2	2
CO-5	2	1	3	2	2	2		1			1	2	3	2	2
CO-6	2	1	3	2	2	2		1			1	2	3	2	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	00	

2. Computer Laboratory	30	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		85

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

For Combined Courses (Theory + Laboratory)					
Focus of COs on each Component or Subcomponent of Evaluation					
Course Outcome	CE (Weightage: 60 %) Four components including one Lab component			SEE (Weightage: 25 %)	Lab (Weightage: 15 %)
	Tests (30 %)	Written Assignments+ Lab (20 %)	Assignment +Lab CE (10%)	Written exam	LSEE: SEE
CO-1	×			×	
CO-2	×	×		×	
CO-3	×	×		×	
CO-4	×	×		×	
CO-5			×		×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.					

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving Cos

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class notes
2. Dromey, R. G., 1982, How to Solve It by Computer, New Delhi: Pearson Education.

b. Recommended Reading

1. Downey, A. B., 2016, Think Python: How to Think Like a Computer Scientist, O'Rielly.
2. Polya, G., 1990, How to Solve It: A New Aspect of Mathematical Method, 2nd edn. New Delhi: Penguin Books.
3. Aho, A. V., Hopcropt, J. E., and Ulman, J. D., 1974, The Design and Analysis of Computer Algorithms, New Delhi: Pearson Education.

c. Magazines and Journals

1. Quanta Magazine Computer Science Section, http://www.quantamagazine.org/ computerscience
2. Dr. Dobb's Journal, http://drdobbs.com/
3. Lifehacker, https://lifehacker.com/

d. Websites

1. Association of Computing Machinery (ACM), http://www.acm.org/
2. IEEE Computer Society, http://www.computer.org/

e. Other Electronic Resources

1. Electronic resources on the course area available on MSRUAS library
2. Think Python online: http://openbookproject.net/thinkcs/python/english2e/

Course Specifications: Professional Communication

Course Title	Professional Communication
Course Code	TSN102A
Course Type	Ability Enhancement Compulsory Course
Department	Applicable to all Programmes
Faculty	Engineering and Technology

1. Course Summary

This course aims at equipping students with the skills required for effective communication in professional context. The students will be guided through professional practices of written and oral communication. Students will be sensitized to the importance of professional etiquette. Students will be taught to apply oral and written communication skills in a given situation.

2. Course Size and Credits

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	2:0:0
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Directorate of Transferable Skills and Leadership Development
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Apply the concepts of grammar for communication
CO-2. Compose precise paragraphs
CO-3. Demonstrate professional etiquette
CO-4. Demonstrate appropriate verbal and non-verbal communication in the given context
CO-5. Develop professional written document

4. Course Contents

Unit 1 (Grammar for Effective Communication): Sentence formation, sentence types, different parts of speech, adjectives and articles, verbs and preposition, present and past tense, future tense, use of participles in different tenses, usage of tenses, rules of subject verb agreement, Direct and indirect sentences, usage of direct and indirect sentences

Unit 2 (Communication – Verbal: Written): Paragraph Writing: Structure of a paragraph – topic sentence, supporting sentence, conclusion sentence, functions of paragraph, paragraph patterns, paragraph writing principles – coherence, unity, order, length; Précis Writing; Paraphrasing techniques, Usage of appropriate words;

Report Writing: Purpose of report writing, report format, use of language while report writing

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Unit 3 (Communication-Nonverbal): Meaning, Nature and importance, Kinesics, Proxemics, Time, Paralanguage, Touching Behavior, Body Language, effects of nonverbal communication on verbal communication

Unit 4 (Professional Etiquette): Etiquette and its importance, types of etiquette - email etiquette, telephone etiquette, conversation; Body language in conversation, tones in conversation, conversation manners, stages of conversation – introduction, feed forward, close, order of introduction, conversation barriers

Unit 5 (Presentation): The importance of presentation skills, various stages of presentation planning – development of structure and style, interpersonal sensitivity, presentation accessories and equipment, time management during presentation, stages of presentation – introduction, body and conclusion, presentation etiquette

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1										2					2
CO-2										3					3
CO-3									3						3
CO-4									3	3					3
CO-5										3					3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		0
1.Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		0
1. Solving Numerical Problems	00	
Practical Work		04
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	04	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		06
1. Case Study Presentation	02	

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2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	02	
5. Group Discussions	02	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment is presented in the Programme Specifications document pertaining to the B.Tech. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2), COs are assessed as illustrated in the following Table.

Focus of CO's on each Component or Subcomponent of Evaluation:

For AECC Only		
Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: CE (60% Weightage)	**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests or Assignments**	
CO-1	**X**	**X**
CO-2	**X**	**X**
CO-3	**X**	**X**
CO-4	**X**	**X**
CO-5	**X**	**X**
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.		

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Face to face lectures
2.	Understanding	Face to face lectures, group discussions
3.	Critical Skills	--
4.	Analytical Skills	Face to face lectures, activities, , group discussions, assignment
5.	Problem Solving Skills	--

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6.	Practical Skills	Face to face lectures, activities, , group discussions, course work
7.	Group Work	Course work, practice, assignment, group discussion
8.	Self-Learning	Course work, practice, assignment, group discussion
9.	Written Communication Skills	Face to face lectures, Course work, practice, assignment, group discussion
10.	Verbal Communication Skills	Face to face lectures, Course work, practice, assignment, group discussion
11.	Presentation Skills	--
12.	Behavioral Skills	Course work, practice, assignment, group discussion, presentation practice, role plays
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Raman M and Sharma S (2004) Technical Communication: Principles and Practice. New Delhi: Oxford University Press
3. Hory Sankar Mukherjee, (2013), Business Communication, Oxford University Press
4. Kroehnert, Gary (2004), Basic Presentation Skills, Tata McGraw Hill

b. Recommended Reading

1. Sathya Swaroop Debashish and Bhagaban Das, (2014), Business Communication, PHI, New Delhi
2. Young, Dona J (2006) Foundations of Business Communications:
3. An Integrated Approach, Tata McGraw Hill
4. Kaul, Asha (2007) Effective Business Communication, Prentice Hall India
5. Bienvenu, Sherron (2008) The Presentation Skills Workshop, Prentice Hall
6. KavitaTyagi and Padma Misra (2011) Professional Communication, PHI Learning Private Limited, New Delhi

c. Magazines and Journals

d. Websites

1. www.myenglishpages.com
2. www.britishcouncil.com
3. www.englishmagazine.com
4. www.justenglishmagazine.com

e. Other Electronic Resources

1. Electronic resources on the course area are available on RUAS library

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Course Specifications
(3rd Semester)

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Course Specifications: Engineering Mathematics - 3

Course Title	Engineering Mathematics - 3
Course Code	MTB201A
Course Type	Core Theory
Department	Mathematics and Statistics
Faculty	Engineering and Technology

10.Course Summary

This course deals with vector calculus, Fourier transform techniques in the context of engineering problems. The rudimentary principles and important theorems in vector calculus are taught in this course. The assumptions, principles and distinguishing features of Fourier series, Fourier transform and vector calculus are emphasized. This course also covers the underlying principles and applications of Fourier series and Fourier transform techniques in various engineering disciplines. This course also aims at solving engineering problems associated with Fourier series, Interpolation and numerical integration using MATLAB.

11. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mathematics and Statistics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

12. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-6.** State and explain the important theorems in Fourier series, Fourier transform and vector integral calculus
- **CO-7.** Solve simple problems in Fourier series, Fourier transform and vector integral calculus
- **CO-8.** Apply Fourier series, Fourier transform and vector integral calculus in solving complex real world engineering problems
- **CO-9.** Implement the programs to solve system of linear equations and non-linear equations of single variable using MATLAB.
- **CO-10.** Apply interpolation and curve fitting by least square method using MATLAB in analyzing some real world problems

13. Course Contents

Unit 1 (Fourier Series): Periodic functions, Dirichlet's conditions for convergence of Fourier series, Fourier series for a periodic function of period T, half range Fourier series, complex Fourier series.

Unit 2 (Fourier transform): Definition, Fourier transform of elementary functions, properties. Inverse Fourier transform, solution of initial value problems.

Unit 3 (Vector calculus): Review of vector algebra, vector and scalar fields, derivatives of vector valued functions, curves, tangents, arc length. Gradient of a scalar field, directional derivatives, divergence and curl of a vector field. Polar, Cylindrical and Spherical coordinates systems. Line integral, double integral, change of order, Jacobian, change of variables, and triple integral. Green's theorem, Stokes' theorem, Gauss divergence theorem.

Unit 4 (MATLAB): Introduction to MATLAB, Basic algebraic and matrix operations, built-in and command line functions. Plots Scripts and functions. Newton-Raphson method and Numerical solution of system of linear equations by Gauss-Seidel method. Fourier series for discrete data points. Interpolation - Lagrange interpolation, Newton's divided difference interpolation. Newton-Cotes' quadrature, trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules, and Gaussian quadrature.

14. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2							1			1	1	
CO-2	3	3	1							1			1	1	
CO-3	3	3	2	3						2			1	2	
CO-4	3	3	2	2						2			1	2	
CO-5	3	3	2	2						2			1	1	
		The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.													

15. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	

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2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

16. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	×		×
CO-2	×		×
CO-3	×		×
CO-4		×	×
CO-5		×	
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

17. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study

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9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

18. Course Resources

k. Essential Reading

3. GlynJames,2016, Advanced Modern Engineering Mathematics, 4th edition, Pearson
4. Richard Burden and Douglas Faires, 2017, Numerical Analysis, 9th edition, Massachusetts, Brooks/Cole

l. Recommended Reading

1. Erwin Kreyszig, 2015, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons Inc
2. M. K. Jain, S.R.K. Iyengar and R.K. Jain, 2008, Numerical Methods, New Delhi, New Age
3. L. Chanparro, 2010, Signals and Systems using MATLAB, Academic Press
4. S.D. Stearns and D. R. Hush, 2011, Digital Signal Processing with Examples in MATLAB, CRC Press

m. Magazines and Journals

n. Websites

1. http://nptel.ac.in/
2. https://ocw.mit.edu/index.htm

o. Other Electronic Resources

1. https://www.khanacademy.org/
2. tutorial.math.lamar.edu/

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Course Specifications: Mechanics of Solids

Course Title	Mechanics of Solids
Course Code	CEC202A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the concepts and principles of strength of materials to enable the students to analyze the behavior of deformable structural elements, subjected to different types of loadings. Students are taught the concepts of stress, strain, deformation and their applications in solving general engineering problems. Students are trained to analyze the response of the simple structural components and determinate structures to applied forces and boundary conditions.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture:Tutorial:Practical)	2:2:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-11. Describe the basic concepts of the stresses and strains for different materials and strength of structural elements

CO-12. Explain stress strain behaviour of materials, axial forces, bending, torsion, shear force, bending moment, principal stresses and strains, shear force diagram, bending moment diagram and thin vessels.

CO-13. Determine shear force and bending moment, bending and shear stress distribution, principal stresses and planes, and strain energy

CO-14. Calculate load carrying capacity of members subjected to bending/shear/torsion/axial force analytically

CO-15. Analyse and design members subjected to combined bending, torsion and axial forces.

4. Course Contents

Unit 1 (Simple Stresses and Strain): Introduction, definition and concept of stress and strain; Hooke's law, Stress-Strain diagrams for ferrous and non-ferrous materials, factor of safety; Elongation of tapering bars of circular and rectangular cross sections, Elongation due to self-weight, traction and point loads. Saint Venant's principle; Assembly and thermal stresses: Composite bars in tension and compression, coefficient of thermal expansion, thermal strain, thermal stress, temperature stresses in composite rods. Statically indeterminate structural problems; Elastic constants and their relationship; Strain Energy: Strain energy in tension - compression and shear - resilience -stresses due to gradual, impact and suddenly applied load.

Unit 2 (Compound Stresses): Stress on inclined planes for axial and biaxial stress fields, transformation of plane stress, principal stresses and principal planes- Mohr's circle of stress.
Transformation of plane strain, principal strains and principal axes of strain; Mohr's circle for stresses; Strain rosettes, determination of principal strains from strain measurements, calculation of principal stresses from principal strains.

Unit 3 (Shear Force and Bending Moment in Beams): Introduction to types of beams, supports and loadings; Definition of bending moment and shear force, Sign conventions; Relationship between load intensity, bending moment and shear force; Shear force and bending moment diagrams for statically determinate beams subjected to points load, uniformly distributed loads, uniformly varying loads, couple and their combinations.

Unit 4 (Bending and Shear Stresses in Beams): Introduction, pure bending theory, Assumptions, derivation of bending equation, modulus of rupture, section modulus, flexural rigidity. Expression for transverse shear stress in beams, Bending and shear stress distribution diagrams for circular, rectangular, 'I', and 'T' sections. Shear centre(only concept)

Unit 5 (Torsion): Torsion of circular shafts and helical springs, strength of solid and hollow circular shafts, power transmission, strain energy in shear and torsion, design of circular members in torsion, close coiled and open coiled helical springs

Unit 6 (Columns and Struts): Introduction, short and long columns. Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory. Rankine-Gordon's formula for columns.

Unit 7 (Thin and Thick Cylinders): Introduction, Thin cylinders subjected to internal pressure; Hoop stresses, Longitudinal stress and change in volume. Thick cylinders subjected to both internal and external pressure; Lame's equation, radial and hoop stress distribution.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3		2									3		
CO-2	3	3											3		
CO-3	3	3											3		
CO-4	3	3	3	2	1				1	1			3	2	1
CO-5	3	3	3	3	1				1	1			3	3	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

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6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1.Demonstration usingVideos	02	
2. Demonstration using PhysicalModels / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		15
1. Solving Numerical Problems	30	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests,Laboratory Examination/Written Examination,Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	×	×	×
CO-2	×	×	×
CO-3	×	×	×
CO-4		×	×
CO-5		×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

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The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Bhavikatti S.S., 2010, Strength of materials, Oxford University Press, Edition
3. Subramanyam , 2008, Strength of Materials, Oxford University Press, Edition

b. Recommended Reading

1. Rajput, R.K., 1996, Strength of Materials, New Delhi, S. Chand & Co,
2. Punmia B.C., Ashok Jain and Arun Jain, 2000, Mechanics of Materials, New Delhi, Lakshmi Publications,
3. Hibbeller R C, Mechanics of materials, NewYork, Prentice Hall.

c. Magazines and Journals

d. Websites

e. Other Electronic Resources

1. https:// nptel.ac.in/

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Course Specifications: Engineering Survey

Course Title	Engineering Survey
Course Code	CEC204A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with various types of surveys undertaken on field, their methods and principles. Students will be introduced to surveying instruments such as compass, plane table and theodolite and their working principles. Students are taught leveling and its applications, contouring and tachometric surveying. Students will be trained to determine and report distances, angles, directions, locations, elevation, areas and volume data from field survey.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Measure distance between two stations, procedure to set out perpendiculars at various points on a given line and polygons using tapes and chains and other accessories
- **CO-2.** Develop and plot the various features on the ground using various methods of plane table surveying
- **CO-3.** Determine the elevations using various methods and also identify a suitable method for a given case
- **CO-4.** Determine horizontal and vertical angles by different methods, heights and distances, closing errors in traversing, areas and volume
- **CO-5.** Determine tacheometric constant, measure elevation, horizontal distance and gradient between given points
- **CO-6.** Setting out simple curves by suitable methods

4. Course Contents

Unit 1 (Introduction) : Definition, principles of surveying, scales, types of surveying. Field and office work, conventional signs, equipment's, their care and adjustment. Chains, tapes, arrows, ranging rods- ranging and chaining, reciprocal ranging - overcoming obstacles in chaining - chaining on a sloping ground, hypotenuse allowance, setting perpendiculars, traversing, plotting, enlarging and reducing figures

Unit 2 (Compass Surveying): Meridians and bearings, principles, working, prismatic compass and surveyor's compass - magnetic and true bearings, WCB and reduced bearings - errors in compass surveying, Local attraction, determination and corrections. Dependent and independent coordinates, magnetic declination, dip. Traversing, plotting, traverse adjustment, checks for closed traverse and determination of closing error and its direction. Bowditch's rule and transit rule, Bowditch's graphical method of adjustment of closed traverse, omitted measurements, area computation, Simpson's rule and trapezoidal rule-area from latitude and departure -volumes - trapezoidal and prismoidal formula

Unit 3 (Minor Instruments): Box sexant, planimeter, pentagraph, inclinometer, clinometer, ceylon ghat tracer, hand level and pantagraph. Plane Table Surveying: Plane table instruments and accessories, merits and demerits. Orientation- methods of orientation, Methods of plotting-radiation, intersection, traverse and resection. Three point and two point problems, solution to three point problem Bessel's graphical method - solution to two point problem by graphical method, errors in plane table survey.

Unit 4 (Leveling and its Applications): Level line, horizontal line, levels and staff, spirit level. Sensitiveness, benchmarks, temporary and permanent adjustments. Differential leveling, Fly leveling, profile leveling, block leveling, booking, reduction of levels, checks, curvature and refraction, reciprocal leveling, longitudinal and cross sectioning. Plotting, calculation of areas and volumes.

Unit 5 (Contouring): characteristics and uses of contours, methods of contouring, direct and indirect methods, uses of contours. Numerical problems on determining intervisibility, grade contours and uses, plotting, earthwork volume, capacity of reservoirs, automatic levels.

Unit 6 (Theodolite Surveying): Vernier and microptic theodolite, description, temporary and permanent adjustments. Two face observation, necessity, measurements of horizontal angles by repetition and Reiteration, measurements of vertical angles and magnetic bearing. Prolonging a line, lining in and setting out an angle with a theodolite, heights and distances, traversing, computation of consecutive and independent co-ordinates, area calculation by independent co-ordinates. Omitted measurements, compensating and cumulative errors, elimination of errors, and adjustment of closed traverse by transit rule and Bowditch's rule, Gale's traverse table.Open traverse and its uses, measurement of deflection angles using transit theodolite, open traverse survey, checks in open traverse

Unit 7 (Tacheometry): Introduction, basic definitions, fundamental principles, tachometric systems. Trigonometric Leveling: Introduction, basic definitions, fundamental principles. Curve Setting: Curves - necessity & types. Simple curves- Elements, designation of curves, setting out simple curves by linear method, setting out curves by Rankine's deflection angle method. Compound curves-Elements, design of compound curves, setting out of compound curves, reverse curve between two parallel straights (equal radius and unequal radius). Transition curves- characteristics, length of transition curve and Bernoulli's lemniscates; vertical curves- types, simple numerical problems.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2											3		
CO-2	3	2	1										3		
CO-3	3	3	2										3		
CO-4	3	3	2										3		
CO-5	3	1											3		
CO-6	3	2	2										3		
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		15
1. Solving Numerical Problems	30	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		70

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	×	×	×
CO-2	×	×	×
CO-3	×	×	×
CO-4	×	×	×
CO-5		×	×
CO-6		×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

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p. Essential Reading

1. Class Notes
2. Punmia B. C., 2005, Surveying Vol –I, II and III, New Delhi, Laxmi Publications
3. Arora K. R., 1990, Surveying Vol- I and II, New Delhi, STD Book
4. Kanetkar T.P., 1994, Surveying and Levelling- Vols. I and II, United Book Corporation Pune

q. Recommended Reading

1. Subramanian R., 2007, Surveying and Levelling, Oxford University Press
2. Venkataramiah C., 2009, Text Book of Surveying, Universities Press
3. Bannister A. and Raymond S., 1992 Surveying, ELBS, Sixth Edition
4. S.K. Duggal, 2013, Surveying Vol. I, New Delhi, Tata McGraw Hill - Publishing Co. Ltd
5. James M. Anderson and Edward M. Mikhail, 1985, Introduction to Surveying, McGraw-Hill Book Company

r. Magazines and Journals

1. http://www.academicpub.org/jsme/
2. https://ascelibrary.org/journal/jsued2

s. Websites

1. http://nptel.ac.in/
2. https://ocw.mit.edu

t. Other Electronic Resources

1. Electronic resources on the course area are available on MSRUAS library

Course Specifications: Engineering Geology and Properties of Soils

Course Title	Engineering Geology and Properties of Soils
Course Code	CEC205A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

The course aims at providing a basic geological understanding relevant to Civil Engineering. The students are introduced to various geo-scientific disciplines having a strong relationship to engineering. In this context, students are taught the basic geodynamics that includes identification of Stable and unstable domains in the Earth. The lectures are followed by an introduction to specialized fields of mineralogy and petrology dealing with minerals and rocks in terms of origin, distribution, geotechnical, physical and chemical characteristics and applications in Industry and Engineering. The students are also introduced to the deformation aspects of rocks having a profound bearing on the foundation and excavation characteristics. Integration of the above disciplines are explained with reference to selection of sites and construction of selected major engineering structures, governing the safety, stability and economy of the project. Special emphasis is given for utilization of Remote sensing techniques as well as GIS in exploration and site selection. In addition, Geomorphology that deals with the landscape and surface processes, offshore resources and geoengineering, groundwater, soil study and Environmental geology have also been included in the curriculum.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Explain the branches of Geoscience having a relevance to civil engineering.

CO-2. Classify and describe some of the common rocks and minerals of the Earth's Crust.

CO-3. Discuss the geo-scientific factors responsible for triggering of Earthquakes, landslides, tsunami besides under the surface geological processes having a great relevance to civil engineering.

CO-4. Explain the basic concepts of Geo-hydrology, Soil study (Pedology), Marine Geology, environmental geology and Remote sensing in various civil engineering applications.

CO-5. Apply and integrate some of the basic geoscientific concepts and principles in Engineering site selection and construction.

4. Course Contents

Unit 1: Introduction to Applied Engineering Geology, Evolution and structure of Earth,

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Composition of Earth

Unit 2: Rock forming minerals, Ore minerals and Energy minerals – Coal and Petroleum; Classification, physical characteristics and engineering properties of Rocks

Unit 3: Earthquakes, Tsunami, Landslides – causes, effects and mitigation measures; Plate-tectonics; Deformation in rocks; Physiography and resources of ocean floor

Unit 4: Soil profile, Soil-forming process, classification, description; Weathering and Erosional process

Unit 5: Site selection for civil engineering projects – Dams, tunnels and bridges; Geological maps and cross- section; Importance of lithological, groundwater, geomorphological and structural studies

Unit 6: Groundwater zones, Hydrological cycle, Aquifers, Water table, groundwater properties, contamination, recharge and Rainwater harvesting, Well-site selection, Seawater intrusion; Remote sensing and GIS applications in geology

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3												3		
CO-3	3		1										3		
CO-4	3												3		
CO-5	1		3										3		
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		35
Demonstrations		02
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		05
1. Solving Numerical Problems	05	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	

6. Model Studio	00	
Others		03
1. Case Study Presentation	00	
2. Guest Lecture	01	
3. Industry / Field Visit	02	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**55**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	×		×
CO-2	×		×
CO-3	×	×	×
CO-4	×	×	×
CO-5		×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination

6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study, Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. **Course Resources**

a. **Essential Reading**

1. Class Notes
2. Blyth F G H and de Freitas M H, 2015 A Geology for Engineers, New York, CRC Press
3. Khumri R S, 1979, Fundamentals of Engineering Geology New Delhi, Dhanpat Rai and sons
4. N. Chenna Kesavulu.2007, Textbook of Engineering Geology, New Delhi, Macmillan India Ltd.
5. Venkat Reddy,1993, Engineering Geology for Civil Engineers, D.Oxford & IBH

b. **Recommended Reading**

1. Krynine D P., 2003 Principles of Engineering geology and Geotechnics. Mc-Graw Hil.
2. Parbin Singh, 1993, A Text book of Engineering and General Geology, Ludhiana, Katson publishing house

c. **Magazines and Journals**

1. **Jour. Engineering Geology. Elsevier**
2. ***Jour.* Indian Society of Engineering Geology (*Journal* of ISEG)**
3. **Jour. Geological Society of India**

d. **Websites**

1. **https://www.slideshare.net/gauravhtandon1/engineering-geology-civil-engineering-applications**
2. **http://www.tubbs.com/geotech/geotech.htm**
3. **Other Electronic Resources**
4. **Electronic resources on the course area are available on MSRUAS library**

e. **Other Electronic Resources**

1. https://nptel.ac.in

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Course Specifications: Material Testing Laboratory

Course Title	Material Testing Laboratory
Course Code	CEL207A
Course Type	Laboratory
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

1. Course Summary

This course deals with the experiments related to strength of materials. Students are taught experimental methods to analyze material behavior under different types of loading conditions. Students are taught determine structural materials properties and evaluate these properties from first principles. Students are trained to perform tests on materials, analyze the data and present the results as per standards.

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:1
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-7.** Conduct tests to evaluate the tension, compression, torsion and shear parameters of mild steel and aluminum
- **CO-8.** Perform bending test on wood, impact test on mild steel and hardness tests on ferrous and nonferrous metals
- **CO-9.** Explain fatigue tests, strain gauges and strain indicators
- **CO-10.** Generate Evaluate characteristic properties of construction materials such as aggregates, tiles and bricks
- **CO-11.** Recommend the suitability of the materials based on results obtained from the tests

4. Course Contents

1	Tension test on mild steel (Tensile strength-Density-Proof Stress-Stress - Strain Curve -Young's Modulus)
2	Compression test of mild Steel and aluminum.
3	Single and double shear test on mild steel and aluminum.

4	Torsion test on mild steel and aluminum
5	Bending test on Wood Under two point loading
6	Impact test on mild steel (Charpy & Izod)
7	Hardness tests on ferrous and non-ferrous metals – Brinell's, Rockwell and Vicker's
8	Tests on fine aggregates: Specific gravity, Fineness modulus, bulk density, bulking.
9	Tests on coarse aggregates: Specific gravity, Fineness modulus, bulk density.
10	Tests on bricks: water absorption, compressive strength
11	Demonstration of fatigue test , strain gauges and strain indicators

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3			3					1				3	3	1
CO-2	3			3					1				3	3	1
CO-3	3			3					1				3	3	1
CO-4	3			3					1				3	3	1
CO-5	3			3					1				3	3	1

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching a n d LearningMethods	Duration in hours	Total DurationinHours
FacetoFaceLectures		
Demonstrations		00
1. Demonstration using Videos		
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Numeracy		00
1. Solving Numerical Problems		
PracticalWork		30
1. Course Laboratory	30	
2. Computer Laboratory		
3. Engineering Workshop / Course Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		

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6. Model Studio		
Others		00
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Tests, Laboratory Examination / Written		10
Total Duration in Hours		40

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Civil Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

For Laboratory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Conduct of Experiments	Laboratory Report + Viva	Laboratory SEE
CO-1	×	×	×
CO-2	×	×	×
CO-3	×	×	×
CO-4	×	×	×
CO-5	×	×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Laboratory instruction
2.	Understanding	Laboratory instructions and experiments
3.	Critical Skills	Laboratory work
4.	Analytical Skills	Laboratory work
5.	Problem Solving Skills	Laboratory work
6.	Practical Skills	Laboratory work
7.	Group Work	Laboratory work

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8.	Self-Learning	Laboratory work
9.	Written Communication Skills	Laboratory work, ,examination
10.	Verbal Communication Skills	Laboratory examination
11.	Presentation Skills	Viva Voce
12.	Behavioral Skills	Course work
13.	Information Management	Laboratory work
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. **Essential Reading**

8. Laboratory manual
9. Relevant IS codes

b. **Recommended Reading**

--

c. **Magazines and Journals**

1. Strategize publication
2. Concrete construction magazine

d. **Websites**

1. www.astm.org
2. www.nptel.ac.in

e. **Other Electronic Resources**

1. Electronic resources on the course area are available on MSRUAS library

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Course Specifications: Survey Practice

Course Title	Survey Practice
Course Code	CEL208A
Course Type	Laboratory
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

1. **Course Summary**

This course deals with conducting of different types of field surveys. The lab sessions will consist of experiments on chain, compass, plane table and theodolite surveying and study of minor instruments. Students will be trained in determining and reporting distances, angles, directions, locations, elevation and area data form the survey. Lab sessions consist of experiments to determine distances, angles, gradients and elevation using total station and tacheometric survey. Azimuth determination of a survey line and setting out of foundation layout as well as that of simple and transition curves will also be carried out.

2. **Course Size and Credits:**

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:1
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. **Course Outcomes (COs)**

After the successful completion of this course, the student will be able to:

CO 1. Measure distance between two stations, procedure to set out perpendiculars at various points on a given line and polygons using tapes and chains and other accessories.

CO 2. Develop and plot the various features on the ground using various methods of plane table surveying

CO 3. Determine the elevations using various methods and also identify a suitable method for a given case.

CO 4. Determine horizontal and vertical angles by different methods, heights and distances, closing errors in traversing, areas and volume

CO 5. Determine tacheometric constant, measure elevation, horizontal distance and gradient between given points.

CO 6. Setting out simple curves by suitable methods.

4. **Course Contents**

1	Measuring the distance between two stations using direct ranging. Setting out perpendiculars at various points on given line using cross staff, optical square and tape. Measurement of bearing of survey lines by prismatic compass. Running a closed compass traverse – plotting and adjustments.
2	Plotting the salient features in an area by plane table survey using radiation and intersection method. Solving Two point and Three point problem.

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3	Determining difference in elevation between two points using fly leveling technique & to conduct fly back leveling. Booking of levels using both HI and Rise & Fall methods. Determining difference in elevation between two points using reciprocal leveling and to determine the collimation error.
4	Measurement of horizontal angles using a theodolite by the method of repetition. Measurement of horizontal angle using a theodolite by the method of reiteration. Solution to problems on heights and distances by observations using a theodolite.
5	Determination of constant of a Tacheometer. Determination of elevation of a point and horizontal distance between two given points by Tacheometric survey. Determination of gradient of given length of road by Tacheometric survey
6	Setting out a simple circular curve by ordinates from long chord. Setting out a circular curve by Rankine's method of tangential angles. Setting out a simple circular curve by ordinates using double theodolite method. Setting out of transition curves

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	2					1				3	2	1
CO-2	3	3	3	2					1				3	2	1
CO-3	3	3	3	3					1				3	3	1
CO-4	3	3	3	3					1				3	3	1
CO-5	3	3	3	3					1				3	3	1
CO-6	3	3	3	3					1				3	3	1

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		00
Demonstrations		00
1. Demonstration using Videos		
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Numeracy		00
1. Solving Numerical Problems		
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory		

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3. Engineering Workshop / Course Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		00
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Tests, Laboratory Examination / Written Examination,		10
Total Duration in Hours		40

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Civil Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

For Laboratory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Conduct of Experiments	Laboratory Report + Viva	Laboratory SEE
CO-1	X	X	X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
CO-5	X	X	X
CO-6	X	X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities	How imparted during the course
1.	Knowledge	Laboratory instruction
2.	Understanding	Laboratory instructions and experiments
3.	Critical Skills	Laboratory work

4.	Analytical Skills	Laboratory work
5.	Problem Solving Skills	Laboratory work
6.	Practical Skills	Laboratory work
7.	Group Work	Laboratory work
8.	Self-Learning	Laboratory work
9.	Written Communication Skills	Laboratory work, ,examination
10.	Verbal Communication Skills	Laboratory examination
11.	Presentation Skills	Viva Voce
12.	Behavioral Skills	Course work
13.	Information Management	Laboratory work
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Laboratory Manual
2. Punmia B. C., 2005, Surveying Vol-I, II and III, New Delhi, Laxmi Publications
3. Arora K. R., 1990, Surveying Vol- I and II, New Delhi, STD Book
4. Kanetkar T.P., 1994, Surveying and Levelling- Vols. I and II, United Book Corporation, Pune.

b. Recommended Reading

1. Subramanian R., 2007, Surveying and Levelling, Oxford University Press
2. Venkataramiah C., 2009, Text Book of Surveying, Universities Press
3. Bannister A. and Raymond S., 1992 Surveying, ELBS, Sixth Edition
4. S.K. Duggal, 2013, Surveying Vol. I, New Delhi, Tata McGraw Hill - Publishing Co. Ltd
5. James M. Anderson and Edward M. Mikhail, 1985, Introduction to Surveying, McGraw-Hill Book Company

c. Magazines and Journals

1. http://www.academicpub.org/jsme/
2. https://ascelibrary.org/journal/jsued2

d. Websites

1. http://nptel.ac.in/
2. https://ocw.mit.edu

e. Other Electronic Resources

2. Electronic resources on the subject area are available on MSRUAS library

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Course Specifications: Applied Engineering Geology Laboratory

Course Title	Applied Engineering Geology Laboratory
Course Code	CEL209A
Course Type	Laboratory
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

1. Course Summary

The lab course is intended to introduce students to the basic applications of geoscientific principles to Civil engineering. Students are taught to identify the commonly occurring rocks and minerals with the help of physical properties that are easily identifiable in the field without sophisticated instruments or techniques. Identification of rocks and minerals are essential for the civil engineers as most of the geotechnical parameters are correlatable with geological properties and also most of the minerals present if present in sufficient quantities serve as industrial minerals enabling extraction. The rocks are of varying origin and recognition is essential to understand the integrated geological and geotechnical characteristics for varying engineering applications.

The geological as well as the topographical maps are vital in exploration, planning and designing of various engineering structures. In this context, the students are exposed to read the maps and trained in profiling to understand the surface and subsurface geological characteristics that are relevant to engineering. In addition, students are taught to utilize the surface geological data in determining mainly the subsurface behavior of rocks in terms of depth persistence, thickness, inclination, strike direction etc., by graphical drawings as well as computation by trigonometric methods. In summary, the course touches upon geoscientific disciplines of petrology, mineralogy, geomorphology and structural geology.

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:1
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Describe the physical properties aiding field identification of some of the common rocks and minerals

CO 2. Read the topographic maps with respect to physiographic details, natural and cultural features

CO 3. Read the geological maps with respect to rock and soil distribution, primary structural patterns as well as deformational structures aiding preparation of geological cross section and interpretation.

CO 4. Graphically represent the surface geological details in determination of subsurface thickness, depth of persistence and inclination; includes validation of results by trigonometric method.

CO 5. Determine the Strike and dip component (True and Apparent) of rocks graphically with the drilling data and surface measurements

4. Course Contents

1	Minerals classification and Identification of common Rock-forming minerals Identification of Economic minerals including Ores
2	Description and identification of common Igneous Rocks Description and identification of common Metamorphic and Sedimentary Rocks
3	Topo-sheets study, profiling and interpretation Geological Maps and drawing Geological Cross-sections related to haorizontal and inclined strata; interpretation and feasibility study Geological Maps and drawing Geological Cross-sections related to folded and faulted rock; interpretation and feasibility study
4	Graphical method of determination of Dip and Strike of rocks using surface data
5	Computing Strike and Dip with drilling data by graphical method: Three point level-ground method (graphical) Determination of Depth, Inclination (Dip) and Thickness of the Strata by graphical method; validation by trigonometric method

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3			2									3		
CO-2	3	1		2									3		
CO-3	3	1		2									3		
CO-4	3	1		2									3		
CO-5	3	1		2									3		

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		00
Demonstrations		00
1. Demonstration using Videos		
2. Demonstration using Physical Models / Systems		

3. Demonstration on a Computer		
Numeracy		00
1. Solving Numerical Problems		
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory		
3. Engineering Workshop / Course Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		00
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Tests, Laboratory Examination / Written Examination,		10
Total Duration in Hours		40

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Civil Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

For Laboratory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Conduct of Experiments**	**Laboratory Report + Viva**	**Laboratory SEE**
CO-1	x	x	x
CO-2	x	x	x
CO-3	x	x	x
CO-4	x	x	x
CO-5	x	x	x
CO-6	x	x	x
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following

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teaching and learning methods:

S. No	Curriculum and Capabilities	How imparted during the course
1.	Knowledge	Laboratory instruction
2.	Understanding	Laboratory instructions and experiments
3.	Critical Skills	Laboratory work
4.	Analytical Skills	Laboratory work
5.	Problem Solving Skills	Laboratory work
6.	Practical Skills	Laboratory work
7.	Group Work	Laboratory work
8.	Self-Learning	Laboratory work
9.	Written Communication Skills	Laboratory work, ,examination
10.	Verbal Communication Skills	Laboratory examination
11.	Presentation Skills	Viva Voce
12.	Behavioral Skills	Course work
13.	Information Management	Laboratory work
14.	Personal Management	Course work
15.	Leadership Skills	--

9. **Course Resources**

a. **Essential Reading**

5. Laboratory Manual

b. **Recommended Reading**

6. A Textbook of Mineralogy 4th edition (1991) Ed. Dana, Ed. Edward Salisbury, Ford, William E. (1991). Wiley pub.
7. Geology for Engineers.-7th ed. Blyth and De Freitas, MH

c. **Magazines and Journals**

d. **Websites**

e. **Other Electronic Resources**

3. http://nptel.ac.in/

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Course Specifications: Environmental Studies

Course Title	Environmental Studies
Course Code	BTN101A
Course Type	Ability Enhancement Compulsory Course
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The aim of this course is to invoke awareness among students about the burning global environmental issues.The course exposes the students to various problems associated with abuse of natural resources. The concepts of ecosystems, biodiversity and its conservation and environmental pollution will be discussed. The course emphasizes social issues associated with the environment, and the impact of human population on the environment.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	2:0:0
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Department of Biotechnology
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Illustrate the multidisciplinary nature of environmental studies and recognize the need for public awareness
- **CO-2.** Explain the various natural resources and their associated problems, ecosystem, and environmental pollution
- **CO-3.** Analyse the concept of ecosystem and classify various types
- **CO-4.** Compare biodiversity at local, national and global levels
- **CO-5.** Discuss various social issues pertaining to environment including sustainable development and energy issues

4. Course Contents

Unit 1: Natural resources:

Forest resources: Use and over-exploitation, deforestation, **Water resources:** Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems, Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. **Food resources:** World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. **Energy resources:** Growing energy needs, renewable and non-renewable energy

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sources, use of alternate energy sources. **Land resources:** Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Unit 2: Ecosystems:

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, ocean estuaries).

Unit 3: Biodiversity and its conservation:

Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical aesthetic and option values Biodiversity at global, national and local levels, India as a mega-diversity nation, Hot-spots of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit 5: Environmental Pollution:

Definition, causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear pollution, Solid waste management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution. **Disaster management:** floods, earthquake, cyclone and landslides

Unit 6: Social Issues and the Environment:

From unsustainable to sustainable development, Urban problems and related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns.

Unit 7: Environmental ethics:

Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies, Wasteland reclamation, Consumerism and waste products, Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public awareness. Human Population and the Environment: Population growth, variation among nations, Population explosion

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5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	1					3							1	3	
CO-2	1					3							1	3	
CO-3	1					3							1	3	
CO-4	1					3							1	3	
CO-5	1					3							1	3	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		22
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		03
1. Case Study Presentation	03	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For AECC Only		
Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: CE (60% Weightage)	Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests or Assignments	
CO-1	×	×
CO-2	×	×
CO-3	×	×
CO-4		×
CO-5		×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.		

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. **Essential Reading**

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1. Class notes
2. Bharucha, E., 2004, Environmental Studies, New Delhi, University Grants Commission Ahluwalia, V.K., 2013,
3. Environmental Studies: Basic concepts, The Energy and Resources Institute (TERI).

b. Recommended Reading

1. Jadhav, H. and Bhosale, V. M., 1995, Environmental Protection and Laws, New Delhi, Himalaya Publishing House

c. Magazines and Journals

https://www.omicsonline.org/environmental-sciences-journals-impact-factor-ranking.php

d. Websites

https://www.sciencedaily.com/news/earth_climate/environmental_science

e. Other Electronic Resources

http://www.globalissues.org/issue/168/environmental-issues

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Course Specifications
(4th Semester)

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Course Specifications: Engineering Mathematics - 4

Course Title	Engineering Mathematics - 4
Course Code	MTB211A
Course Type	Core Theory
Department	Mathematics and Statistics
Faculty	Mathematical and Physical Sciences

1. Course Summary

The course introduces the basic concepts of complex analysis and partial differential equations. The course encompasses the essentials of statistics, probability theory and numerical solution of differential equations. Students are taught the probability theory and statistical distributions needed to quantify uncertainty and accuracy of information. The significance and use of numerical methods for solution of ordinary and partial differential equations are emphasized in this course. The utility of complex analysis to solve complex engineering problems and that of partial differential equations in modeling real world problems are highlighted. The students will be able to implement probabilistic /numerical technique to solve a diverse range of applied mathematical problems using MATLAB.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mathematics and Statistics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Define and explain the concepts of correlation, regression, random variables, probability distribution, partial differential equations and complex analysis
- **CO-2.** State theorems and solve simple problems in partial differential equations, complex analysis , probability , probability distributions
- **CO-3.** Apply numerical methods to solve ordinary and partial differential equations using MATLAB
- **CO-4.** Solve complex engineering problems associated with numerical methods using MATLAB
- **CO-5.** Analyze real world problems associated with probability, probability distributions, partial differential equations and complex analysis
- **CO-6.** Construct the Bar chart, pie chart, Histogram , Box-plot and fitting of curves by using MATLAB

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4. Course Contents

Unit I (Partial differential equations): Basic concepts, classification of first order partial differential equations. Solutions by Lagrange's method. Classification of second order linear partial differential equations. Solutions of heat, wave and Laplace's equations by method of separation of variables.

Unit II (Probability and Probability distribution): Review of basics of probability, conditional probability and Bayes' theorem. Random variables, probability distributions. Probability density function and cumulative density function. Mean and variance of distributions. Binomial, exponential and normal distributions.

Unit III (Complex analysis): Complex valued functions, limits, continuity and differentiability. Analytic functions and Cauchy-Riemann equations. Construction of analytic functions, Harmonic functions. Complex line integral, Cauchy's integral theorem and integral formula. Taylor and Laurent series. Singularities and residues, Cauchy's residue theorem.

Unit IV (Correlation and Regression): Review of statistics. Contingency, correlation and regression Curve fitting: Least squares method - polynomial, exponential and power fit.

Unit V (Numerical Methods): Types of errors, numerical solution of ordinary differential equations by single-step methods – Euler's, modified Euler's and Runge-Kutta methods. Multi-step methods – Milne's and Adams' methods. Solution by MATLAB built-in function ode45.

Unit VI (Finite Difference Method): Finite differences, explicit methods for one dimensional heat and wave equations, stability conditions. Implicit method for one dimensional heat equation. Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3											3		
CO-2	2	2	2										2		
CO-3	3	3	2							1			3		1
CO-4	3	3	2		2				1	1			3	2	1
CO-5	3	3	2		2					1			3	2	1
CO-6	3	3			1				1	1			3	1	1

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		15
1. Course Laboratory	00	
2. Computer Laboratory	15	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

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For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	×		×
CO-2	×		×
CO-3	×		×
CO-4		×	×
CO-5		×	×
CO-6		×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

10. Dennis Zill and Patrick Shanahan, 2013, Complex Analysis, 3rd edition, Jones and Bartlett
11. Richard Burden and Douglas Faires, 2017, Numerical Analysis, 9th edition, Massachusetts, Brooks/Cole
12. Erwin Kreyszig, 2015, Advanced Engineering Mathematics, 10th edition,

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John Wiley & Sons Inc

b. **Recommended Reading**

1. Rao V. Dukkipati, 2011, Applied Numerical Methods using MATLAB, 1st edition, New Delhi, New Age
2. M. K. Jain, S.R.K. Iyengar and R.K. Jain, 2008, Numerical Methods, New Delhi, New Age
3. James Brown and Ruel Churchill, 2017, Complex Variables and Applications, 8th edition, McGraw Hill Education
4. Sheldon Ross, 2013, A first course in probability, 9th edition, Pearson education
5. Richard A. Johnson, 2011, Miller and Freund's – Probability and Statistics for Engineers, 8th edition, Prentice hall India

c. **Magazines and Journals**

d. **Websites**

1. http://nptel.ac.in/
2. https://ocw.mit.edu/index.htm
3.

e. **Other Electronic Resources**

1. https://www.khanacademy.org/
2. tutorial.math.lamar.edu/

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Course Specifications: Transportation Engineering I

Course Title	Transportation Engineering - I
Course Code	CEC212A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

The course deals with various aspects of highway engineering. Students will be taught highway planning, engineering surveys for highway alignment, design of geometric elements of highways and rigid and flexible pavements design. Desirable properties of highway materials and various practices adopted for highway construction will be explained. Students will also be trained to evaluate pavements and decide appropriate types of maintenance.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Describe the Highway Development Programme and the basic principles of planning for achieving them

CO-2. Identify and discuss pavement components and the types of pavement construction

CO-3. Conduct tests and evaluate the properties of pavement materials

CO-4. Explain highway geometrics and structural designs for flexible and rigid pavements

CO-5. Analyse economics of highway projects and compare alternatives from an economic point of view

4. Course Contents

Unit 1 (Highway Development and Planning): Importance of transportation, different modes of transportation and comparison. Highway development in India- Jayakar Committee Recommendations and Realizations- Twenty- year Road Development Plans- present scenario of road development in India (NHDP & PMGSY). Institutions for Highway Development at National level - Indian Roads Congress, Highway Research Board- National Highway Authority of India- Ministry of Road Transport and Highways (MORTH) and Central Road Research Institute. Road types and classification- road patterns. Planning surveys- master plan- saturation system of road planning- phasing road development in India- problems on best alignment among alternate proposals.

Unit 2 (Highway Alignment and Surveys): Ideal alignment, factors affecting the alignment. Engineering surveys- map study- reconnaissance- preliminary and final location & detailed survey. Reports and drawings for new and re-aligned projects

Unit 3 (Highway Geometric Design): Importance- terrain classification- design speed- factors affecting geometric design. Cross sectional elements- right of way- carriageway- camber- kerbs- shoulders- width of formation- typical cross sections. Sight Distance- restrictions to sight distance- factors affecting sight distances- PIEV theory stopping sight distance- overtaking sight distance- intermediate sight distance- overtaking zones- examples- sight distance at intersections- geometric design of hill roads. Horizontal alignment- radius of curve- super elevation- extra widening- transition curve and its length- setback distances. Vertical alignment- rolling- limiting- exceptional and minimum gradients- summit and valley curves.

Unit 4 (Pavement Materials): Sub grade soil- desirable properties- HRB soil classification- determination of CBR and modulus of sub grade reaction. Aggregates- desirable properties- crushing- abrasion- impact tests- water absorption flakiness and elongation indices and stone polishing value test. Bituminous materials- explanation on tar- bitumen- cutback and emulsion- penetration ductility- viscosity- binder content and softening point tests.

Unit 5 (Pavement Design): Pavement types, component parts of flexible and rigid pavements and their functions. Factors affecting design of pavements- ESWL and its determination- climate- sub-grade soil and traffic. Flexible pavement- design of flexible pavements as per IRC:37-2001. Rigid pavement- Westergard's equations for load and temperature stresses- design of slab thickness only as per IRC recommendations. Pavement Construction: Earthwork- cutting, filling, preparation of sub grade. Specifications and construction of granular sub base- WBM Base- WMM base- bituminous macadam- dense bituminous macadam- bituminous concrete- dry lean concrete sub base and PQC concrete roads.

Unit 6 (Highway Drainage and Maintenance): Significance and requirement- surface drainage system and design- sub surface drainage system- design of filter materials. Types of defects in flexible pavements- surface defects- cracks- deformation disintegration- symptoms- causes and treatments. Failures in rigid pavements- scaling- shrinkage- warping- structural cracks- spalling of joints and mud pumping- special repairs. Pavement Evaluation- pavement surface conditions and structural evaluation- evaluation of pavement failure and strengthening- overlay design by Benkelman Beam Method.

Unit 7 (Traffic Engineering): Fundamental parameters of traffic flow- vehicular and road user characteristics- traffic characteristics- traffic studies- variation in speeds- speed and delay studies and problems-origin and destination studies- traffic density- traffic volume study and traffic volume relation between speed- travel time and traffic volume- traffic density and passenger car units- parking study. Traffic safety and control measures- traffic signs- markings- islands- signals- cause and type of accidents- use of intelligent transport system. Traffic environment interaction- noise pollution- vehicular emission- pollution mitigation measures.

Unit 8 (Highway Economics): Highway user benefits, VOC using charts. Economic analysis- annual cost method- benefit cost ratio method- NPV, IRR methods- Highway financing-BOT, BOOT concepts.

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5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3	2											3		
CO-3	3	2	1										3		
CO-4	3	2	2										3		
CO-5	3	2											3		

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		05
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		10
1. Solving Numerical Problems	30	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		55

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Civil Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs In either component

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(CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	×	×	×
CO-2	×	×	×
CO-3	×	×	×
CO-4		×	×
CO-5		×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

u. **Essential Reading**

1. Class Notes
2. Punmia B. C., 2005, Surveying Vol –I, II and III, New Delhi, Laxmi Publications

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3. Arora K. R., 1990, Surveying Vol- I and II, New Delhi, STD Book
4. Kanetkar T.P., 1994, Surveying and Levelling- Vols. I and II, United Book Corporation, Pune

v. Recommended Reading

1. Subramanian R., 2007, Surveying and Levelling, Oxford University Press
2. Venkataramiah C., 2009, Text Book of Surveying, Universities Press
3. Bannister A. and Raymond S., 1992 Surveying, ELBS, Sixth Edition
4. S.K. Duggal, 2013, Surveying Vol. I, New Delhi, Tata McGraw Hill - Publishing Co. Ltd
5. James M. Anderson and Edward M. Mikhail, 1985, Introduction to Surveying, McGraw-Hill Book Company

w. Magazines and Journals

1. http://www.academicpub.org/jsme/
2. https://ascelibrary.org/journal/jsued2

x. Websites

1. http://nptel.ac.in/
2. https://ocw.mit.edu

y. Other Electronic Resources

1. Electronic resources on the course area are available on MSRUAS library

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Course Specifications: Structural Analysis-I

Course Title	Structural Analysis-I
Course Code	CEC213A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the concepts structural forms and their analysis. The students are taught about virtual work, strain energy, consistent deformation, determinate structures, indeterminate structures, influence lines and stability as applied to various structural forms. Students are taught to extend the principles of virtual work and strain energy to determinate structures to compute deflections. Analysis of indeterminate beams and trusses, arches and cable stayed bridges are also addressed. Students are trained on influence line diagrams of various structural forms.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture:Tutorial:Practical)	2:2:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Define and describe various structural forms and relevant concepts that can be applied for structural analysis
- **CO-2.** Determine deflections in determinate structures
- **CO-3.** Analyze arches and cable suspension bridges
- **CO-4.** Analyze determinate structures by applying the concepts of strain energy and force methods
- **CO-5.** Derive influence line diagrams for beams and explain their behavior under the effect of rolling loads

4. Course Contents

Unit 1 (Structural Analysis and Concepts): Forms of structures, conditions of equilibrium, degree of freedom, linear and nonlinear structures, one, two, three dimensional structural systems, determinate and indeterminate structures [Static and Kinematics],

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Unit 2 (Deflection of Beams): Definition of slope, Deflection and curvature, Sign conventions, Derivation of moment-curvature equation. Double integration method and Macaulay's method: Slope and deflection for standard loading cases and for determinate prismatic beams subjected to point loads, UDL, UVL and couple.

Unit 3 (Moment Area and Conjugate Beam Method): Derivation, Mohr's theorems, Sign conventions, Application of moment area method for determinate prismatic beams, Beams of varying section, Use of moment diagram by parts.
Conjugate beam method: Real beam and conjugate beam, conjugate beam theorems, Application of conjugate beam method of determinate beams of variable cross sections

Unit 3 (Moment Area and Conjugate Beam Method): Derivation, Mohr's theorems, Sign conventions, Application of moment area method for determinate prismatic beams, Beams of varying section, Use of moment diagram by parts.
Conjugate beam method: Real beam and conjugate beam, conjugate beam theorems, Application of conjugate beam method of determinate beams of variable cross sections

Unit 4(Energy Principles and Energy Theorems): Principle of virtual displacements, Principle of virtual forces, Strain energy and complimentary energy, Strain energy due to axial force, bending, shear and torsion, Deflection of determinate beams and trusses using total strain energy, Deflection at the point of application of single load, Castigliano's theorems and its application to estimate the deflections of trusses, bent frames, Special applications-Dummy unit load method.

Unit 5 (Arches and Cable Structures): Three hinged parabolic arches with supports at the same and different levels. Determination of normal thrust, radial shear and bending moment. Analysis of cables under point loads and UDL. Length of cables for supports at same and at different levels- Stiffening trusses for suspension cables.

Unit 6 (Rolling Load and Influence Lines): Concepts of influence lines-ILD for reactions, SF and BM for determinate beams-ILD for axial forces in determinate trusses- Reactions, BM and SF in determinate beams using rolling loads concepts.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3											3		
CO-2	3	3											3		
CO-3	3	3											3		
CO-4	3	3											3		
CO-5	3	3											3		
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours

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Face to Face Lectures		30
Demonstrations		5
1.Demonstration usingVideos	05	
2. Demonstration using PhysicalModels / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		25
1. Solving Numerical Problems	25	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		70

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	×	×	×
CO-2	×	×	×
CO-3	×	×	×
CO-4		×	×
CO-5		×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

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Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignments
2.	Understanding	Class room lectures, Assignments
3.	Critical Skills	Class room lectures, Assignments
4.	Analytical Skills	Class room lectures, Assignments
5.	Problem Solving Skills	Class room lectures, Assignments
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, examination
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Punmia B. C. and Jain R. K., Strength of Materials and theory of structures Vol I & II, Laxmi Publication, New Delhi.
3. Reddy C S, Basic Structural Analysis, Tata McGraw Hill, New Delhi.
4. Muthu K U. etal, Basic Structural Analysis, 2nd edition, IK International Pvt. Ltd., New Delhi,2015.
5. Pandit G. S, and Guta S.P., "Theory of Structures", Vol. – I, Tata McGraw Hill, New Delhi.

a. Recommended Reading

1. Hibbeler R C, Structural Analysis, Prentice Hall, 9th edition, New Delhi,2015.
2. Devadoss Menon, Structural Analysis, Narosa Publishing House, New Delhi, 2008.
3. Prakash Rao D S, Structural Analysis, University Press Pvt. Ltd, 2007.

b. Magazines and Journals

c. Websites

d. Other Electronic Resources

1. Electronic resources on the course area are available on MSRUAS library

Course Specifications: Hydraulics and Hydraulic Machines

Course Title	Hydraulics and Hydraulic Machines
Course Code	CEC214A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with basics of fluid flow patterns, boundary layer theory and drag. Students are taught open channel hydraulics, dimensional analysis, momentum principle of impact of jets on plane and curved surfaces, different types of turbines and centrifugal pumps. Students are trained to classify the types of flows in open channel and also to design open channel sections in a most economical fashion with minimum wetted perimeter and critical flows.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO 1.** Describe fluid flow patterns and boundary layer theory
- **CO 2.** Apply the concepts of dimensional analysis to model hydraulic systems
- **CO 3.** Design the most economical section for uniform open channel flow
- **CO 4.** Analyze non-uniform flow in open channel flow
- **CO 5.** Evaluate the work done due to impact of jet on surfaces for different conditions
- **CO 6.** Discuss the theory, working principles and performance characteristics of various hydraulic machines

4. Course Contents

Unit 1 (Introduction): Ideal fluid flow- Uniform flow- sources - sink- doublet - combination of flow patterns - uniform flow and source- flow around cylinder - flow with circulation - lift. Boundary layer - displacement and momentum thickness - development of flow in circular pipes - Von Karman momentum equation - laminar and turbulent boundary layers on flat plates - drag in flat plates, cylinders and spheres - drag coefficients - boundary layer control.

Unit 2 (Dimensional analysis): Introduction; systems of units; dimensions of quantities; dimensional homogeneity; Rayleigh's and Buckingham's Π methods; problems Model studies: Introduction; model and prototype; types of similarities; dimensionless numbers; Reynold's and Froude's model

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laws, problems; undistorted and distorted models

Unit 3 (Uniform flow in open channels): Introduction to open channel flow, types: uniform and non-uniform flow; uniform flow: geometric properties of rectangular, triangular, trapezoidal and circular channel sections; Chezy's and Manning's equations; problems; most economical open channel sections: rectangular, triangular, trapezoidal and circular cross-sections, problems

Unit 4 (Non-uniform flow in open channels): Introduction; classification, specific energy, specific energy curve, theory and problems on critical flow: critical depth, critical velocity, minimum specific energy; subcritical, supercritical and critical flow; dynamic equation for gradually varied flow; back water curve and drop down curve; theory and problems on hydraulic jump; classification of surface profiles and problems

Unit 5 (Impact of Jet on Flat Vanes): Introduction; impulse-momentum equation; force exerted and work done by impact of jet on the following cases: direct and oblique impact on a stationary flat plate; direct and oblique impact on a moving plate; impact on series of flat plates; impact on vertical flat plate hinged at the top; problems

Unit 6 (Impact of Jet on Curved Vanes): Introduction; force exerted by a jet on fixed curved vane when jet striking at center, fixed curved vane when jet striking tangentially, fixed non-symmetric curved vane when jet striking tangentially; force exerted and work done by impact of jet on moving curved vane when jet strikes at the center; introduction to concept of velocity triangles; force exerted, work done and hydraulic efficiency for the tangential impact of jet on moving curved plate; force exerted, work done and hydraulic efficiency for the impact of jet on series of curved vanes; problems.

Unit 7 (Turbines): Introduction to hydraulic machines; general layout of a hydro-electric power plant; classification of turbines; Pelton wheel: components, working, velocity triangles, force exerted, work done, maximum efficiency, working proportions, problems; Francis turbine: components, working, velocity triangles, work done, hydraulic efficiency and discharge of the turbines, problems. Kaplan turbine: components, working, velocity triangles, discharge, speed, problems; draft tube: functions, types and efficiency

Unit 8 (Pumps): Introduction; classification; centrifugal pumps: components, working, velocity triangles, work done, heads, efficiencies, minimum starting speed, muti-stage centrifugal pumps: series and parallel, priming, characteristic curves, cavitation

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2		3											3		
CO-3		2	3										3		
CO-4		3	2										3		
CO-5	1	3	2										3		
CO-6	3												3		

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		05
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		55

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	×	×	×
CO-2	×	×	×
CO-3	×	×	×
CO-4		×	×
CO-5		×	×
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

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The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Bansal R. K.,(2008) Text Book Of Fluid Mechanics & Hydraulic Machines, Laxmi Publications, New Delhi.
3. Modi P N and Seth S M, 2009, Hydraulics and Fluid Mechanics, New Delhi, Standard Book House

b. Recommended Reading

1. Subramanya K., 2015, Hydraulic Machines, New Delhi, McGraw Hill Education India
2. Fox R W, McDonald A T and Pritchard P J , 2009, Hydraulic Machines, New Delhi, Wiley India
3. Shaughnessy E J Jr., Katz I M and Schaffer J P, 2005, Introduction To Fluid Mechanics, New Delhi, Oxford University Press

c. Other Electronic Resources

1. https://nptel.ac.in

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Course Specifications: Environmental Engineering

Course Title	Environmental Engineering
Course Code	CEC215A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with water supply and waste water engineering. The students are introduced to basic characteristics of water and sewage, their determination methods and treatment. The students are provided information about water quality requirements, sewage disposal standards, air pollution and its effects, and solid waste generation. The students are explained design of water and sewage treatment systems. They are also trained in design.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Identify the sources of water and water demand.
CO-2. Prepare basic process designs of water and wastewater treatment plants, collect, Reduce, analyze, and evaluate basic water quality data
CO-3. Apply the water treatment concepts and methods
CO-4. Compare and contrast water distribution processes and operation and maintenance of Water supply
CO-5. Analyze the sewage characteristics and design various sewage treatment plants
CO-6. Design and operate municipal water and wastewater treatment system

4. Course Contents

Unit 1 (Water Supply Engineering): Introduction- Human activities and environmental pollution, Water for various beneficial uses and quality requirement. Need for protected water supply. Public water supply system Planning - Objectives, Design period, Population forecasting Water Demand: Types of water demands- domestic demand in detail, institutional and commercial, public uses, fire demand. Per capita consumption –factors affecting per capita demand, population forecasting, different methods with merits & demerits- variations in demand of water. Fire demand – estimation by Kuching's formula, Freeman formula & national board of fire under writer's formula, peak factors, design periods & factors governing the design periods.

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Unit 2 (Sources of Water and their Characteristics): Impounding Reservoir -Well hydraulics-Development and selection of source, Surface and Groundwater – suitability with regard to quality and quantity, Sources. Quality of water: Water quality characterization, Drinking water quality standards, Objectives of water quality management; wholesomeness & palatability, water borne diseases. Water quality parameters – Physical, chemical and Microbiological; Sampling of water for examination. Water quality analysis (IS: 3025 and IS: 1622) using analytical and instrumental techniques. Drinking water standards BIS & WHO guidelines; Health significance of Fluoride, Nitrates and heavy metals like Mercury, Cadmium, Arsenic etc. and toxic / trace organics.

Unit 3 (Collection and Conveyance of Water): Intake structures – different types of intakes; factors of selection and location of intakes; (Functions and drawings), Pumps- Necessity, types – power of pumps; factors for the selection of a pump. Pipes – Design of the economical diameter for the rising main; Nomograms – use; Pipe appurtenances. Pipes and conduits for water – Pipe materials – Hydraulics of flow in pipes – Transmission main design- Laying, jointing and testing of pipes – appurtenances- Drawings; Selection of pipe materials.

Unit 4 (Water Treatment): Objectives – Unit operations and processes-Treatment flow-chart. Aeration- Principles, types of Aerators. Sedimentation- Theory, settling tanks, types, design. Coagulant aided sedimentation, jar test, chemical feeding, flash mixing, and clariflocculator. Filtration- Mechanism – theory of filtration, types of filters, slow sand, rapid sand and pressure filters including construction, operation, cleaning and their design – excluding under drainage system – back washing of filters. Operational problems in filters.(Functions design and drawing of flash mixers, flocculators, sedimentation tanks and sand filters) Disinfection – Theory of disinfection, types of disinfection, THM; Iron and Manganese removal, Defluoridation and defluoridation, Residue Management, Corrosion Control, Chlorination- chlorine demand, residual chlorine and use of bleaching powder. Construction, Operation and Maintenance aspects - Layout and Hydraulic Profile of water treatment plants. Softening – definition, Desalination demineralization – Adsorption -Membrane Systems methods of removal of hardness by lime soda process and zeolite process. Construction and Operation & Maintenance aspects – Recent advances- Miscellaneous treatment - Removal of colour, odour, taste, use of copper sulphate, adsorption technique, RO & Membrane technique, UV irradiation treatment – treatment of swimming pool water.

Unit 5 (Water Distribution and Supply to Buildings): Systems of supply, Requirements of water distribution – Components – Water supply schemes – gravitational, pumping and combined schemes – Pumps, Pumping stations, transmission of water, materials of water supply pipes, design of gravity and pumping main, distribution systems, different layout of pipe networks, Network design, Economics. Pipe appurtenances, Valves, Fire hydrants. Pipe materials: Different materials with advantages and disadvantages. Factors affecting selection of pipe material. Storage Reservoirs – balancing reservoir, Service reservoirs and their capacity determination, detection and prevention of leaks in the distribution systems, operation and maintenance of distribution systems.

Unit 6 (Waste Water Engineering) : Planning for Sewerage Systems: Sources of wastewater generation – Effects, Estimation of sanitary sewage flow, Dry weather flow, factors affecting dry weather flow, flow variations and their effects on design of sewerage system, computation of design flow, estimation of storm flow, rational method and empirical formulae of design of storm water drain. Factors affecting characteristics and composition of sewage and their significance Time of concentration– Effluent standards – Legislation requirements. Necessity for sanitation, methods of domestic waste water disposal, types of sewerage systems and their suitability.

Unit 7 (Sewer Network Design): Sewerage – Hydraulics of flow in sewers – Objectives – Hydraulic formulae for velocity, effects of flow variations on velocity, self-cleansing and non-scouring velocities, Design of hydraulic elements for circular sewers flowing full and flowing partially full-Design period. Design of sanitary and storm sewers – Small bore systems – (Computer applications) – Laying, joining & testing of sewers. Secondary Treatment of Sewage: Appurtenances – Pumps – selection of pumps and pipe Drainage - Plumbing System for Buildings – One pipe and two-pipe systems.

Unit 8 (Primary Treatment of Sewage): Objective – Unit Operation and Processes – Selection of treatment processes – Onsite sanitation - Septic tank, Grey water harvesting. Preliminary & Primary treatment – Principles, Flow diagram of municipal waste water treatment plant: Screening, grit chambers, skimming tanks, primary sedimentation tanks – Design criteria-Design examples. Construction, Operation and Maintenance aspects.(functions design and drawing of screen, grit chambers and primary sedimentation tanks). Objective – Selection of Treatment Methods – Principles-Suspended growth and fixed film bioprocess, (Functions, Design and Drawing of Units) - Activated Sludge Process and Trickling filter, other treatment methods; Activated sludge process (ASP) - Principle and flow diagram, Modifications of ASP,F/M ratio, Design of ASP Trickling filter – theory and operation, types and designs. Construction and Operation & Maintenance aspects – (Layout and Hydraulic profile of treatment plants). Disposal of Sewage and Sludge: Standards for Disposal - Methods – dilution – Self-purification of surface water bodies – Oxygen sag curve – Land disposal – Sewage farming – Deep well injection – Soil dispersion system. Sludge characterization – Thickening – Sludge digestion – Biogas recovery – Sludge- Conditioning and Dewatering – disposal – Advances in Sludge Treatment and disposal. Recent Advances in Sewage Treatment: Anaerobic Sludge digestion, Sludge digestion tanks, Design of Sludge drying beds. Low cost waste treatment method. Septic tank, Oxidation Pond and Oxidation ditches – Design. Reuse and recycle of waste water Oxidation ditches, UASB – Waste Stabilization Ponds Reclamation and Reuse of sewage

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1		2		2		3							2	3	
CO-2			3				3						3	3	
CO-3	3				3	3	3				2		3	3	2
CO-4		2					3	2			3		2	3	3
CO-5	3		3	3			3						3	3	
CO-6	3		3	3			3						3	3	
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15

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1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**55**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	×	×	×
CO-2	×	×	×
CO-3	×	×	×
CO-4	×	×	×
CO-5		×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

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8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures, Assignments
2.	Understanding	Classroom lectures, Assignments
3.	Critical Skills	Classroom lectures, Assignments
4.	Analytical Skills	Classroom lectures, Assignments
5.	Problem Solving Skills	Classroom lectures, Assignments
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, Examination
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Garg S. K., 2001, Environmental Engineering, Vol. I, II New Delhi, Khanna Publications.
3. Punmia, B.C., 2010, Jain, A.K., and Jain.A.K.., Environmental Engineering, Vol.II, Laxmi Publications.
4. Metcalf and Eddy, 2009, Wastewater Engineering - Collection, Treatment, Disposal and Reuse, McGraw Hill Pub.Co.

b. Recommended Reading

1. M. J. Hammer, 2007, Water and Wastewater Technology, Prentice Hall, Prentice Hall, Inc., New Jersey 6th edition.
2. Benny Joseph 2006, Environmental Science and Engineering, New Delhi, Tata McGraw-Hill.
3. Howard S. Peavy, Donald R. Rowe, George Technobanoglous, Environmental Engineering, McGraw Hill International Edition.
4. Duggal K.N., 2014, Elements of Environmental Engineering, New Delhi S.Chand and Co. Ltd.
5. Birdie G.S & Birdie J.S, 1998, Water Supply and Sanitary Engineering, New Delhi, Dhanpat Rai & Sons.

c. Magazines and Journals

d. Websites

1. https://www.coursera.org/

e. Other Electronic Resources

1. http://nptel.ac.in/

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Course Specifications: Building Planning and Computer Aided Drafting

Course Title	Building Planning and Computer Aided Drafting
Course Code	CEC216A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with physics, services, planning, design and green construction of buildings. Students are also taught about building services which consist of vertical transportation, ventilation and air conditioning, and plumbing services. Students are trained to plan, design and prepare drawings for residential and public buildings using AutoCAD and Revit software.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	1:0:2
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Explain the various aspects of building services and green construction
CO 2. Discuss the various components of the residential and public buildings as per NBC
CO 3. Develop schematic diagram for a given requirement of areas and specification for residential and public buildings
CO 4. Develop functional design of a building using circulation diagrams
CO 5. Develop functional design of a building using circulation diagrams
CO 6. Develop water supply, sanitary, and electrical layout for residential buildings

4. Course Contents

Unit 1 **(Building Components):** Doors, Ventilators and Windows: technical terms, classification, size specification.

Unit 2 **(Building Services):** Vertical transportation: Stairs, elevators, escalators and ramps. Ventilation and air conditioning: Ventilation requirements, summer and winter air conditioning, parts and operation of A/C plant. Plumbing services: Typical details of water supply and sewage disposal arrangements for buildings, standard requirements.

Unit 3 **(Building Physics):** Climate: Global climatic factors, elements of climate, data and measurement of elements of climate, graphical representation methods, site climate, classification of climates.

Thermal comfort: Thermal balance of human body, thermal comfort indices and uses, comfort zone.

Sun's movement and building orientation: Solar temperature concept, solar gain factor, apparent movement of sun, solar charts and its use, external shading devices, internal blinds and curtains and special glasses.

Unit 4 (Introduction to Green Construction): Green Concepts and Vocabulary, Components of Sustainable Design and Construction, Green Design and the Construction Process, Building Information Modeling, Indoor Environment Quality, Water Efficiency and Sanitary Waste, Indian Green Building Council (IGBC) certification.

Unit 5 (Building components and Bye-laws): Introduction to anthropometrics and ergonomics, occupancy classification of buildings, essentials of National Building Code (NBC), essentials of building and development rules. . Building standards, bye laws, set back distances, calculation of carpet area, plinth area and floor area ratio.

Unit 6 (Functional design of building): Positioning of various components of buildings, orientation of buildings, circulation diagram, development of functional diagram and approval plan.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	
CO-1						2	2							2		
CO-2						2			2		2			2	2	
CO-3	3		3										3			
CO-4	3		3										3			
CO-5							3		3		3			3	3	
CO-6	3		3				3						3	3		

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		20
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	20	
Numeracy		00
1. Solving Numerical Problems		
Practical Work		35
1. Course Laboratory	00	
2. Computer Laboratory	35	

3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**85**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	×	×	×
CO-2	×	×	×
CO-3	×	×	×
CO-4	×	×	×
CO-5	×	×	×
CO-6		×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignment
2.	Understanding	Class room lectures, Assignment
3.	Critical Skills	Assignment

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4.	Analytical Skills	Class room lectures, Assignment
5.	Problem Solving Skills	Class room lectures, Assignment
6.	Practical Skills	Class room lectures, Assignment
7.	Group Work	--
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	--
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Raja Rao and Subrahamanyam, 2015, Planning and designing of residential building, New Delhi, Standard Publishers
3. Bhavikatti and Chitawadagi, 2017, Building planning and drawing, New Delhi, I. K. International publishing house Pvt. Ltd.
4. N. Kumara Swamy and A Kameswara Rao, 2015, Building planning and drawing, Anand, Charotar publishing house Pvt. Ltd.

b. Recommended Reading

11. National Building Code, 2013, New Delhi, BIS
12. Shah M. H. and Kale C. M., 2007, Building Drawing, New Delhi, Tata Mc-Graw Hill Publishing.
13. Shah M. G., Kale C. M. and Patki S. Y., 2002, Building drawing with an integrated approach to built environment, New Delhi, Tata Mc-Graw Hill Publication.
14. Wakita O. A. and Linde R. M., 1994, Study guide for the professional practice of architectural working Drawings, U.S.A., John Wiley

c. Magazines and Journals

a. Computer Aided Civil and Infrastructure Engineering, Wiley
b. Engineering Construction and Architectural Management, Wiley

d. Websites

1. https://www.autodesk.com/community
2. https://www.revitcity.com/index.php

e. Other Electronic Resources

1. https://nptel.ac.in/

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Course Specifications: Hydraulics and Hydraulic Machinery Laboratory

Course Title	Hydraulics and Hydraulic Machinery Laboratory
Course Code	CEL217A
Course Type	Laboratory
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

1. Course Summary

This course deals with the verification and application of principles of fluid mechanics by conducting experiments. Experiments consist of study of hydraulic pressure as well as study of flow properties of fluids using notches, orifices, venturimeter, mouthpieces, etc. Experiments on determination of losses in pipes and tests on different types of turbines and pumps will also be conducted.

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:1
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Describe and explain pressure and viscosity measuring instruments such as pressure gauge, piezometer, manometer, pressure transducers, pitot tubes and viscometer

CO-2. Determine friction and minor losses in flow through pipes

CO-3. Conduct tests on flow measuring devices such as notches, orifices, mouthpieces, venturimeter and orificemeter

CO-4. Generate performance characteristic curves of Pelton, Francis and Kaplan turbines and centrifugal and reciprocating pumps

CO-5. Validate Bernoulli's theorem

4. Course Contents

1	Demonstration experiments on pressure gauge, piezometer, manometer, pressure transducers, pitot tubes and viscometer; Verification of Bernoulli's theorem; Calibration of V - Notch; Calibration of Rectangular notch; Calibration of Cippoletti Notch
2	Calibration of orifices; Calibration of mouth pieces; Calibration of Venturimeter; Calibration of orifice meter
3	Determination of Friction factor of pipes; Determination of minor losses in flow through pipes; Experiment on venturiflume

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4	Calibration of Broad crested weir; Calibration of Sharp crested weir; Calibration of curved weir; Test on impact of jet on vanes
5	Study on performance characteristics of Pelton turbine; Study on performance characteristics of Francis turbine (Demonstration); Study on performance characteristics of Kaplan turbine (Demonstration); Study on performance characteristics of Centrifugal pumps (Constant speed / variable speed); Study on performance characteristics of reciprocating pump

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1		3		2					1				3	2	1
CO-2		2		3					1				2	3	1
CO-3		2		3					1				2	3	1
CO-4		2		3					1				2	3	1
CO-5	2			3					1				2	3	1
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		
Demonstrations		00
1. Demonstration using Videos		
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Numeracy		00
1. Solving Numerical Problems		
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory		
3. Engineering Workshop / Course Workshop / Kitchen		

4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		00
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Tests, Laboratory Examination / Written Examination,		10
Total Duration in Hours		40

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Laboratory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Conduct of Experiments	Laboratory Report + Viva	Laboratory SEE
CO-1	X	X	X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
CO-5	X	X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities	How imparted during the course
1.	Knowledge	Laboratory instruction
2.	Understanding	Laboratory instructions and experiments
3.	Critical Skills	Laboratory work
4.	Analytical Skills	Laboratory work

5.	Problem Solving Skills	Laboratory work
6.	Practical Skills	Laboratory work
7.	Group Work	Laboratory work
8.	Self-Learning	Laboratory work
9.	Written Communication Skills	Laboratory work, ,examination
10.	Verbal Communication Skills	Laboratory examination
11.	Presentation Skills	Viva Voce
12.	Behavioral Skills	Course work
13.	Information Management	Laboratory work
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Laboratory manual
3. Singh, S. (2013). Experiments in Fluid Mechanics. PHI Pvt. Ltd., New Delhi.
4. Modi, P.N. and Seth, S. M., (2010). Hydraulics and Fluid Mechanics. Standard Book House, Delhi.

b. Recommended Reading

1. A. K. Jain, 2002. Fluid Mechanics, New Delhi, Khanna Publishers
2. V. L. Streeter and E. B. Wiley, 1998, Fluid Mechanics, New York, McGraw Hill Co
3. F. M. White 2008, Fluid Mechanics, New Delhi, Tata McGraw Hill

c. Magazines and Journals

d. Websites

1. http://nptel.ac.in/

e. Other Electronic Resources

4. Electronic resources on the subject area are available on MSRUAS library

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Course Specifications: Environmental Engineering Laboratory

Course Title	Environmental Engineering Laboratory
Course Code	CEL218A
Course Type	Laboratory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with quantification of water and wastewater pollutants. Students will be taught to measure the concentration of air pollutants and analyse the characteristics of water,
wastewater and ambient air. They will also be trained to study the growth of microorganism an d its quantification

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:1
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO1.** Quantify the pollutant concentration in water, wastewater and ambient air
- **CO2.** Recommend the degree of treatment required for the water and wastewater
- **CO3.** Analyze the survival conditions for microorganisms and its growth rate

4. Course Contents

1	**Physical characteristics of water:** Total Solids, Suspended Solids, Dissolved Solids, Volatile Solids, Fixed Solids, Settlable Solids.
2	**Chemical characteristics of water:** Electrical conductivity. Determination of Chlorides and Sulphates Determination of Alkalinity, Acidity and pH (Electrometric and Colorimetric);. Determination of Calcium, Magnesium and Total Hardness Determination of sulphates and sulphides in water. Determination of manganese in water Determination of Iron by Phenanthroline method. Determination of Fluorides by SPADNS Method.
3	**Bacteriological tests:** Determination of Dissolved Oxygen. Determination of Biochemical Oxygen Demand.

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	Determination of Chemical Oxygen Demand. Microbiological culture analysis of bacterial samples- Most Probable Number Test.
4	**Jar test :** Jar Test for Optimum Dosage of Alum, Turbidity determination by Nephelometer
5	Chlorine demand and residual test: Determination of percentage of available chlorine in bleaching powder Residual Chlorine and Chlorine Demand.
6	Organic and inorganic solids.
7	**Ambient Air Quality Analysis:** Respirable Particulate Matter (PM10). Total Suspended Particulate matter (TSP); Determination of SO_2 in ambient air; Determination of NO_x in ambient air.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3		3	3		3		1				3	3	3
CO-2	3			3			3		1				3	3	3
CO-3	3			3	3		3		1				3	3	3

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		
Demonstrations		00
1. Demonstration using Videos		
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Numeracy		00
1. Solving Numerical Problems		
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory		
3. Engineering Workshop / Course Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		00
1. Case Study Presentation		

2. Guest Lecture		
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Tests, Laboratory Examination / Written Examination,		10
Total Duration in Hours		40

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Laboratory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Conduct of Experiments**	**Laboratory Report + Viva**	**Laboratory SEE**
CO-1	**X**	**X**	**X**
CO-2	**X**	**X**	**X**
CO-3	**X**	**X**	**X**
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities	How imparted during the course
1.	Knowledge	Laboratory instruction
2.	Understanding	Laboratory instructions and experiments
3.	Critical Skills	Laboratory work
4.	Analytical Skills	Laboratory work
5.	Problem Solving Skills	Laboratory work
6.	Practical Skills	Laboratory work
7.	Group Work	Laboratory work
8.	Self-Learning	Laboratory work
9.	Written Communication Skills	Laboratory work, ,examination
10.	Verbal Communication Skills	Laboratory examination
11.	Presentation Skills	Viva Voce
12.	Behavioral Skills	Course work

13.	Information Management	Laboratory work
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Laboratory Manual
2. Class Notes

b. Recommended Reading

1. IS Standards: 2490-1974, 3360-1974, 3307-1974, 10500-1992.
2. Chemistry for Environment Engineering. Sawyer and Mc Carthy.
3. Manual of Water and Wastewater Analysis – NEERI Publication.
4. Standard Methods for Examination of Water and Wastewater (1995), American Publication Association, Water Pollution Control Federation, American Water Works Association, Washington DC.

c. Magazines and Journals

d. Websites

1. http://nptel.ac.in

e. Other Electronic Resources

1. Electronic resources on the subject area are available on MSRUAS library

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Course Specifications: Innovation and Entrepreneurship

Course Title	Innovation and Entrepreneurship
Course Code	BAU201A
Course Type	Ability Enhancement Course
Department	Management Studies
Faculty	Management and Commerce

1. Course Summary

This course on Innovation and Entrepreneurship is introduced across all the undergraduate programs with an aim to impart comprehensive knowledge of an entrepreneurial ecosystem. Further, the course enables to develop entrepreneurial skills by building entrepreneurial intentions among students. The students also gain knowledge on competencies to provide with necessary inputs for creation of new ventures and scaling up existing startups. The students are also introduced to design thinking process to nurture entrepreneurial way of thinking.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	1:1:1
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Respective Department of the Faculty
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the concepts and process of Innovation as well as entrepreneurship
- **CO-2.** Construct and apply the idea generation techniques
- **CO-3.** Discuss the opportunities for launching of new venture and various entry strategies
- **CO-4.** Examine innovative ideas for the creation and management of entrepreneurship
- **CO-5.** Formulate and present a viable business plan to the investors appraisal

4. Course Contents

Unit 1: Introduction to Entrepreneurship

Introduction to entrepreneurship, Evolution of the concept, Entrepreneurial process, Types of Entrepreneurship - Social entrepreneurship, rural entrepreneurship. Characteristics of an Entrepreneur, Incorporation of a Company, Managing a Family Business, Corporate Intrapreneurship

Unit 2:

Innovation and Creativity: Types of Innovations. Identify Various Sources of Ideas for New Ventures, Methods Available for Generating New Venture Ideas - Creativity, Design Thinking and the Techniques for Creative Problem Solving. Aspects of the Product Planning and Development Process.

Unit 3

New Venture:

Creating Opportunities, Resources, Role of New Ventures and Small Businesses in the Economy, Types of Entry Strategies, Launch a New Venture and the Generic Strategies

Unit 4

Strategies to Sustain and Grow:

Strategies for Expansion, Joint Ventures, Acquisitions, Merges, Franchising, Growth Strategy, Exit Strategy.

Unit 5 Business Plan

Business plan, scope and value of the business plan, step-by-step explanation of the business plan, marketing plan, Organizational plan, financial plan (source of capital), entrepreneurship models

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	2	2	2									2			3
CO-2	3	2	2	2	3								3	2	
CO-3	3	3	2	2								2		2	
CO-4	3	2	2	2	2	3			3	3			2		3
CO-5	2	3		2							3		2	3	
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		02
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Posters	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		03
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	03	

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4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		15
1. Case Study Presentation	05	
2. Guest Lecture	01	
3. Industry / Field Visit	02	
4. Brain Storming Sessions	02	
5. Group Discussions	04	
6. Discussing Possible Innovations	01	
Term Tests, Laboratory Examination/Written Examination, Presentations		05
Total Duration in Hours		**45**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For AECC Only		
Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: CE (60% Weightage)	**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests or Assignments**	
CO-1	**X**	**X**
CO-2	**X**	**X**
CO-3	**X**	**X**
CO-4	**X**	**X**
CO-5	**X**	**X**
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.		

The Course Leader assigned to the course, shall provide the focus of COs in each component of assessment in the beginning of the semester to capture the Group Task evaluation parameters such as: field visit, presentation of business plan, case study presentation on success and failure companies. Ideating and running the business for a day inside the campus.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures
2.	Understanding	Class room lectures
3.	Critical Skills	Assignment
4.	Analytical Skills	Class room, assignment, examination

5.	Problem Solving Skills	Assignment, Field visit and presentation
6.	Practical Skills	Assignment
7.	Group Work	Case study Presentation
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	Case study and group discussions
11.	Presentation Skills	Case study and group discussions
12.	Behavioral Skills	Group discussions
13.	Information Management	Assignment
14.	Personal Management	Assignment and Group Discussion
15.	Leadership Skills	Group discussions and Case study

9. Course Resources

a. Essential Reading

1. Course notes
2. Hisrich, R., Peters, M. and Shepherd, D., 2020. *Entrepreneurship*. 11th ed. Noida: McGraw Hill.

b. Recommended Reading

1. Charantimath, P., 2018. *Entrepreneurship development and small business enterprises*. 3rd ed. Belgaum, India: Pearson Education.
2. Roy, R., 2020. *Entrepreneurship*. 3rd ed. Noida: Oxford University Press.

c. Magazines and Journals

1. Business World: ABP Group
2. Journal of Small Business Management, Blackwell Publishing
3. Business Strategy: PwC Strategy & Inc.

d. Websites

1. India, S., 2022. *Homepage*. [online] Start-up India. Available at: <https://www.startupindia.gov.in/> [Accessed 10 July 2022].
2. Allsharktank, Products., 2022. *Homepage*. [online] All Shark Tank Products. Available at: <https://www.allsharktankproducts.com/> [Accessed 10 July 2022].
3. India, M., 2022. *Make In India*. [online] Makeinindia.com. Available at: <https://www.makeinindia.com/> [Accessed 10 July 2022].

e. Other Electronic Resources

NA

Course Specifications
(5th Semester)

Course Specifications: Design of RCC Elements

Course Title	Design of RCC Elements
Course Code	CEC301A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

19.Course Summary

This course deals with the principles and procedures of design of concrete structural elements. The students are introduced to concepts of different design philosophies in RCC and are trained to use relevant IS codes. Students are taught limit state design for flexure, shear, torsion, bond, anchorage and also for compression and tension. Implementation of limit state design for flexure and shear is done for beams and slabs. Analysis and design of columns subjected to eccentric load are covered by using interaction diagrams in detail. The students are trained to design of various foundation and staircases.

20. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:1:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

21. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-16.** Describe fundamental concepts of working stress method, ultimate load method and limit state method
- **CO-17.** Estimate loads acting on beams, slabs, columns and staircase as per IS 875
- **CO-18.** Analyze load carrying capacity of beams ,slabs, columns and staircases
- **CO-19.** Design of concrete elements like beams, slabs, stairs, column using relevant IS Codes
- **CO-20.** Design of structural system with neat sketches for drafting

22. Course Contents

Unit 1 (Introduction to Design Concepts and Philosophies):

Basic material properties; stress strain behavior of steel and concrete

Basic design concepts - Working Stress Method (WSM), Ultimate Load Method (ULM), Limit States Method (LSM); advantages of Limit State method over other methods. Limit State philosophy as detailed in current IS Code - design philosophy – Limit State Design principles. Philosophy of limit state design, principles of limit states, factor of safety, characteristic and design loads, characteristic and design strength.

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Unit 2 (Principles of Limit State Design and Ultimate Strength of R.C. Section):
General aspects of ultimate strength, stress block parameters for limit state of collapse. Ultimate flexural strength of singly reinforced rectangular sections, ultimate flexural strength of doubly reinforced rectangular sections. Ultimate flexural strength of flanged sections, ultimate shear strength of RC sections, ultimate torsional strength of RC sections, concepts of development length and anchorage. Analysis examples of singly reinforced, doubly reinforced, flanged sections, shear strength and development length.

Unit 3 (Flexure and Serviceability Limit States):
General specification for flexural design of beams, practical requirements, size of beams, cover to reinforcement-spacing of bars.
General aspects of serviceability- deflection limits in IS: 456–2000, calculation of deflection (theoretical method), cracking in structural concrete members, calculation of deflections and crack width.

Unit 4 (Design of Beams):
Design procedures for critical sections for moment and shears. Anchorages of bars, check for development length, reinforcement requirements and slenderness limits for beams to ensure lateral stability. Design examples for simply supported and cantilever beams for rectangular and flanged sections.

Unit 5(Design of Slabs):
General consideration of design of slabs, rectangular slabs spanning in one direction, Rectangular slabs spanning in two directions for various boundary conditions, design of simply supported, cantilever and continuous slabs as per IS: 456 – 2000.

Unit 6(Design of Columns):
General aspects, effective length of column, loads on columns, slenderness ratio for columns and minimum eccentricity. Design of short axially loaded columns, design columns course to combined axial load, uniaxial moment and biaxial moment, using SP – 16 charts.

Unit 7(Design of Stair-cases):
General features, types of stair case, loads on stair cases, effective span as per IS code provisions, distribution of loading on stairs, design of stair cases with waist slabs.

23. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	
CO-1	3	2											3			
CO-2	3	3	2										3			
CO-3	3	3	2										3			
CO-4	3	3	3	2									3	2		
CO-5	3	3	3		3								3	3		

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

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24. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		25
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		20
1. Solving Numerical Problems	20	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**55**

25. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Civil Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	X		X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X

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CO-5		X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

26. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

27. Course Resources

z. Essential Reading

1. Class notes
2. Sinha S.N., 1996, Reinforced Concrete Design, Tata McGraw Hill Publishing Company Ltd.
3. Bhavikatti S. S., Design of RCC Structural Elements Vol-I, New Delhi, New Age International Publications
4. Ramamrutham S. and Narayan R., 1993, Design of Reinforced Concrete Structures, Dhanpat Rai Publications.
5. IS-456-2000 and SP-16

aa. Recommended Reading

1. Jain, 1999, Reinforced Concrete: Limit State design, Nem Chand and Bros.
2. Karve & Shaha, Reinforced concrete Design-by Structures Publishers Pune.
3. S. Unnikrishna Pillai & D. Menon, 2008, Reinforced Concrete Design (Third edition), Tata McGraw Hill.
4. Varghese P.C., 2002, Limit State Design of Reinforced Concrete, Prentice Hall of India Pvt. Ltd.

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5. Nilson A, Darwin D. and Dolan C., Design of Concrete Structures (13th edition), Tata McGraw Hill

bb. Magazines and Journals

1. American concrete institute: https://www.concrete.org/
2. Indian concrete institute: www.indianconcreteinstitute.org/

cc. Websites

dd. Other Electronic Resources

1. http://nptel.ac.in/

Course Specifications: Structural Analysis-II

Course Title	Structural Analysis-II
Course Code	CEC302A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the principles of analysis of statically indeterminate beams and rigid jointed frames by displacement methods of analysis. The students learn classical methods of analysis to analyze the forces in structures like continuous beams and frames. The students are taught the basics Matrix methods of analysis and are trained to model and analyse the practical structural problems. Basics of plastic analysis and structural dynamics are introduced to the students. The students are trained in approximate methods of analysis multi-storeyed structures.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture:Tutorial:Practical)	2:2:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-21.** Use various classical displacement and force methods for analysis of indeterminate structures
- **CO-22.** Apply the basic concepts of matrix methods in structural analysis develop stiffness and flexibility matrices
- **CO-23.** Analyze structures using flexibility and stiffness method
- **CO-24.** Conduct dynamic analysis for SDOF systems
- **CO-25.** Analyze structural system and interpret data.

4. Course Contents

Unit 1 (Slope Deflection Method): Introduction, sign convention, development of slope deflection equation, analysis of continuous beams including settlements, Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy

Unit 2 (Moment Distribution Method):
Introduction, Definition of terms, Development of method, Analysis of continuous beams with support yielding, Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy

Unit 3 (Kani's Method): Introduction, Concept, Relationships between bending moment and deformations, Analysis of continuous beams with and without settlements, Analysis of frames with and without sway.

Unit 3 (Moment Area and Conjugate Beam Method): Derivation, Mohr's theorems, Sign conventions, Application of moment area method for determinate prismatic beams, Beams of varying section, Use of moment diagram by parts.
Conjugate beam method: Real beam and conjugate beam, conjugate beam theorems, Application of conjugate beam method of determinate beams of variable cross sections

Unit 4 (Matrix Method of Analysis (Flexibility Method)):
Introduction, Axes and coordinates, Flexibility matrix, Analysis of continuous beams and plane trusses using system approach, Analysis of simple orthogonal rigid frames using system approach with static indeterminacy ≤3.

Unit 5 (Matrix Method of Analysis (Stiffness Method)):
Introduction, Stiffness matrix, Analysis of continuous beams and plane trusses using system approach, Analysis of simple orthogonal rigid frames using system approach with kinematic indeterminacy ≤3

Unit 6 (Concepts Structural Dynamics):
Basic principles of vibrations and their causes, periodic and aperiodic motion, harmonic and non-harmonic motion, period and frequency, forced and free vibration, damping and equations of single degree of freedom system with and without damping.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	3											3			
CO-2	3	3											3			
CO-3	3	3											3			
CO-4	3	3											3			
CO-5	3	3											3			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.																

6. Course Teaching and LearningMethods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		05
1.Demonstration usingVideos	05	
2. Demonstration using PhysicalModels / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		25
1. Solving Numerical Problems	25	

Practical Work		
1. Course Laboratory	00	00
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	00
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests,Laboratory Examination/Written Examination,Presentations		10
Total Duration in Hours		70

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	×	×	×
CO-2	×	×	×
CO-3	×	×	×
CO-4		×	×
CO-5		×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

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S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignments
2.	Understanding	Class room lectures, Assignments
3.	Critical Skills	Class room lectures, Assignments
4.	Analytical Skills	Class room lectures, Assignments
5.	Problem Solving Skills	Class room lectures, Assignments
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, examination
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

f. **Essential Reading**

13. Class Notes
14. Kinney J. S., 1991. Indeterminate Structural Analysis, Narosa Publishing House, New Delhi.
15. Ramamrutham R. and Narayan N., 1993. Theory of structures, Dhanpat Rai Publications.
16. William Weaver, Jr & James M.Gere, 1995. Matrix analysis of framed structures, New Delhi. CBS Publishers & Distributors
17. Pandit G.S. and Gupta S.P., 2006, Structural Analysis – A Matrix Approach, Tata McGraw Hill Publishing Company Ltd.
18. Bhavikatti S. S, 2003, Structural Analysis, Vol.1 and 2, Vikas Publishing House Pvt Ltd.,

g. **Recommended Reading**

1 Wang C. K., Indeterminate Structural Analysis, Auckland, Mc Graw- Hill.
2 Hibbler R. C., 2007, Structural Analysis, New Delhi, LCE, Pearson Education.

h. **Magazines and Journals**

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i. **Websites**

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j. **Other Electronic Resources**

2. https://nptel.ac.in/

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Course Specifications: Geotechnical Engineering-1

Course Title	Geotechnical Engineering-1
Course Code	CEC303A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the fundamental aspects of soils from its origin to the various properties of the soil controlling its behavior under different loading conditions. Students are taught about the index and engineering properties, physical characteristics and structure of soil. The students are familiarized with the properties like shear strength, compaction and consolidation properties for various field applications.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO 1.** Outline the origin of soils and summarize the various properties of soils and their inter relationships
- **CO 2.** Classify various types of soils based on index properties
- **CO 3.** Interpret the soil behaviour based on engineering properties like permeability, shear strength and consolidation
- **CO 4.** Solve problems on the various index and engineering properties
- **CO 5.** Analyze practical problems and use software tools to solve the problems

4. Course Contents

Unit 1: Introduction, History of soil mechanics, origin and formation of soil, Examples of soil failure cases, Understanding the reasons behind the failures, Modern Geotechnical Engineering.

Unit 2: Phase Relations of Soils, Phase diagrams, volume ratios, mass ratios, densities and unit weights, air content, degree of saturation, water content, specific gravity of soil solids and soil mass and their interrelationships

Unit 3: Index properties of soil, Determination of index properties, Soil Classification, Plasticity chart, Clay mineralogy, Activity of clay, Sensitivity and thixotropy of clay

Unit 4: Permeability of soils and its determination, Stresses, Effective stress concept, Shear strength parameters, Compaction, Laboratory and field compaction methods, Consolidation, Terzaghi's 1-D consolidation theory, Consolidation characteristics of soils

Unit 5: Determination of phase interrelationships, index properties, total stresses, effective stresses, calculation of shear strength parameters, determination of shear strength, compaction characteristics, consolidation coefficients

Unit 6: Demonstration of suitable software for determination of soil behaviour

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3											1	3		1
CO-2		3											3		
CO-3	3	3											3		
CO-4			3									1	3		1
CO-5	3	3	3		2					1			3	2	1
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		03
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		20
1. Solving Numerical Problems	20	
Practical Work		02
1. Course Laboratory	00	
2. Computer Laboratory	02	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	

5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**55**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	X	X	X
CO-2	X	X	X
CO-3		X	X
CO-4	X	X	X
CO-5		X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--

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12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Gopal Ranjan and Rao A.S.R., 2016, Basic and Applied Soil Mechanics, NewDelhi, New Age International Publishers.

b. Recommended Reading

1. Murthy V N S, 2018., Soil Mechanics and Foundation Engineering, New Delhi, CBS Publishers.
2. Braja M Das, 2013., Fundamentals of Geotechnical Engineering, New Delhi, Thomson Business
3. Arora K R., 2008., Soil Mechanics and Foundation Engineering, New Delhi, Standard Publishers.

c. Magazines and Journals

1. Indian Geotechnical Journal
2. Journal of Geotechnical and Geological Engineering
3. International Journal of Geotechnical Engineering

d. Websites

1. http://nptel.ac.in/

e. Other Electronic Resources

1. http://nptel.ac.in/

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Course Specifications: Hydrology and Irrigation Engineering

Course Title	Hydrology and Irrigation Engineering
Course Code	CEC304A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

The course deals with surface water hydrology, groundwater hydrology and irrigation systems. Students will be taught hydrologic cycle, precipitation, losses from precipitation, hydrograph analysis, types of aquifer, well hydraulics and various irrigation techniques. Students will learn to model floods, flood routing, reservoir capacity and irrigation requirement of crops. Students will be able to design hydraulic structures such as gravity dam, earthen dam and spillways.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- CO 1. Describe hydrologic cycle, precipitation, losses from precipitation and water logging and types of aquifers and aquifer characteristics
- CO 2. Explain runoff and its characteristics, water logging, reservoir characteristics, hydraulic structures and soil-water-crop relationships
- CO 3. Discuss hydrograph analysis, floods, well hydraulics, irrigation techniques and spillways
- CO 4. Compute mean precipitation, infiltration losses, inflow and outflow hydrograph (flood routing), reservoir capacity, safe yield from reservoir, crop water requirement and Irrigation efficiencies
- CO 5. Design gravity dam and earthen dam

4. Course Contents

Unit 1: Introduction, Hydrologic cycle (Horton's representation), water budget equation. Precipitation- Introduction, forms of precipitation, types of precipitation, measurement of precipitation (Simon's gauge & Syphon gauge only), selection of rain gauge station. Adequacy of rain gauges, methods of computing average rainfall, interpolation of missing data, adjustment of missing data by double mass curve method. Hyetograph and mass curve of rainfall. Losses from

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Precipitation – Evaporation: Definition, factors affecting, measurement (Class A pan). Estimation using Empirical methods (Meyer's and Rohwer's equation), evaporation control. Evapotranspiration: Definition, factors affecting evapotranspiration, its measurement, estimation (Blaney Criddle method). Infiltration-Definition, factors affecting it, measurement (double ring infiltrometer), infiltration indices, Horton's equation of infiltration. Runoff- Characteristics of runoff - factors affecting runoff - yield from a catchment

Unit 2: Hydrographs: Definition, components of hydrographs, unit hydrograph and its derivation from simple storm hydrograph, base flow separation, Prepositions of unit hydrograph- problems. River Regions and their Characteristics: Classification of rivers on alluvial plains - meandering of rivers - river training, Reservoir Planning- Introduction, classification of Reservoirs, Storage zones of a reservoir, Mass curve, fixing capacity of a reservoir, safe yield, problems, density currents, Trap efficiency, Reservoir sedimentation, life of a reservoir, economic height of a dam, problems. Environmental effects of reservoirs

Unit 3: Estimation of Flood & Flood Routing: Definition of flood, factors affecting flood, methods of estimation (envelope curves, empirical formulae, rational method). Flood routing: Introduction to hydrological routing, relationship of out flow and storage, general storage equation, Muskingum routing method. Ground water - types of aquifers, storage coefficient, coefficient of transmissibility, steady radial flow into a well located in an unconfined and confined aquifers, Tube wells and Open wells, yield from an open well. Water logging - causes and effects of water logging, remedial measures, land reclamation, land drainage, benefits, classification of drains, surface drains, subsurface drains, design principles and maintenance of drainage systems.

Unit 4: Irrigation Engineering: Introduction, need for irrigation, advantages and disadvantages of irrigation, environmental impacts of irrigation, Systems of irrigation: Gravity irrigation, lift irrigation, well irrigation, tube well irrigation, infiltration galleries, sewage irrigation, supplemental irrigation. Soil-Water-Crop Relationship: Introduction, soil profile, physical properties of soil, soil classification. Indian soils, functions of irrigation soils, maintaining soil fertility, soil-water-plant relationship, soil moisture-Irrigation relationship, frequency of irrigation. Water Requirement of Crops-Introduction, definitions, crop seasons of India, water requirements of a crop, duty, delta, base period. Consumptive use and its determination. Irrigation efficiencies. Assessment of irrigation water.

Unit 5: Gravity Dams- Introduction, forces acting on a gravity dam, stress analysis in a gravity dam, Problems, combination of forces for design. Elementary & practical profiles of a gravity dam, stability analysis (without earth quake forces), problems, galleries in gravity dams. Earthen Dams- Introduction, types of Earth dams, construction methods, Design criteria for Earthen dams, causes of failure of earthen dams, section of a dam, control of seepage through earth dams, safety measures. Spillways - Introduction, essentials of a spillway, spillway components, factors affecting type & design of spillways. Energy dissipation below spillways.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3	3											3		
CO-3	3												3		
CO-4		3	2										3		
CO-5	1		3										3		

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**55**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

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For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	X		X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
CO-5	X	X	X
CO-6		X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures, Assignment
2.	Understanding	Classroom lectures, Assignment, Self-study
3.	Critical Skills	Classroom lectures, Assignment
4.	Analytical Skills	Classroom lectures, Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	Assignment, Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, Examination
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

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a. Essential Reading

1. Class notes
2. Subramanya K.,2008, Engineering Hydrology, New Delhi, Tata Mcgraw Hill
3. B.C. Punmia, Ashok. K. Jain, Arun K. Jain, B. L. Pande, 2016, Irrigation and Water Power Engineering, New Delhi, Laxmi publications

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4. Jayarami Reddy, 2016, A Text Book of Hydrology, New Delhi, Laxmi publications
5. Madan Mohan Das, Mimi Das Saikia, 2011, Irrigation and Water Power Engineering, New Delhi, PHI Learning Pvt. Ltd.

b. Recommended Reading

1. V. P. Singh, 1991, Elementary Hydrology, New Jersey, Prentice Hall.
2. Van Te Chow, David R. Maidment, Larry W. Mays, 1988, Applied Hydrology, New Delhi, Tata Mcgraw Hill
3. Modi P. N., 2008, Irrigation, water Resources and water power Engineering, New Delhi, Standard book house

c. Magazines and Journals

d. Websites

e. Other Electronic Resources

1. http://nptel.ac.in

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Course Specifications: Transportation Engineering-II

Course Title	Transportation Engineering-II
Course Code	CEC315A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the planning, design and construction of various modes of transportation systems. Students will be taught various terminologies and components pertaining to railways, airports, harbors and tunnels. Planning and design concepts and technologies adopted in the construction and maintenance of each of them will be explained in detail.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO 1.** Describe various modes of transportation systems and explain their significance and development
- **CO 2.** Explain various terminologies related to railway, airport, harbor and tunnel engineering
- **CO 3.** Identify railway, airport, harbor and tunnel components and the factors influencing their geometric design
- **CO 4.** Discuss the appropriate alignment plan for railways and tunnels and layout of airports and harbors
- **CO 5.** Propose suitable geometrical designs and technologies to be adopted for the construction processes and maintenance of the same

4. Course Contents

Unit 1 (Railway Engineering):
Introduction- scope of railway engineering, railway terminology, railway survey; Components- introduction, typical cross-sections, various gauges, coning of wheels and tilting of rails, functions and requirements of component parts of a railway track, creep of rails;

Unit 2 (Geometrical Design of Railway Track):
Horizontal curves, radius, super elevation, cant deficiency, transition curves, safe speed on

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curves, different types of gradients, grade compensation modern track based systems; Tractive resistance- resistance due to friction, wave action, curves, gradients, speed of the train, hauling capacity and tractive efforts; Permanent way- components parts rail and rail fastenings, ballast, sleepers, railway creep, anti-creep devices, coning of wheel, wear of rail;

Unit 3 (Railway Operation and Control):
Points and crossing, necessity of turnouts, switches and track junction, simple track layouts, design of turnouts; Railway station and yards- types of railway stations, classification of yards; Equipment in station yards- triangle, turn table, scotch block, fouling marks, buffer stops; Signals- classification, function, control on movement of train by different methods; Interlocking- types and function; Railway construction and maintenance- construction of railway track, earthwork, plate laying and packing; Maintenance of track alignment- gauge, renewal of component parts and Drainage, modern methods of track maintenance.

Unit 4 (Airport Engineering):
Introduction, history and development of aviation, aviation organizations and their functions, aircraft characteristics and its influence on airport planning, factors to be considered in airport planning, site selection survey, obstructions and zoning, airport configuration; Geometric design- runway orientation, cross wind component, wind rose diagram, geometric design and corrections for gradients, basic runway lengths, geometric design of runway, exit taxiways and aprons; Airport capacity- runway and terminal capacity and its improvement, delay related capacity, gate position and gate capacity, terminal area facilities and their planning concepts, aircraft parking system; Visual aids and air traffic control system- flight rules, navigational and landing aids, Visual Approach Slope Indicator, Precision Approach Path Indicator enroute air traffic control, Instrument Landing System, Microwave Landing System; Pavement design- Equivalent Single Wheel Loading concepts, Federal Aviation Administration method and Logical Channel Number-Pavement Classification Number method of pavement design; Airport drainage system- design runoff, surface and subsurface drainage.

Unit 5 (Harbors):
Definition- harbors, ports, docks, satellite ports; requirements and classification of harbors; Natural phenomenon affecting the design of harbors- wind, tides and waves, currents, littoral drift, site selection & selection investigation, speed of water, dredging, range of tides, waves and tidal currents; Littoral transport with erosion and deposition, soundings, anchoring grounds, geological characteristics, winds & storms, position and size of shoals; Shore considerations- proximity to towns/cities, utilities, construction materials, coast lines; planning and layouts, entrance, position of light houses; Navigating- terminal facilities, port buildings, warehouse, transit sheds, inter-modal transfer facilities, mooring accessories; Navigational aids- coastal structures, piers, breakwaters, wharves, jetties and piers, quays, spring fenders, dry dock and wet docks, slipways; Coastal shipping, inland water transport and container transportation.

Unit 5 (Tunneling):
Advantages and disadvantages, tunnel alignment and grade, size and shape of a tunnel; Surveying- transferring center line, and gradient from surface to inside the tunnel working face, Weisbach triangle; Methods of tunneling in hard rocks - full face method, heading and bench method, drift method, methods of tunneling in soft soils, compressed air and shield tunneling, needle beam, liner plate, micro tunneling, trenchless technology pilot tunneling, mucking and methods, drilling and drilling pattern; Shafts in tunnels, ventilation of tunnel and various methods, lining of tunnels, drainage and lighting of tunnels.

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5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	3											3			
CO-2	3	3											3			
CO-3	3	3											3			
CO-4	3	3	2			1							3	1		
CO-5	3	3	2	1		1							3	1		

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		25
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Term Examination, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**55**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

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The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	X	X	X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
CO-5		X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	Classroom lectures
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	Classroom lectures
11.	Presentation Skills	Classroom lectures
12.	Behavioral Skills	Classroom lectures
13.	Information Management	Assignment
14.	Personal Management	Classroom lectures
15.	Leadership Skills	Classroom lectures

9. Course Resources

a. **Essential Reading**

1. Course notes
2. Agarwal, M. M and Chandra S., 2008, Railway Engineering, Oxford University.

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3. Antia, K. F., 1960, Railway Track, New Book Company Pvt. Ltd.
4. Khanna, S. K., and Arora, M. G., 2005, Airport Planning and Design. Nemchand and Bros.
5. Srinavasan, R., 2013, Harbour, Dock and Tunneling Engineering. Charotar Publishing House, Anand.

b. Recommended Reading

15. Mundrey, J. S., 2010, Railway Track Engineering. McGraw Hill Publications.

16. Neufville, R., 2003, Airport Systems: Planning, Design, and Management. McGraw-Hill Professional.

17. Alexander, T. W., 2004, Airport Planning and Management. McGraw-Hill Professional.

18. Bindra, S. P., 1993, A Course in Docks and Harbour Engineering. Dhanpat Rai and Sons.

19. Oza, H.P. and Oza, G.H., 1976, A course in Docks & Harbour Engineering. Charotar Publishing Co.

c. Magazines and Journals

3. Computer Aided Civil and Infrastructure Engineering, Wiley

4. Rail Transport Journal

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/
3. http://www.iritm.indianrailways.gov.in
4. https://www.irt-india.com

e. Other Electronic Resources

1. https://ocw.mit.edu/index.htm
2. Electronic resources on the course area are available on MSRUAS library

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Course Specifications: Design and Drawing of RCC Structures

Course Title	Drawing of RCC Structures
Course Code	CEC306A
Course Type	Core Theory Course
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the design and detailing of RC elements. Students are taught drawing and detailing of beams, slabs, columns based on IS codes with Bar Bending Schedule. Students are also taught design and drawing of portal frames and water tanks.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	0:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO 1.** Draw RCC structures like beams, slabs
- **CO 2.** Draw RCC structures like columns, footings and stair-cases
- **CO 3.** Design and draw Portal Frames subjected to gravity loads
- **CO 4.** Design and draw water tanks resting on ground using IS codes
- **CO 5.** Develop Bar-Bending Schedule for beams, slabs
- **CO 6.** Develop Bar-Bending Schedule for columns, footings and stair-cases

4. Course Contents

Unit 1 :

Develop Bar-Bending Schedule for columns, footings and stair-cases

Unit 2 :

Drawing and Detailing of columns, footings and stair-cases.

Unit 3 :

Design and detailing of Simple Portal Frames subjected to gravity loads. (Single bay & single storey).

Unit 4 :

Design and detailing of Circular and Rectangular water tanks resting on ground and free at

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top(Flexible base and Rigid base), using IS:3370 (Part IV) only.

Unit 5:

Bar Bending Schedule of Beams, slabs.

Unit 6:

Bar Bending Schedule of columns, footings and stair-cases.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3							1	2				3		2
CO-2	3	3							2				3		2
CO-3	3	3							2				3		2
CO-4	3	3	3						2				3		2
CO-5	3	3	3		3				2	2			3	3	2
CO-6	3	3	3		3				2	2			3	3	2

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		05
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		20
1. Solving Numerical Problems	20	
Practical Work		05
1. Course Laboratory	00	
2. Computer Laboratory	05	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	

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6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		70

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Civil Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	X	X	X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
CO-5	X	X	X
CO-6	X	X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--

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11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. S.Rajasekaran,(2001), Computational StructuralMechanics, PHI,New Delhi
3. C.S. Reddy,(2001) Basic Structural Analysis, TMH,New Delhi
4. Kinney J. S., 1991. Indeterminate Structural Analysis, Narosa Publishing House, New Delhi.
5. Ramamrutham R. and Narayan N., 1993. Theory of structures, Dhanpat Rai Publications.
6. William Weaver, Jr & James M.Gere, 1995. Matrix analysis of framed structures, New Delhi. CBS Publishers & Distributors
7. Pandit G.S. and Gupta S.P., 2006, Structural Analysis – A Matrix Approach, Tata McGraw Hill Publishing Company Ltd.
8. Bhavikatti S. S, 2003, Structural Analysis, Vol.1 and 2, Vikas Publishing House Pvt Ltd.,

b. Recommended Reading

1. Wang C. K., Indeterminate Structural Analysis, Auckland, Mc Graw- Hill.
2. Hibbler R. C., 2007, Structural Analysis, New Delhi, LCE, Pearson Education.
3. W.Weaver and J.H.Gere,(1980) Matrix Analysis of Framed Structures, VanNastran

c. Magazines and Journals

1. 1.American concrete institute: https://www.concrete.org/
2. 2. Indian concrete institute: www.indianconcreteinstitute.org/

d. Websites

e. Other Electronic Resources

1. http://nptel.ac.in/

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Course Specifications: Geotechnical Engineering Laboratory

Course Title	Geotechnical Engineering Laboratory
Course Code	CEL307A
Course Type	Laboratory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the testing of soils to assess their engineering and index properties. Laboratory classes comprise of experiments to determine the grain size distribution, consistency limits, free swell index and swell pressures of soils. Tests for evaluating the strength parameters of soil will also be conducted. Students will be trained to prepare consolidated report of index properties and strength properties of soil.

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:1
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (Cos)

After the successful completion of this course, the student will be able to:

CO.1 Identify and explain various equipment and procedures concerned with the evaluation of soil properties and its strength parameters
CO.2 Arrive at grain size distribution of soils by sieve analysis
CO.3 Determine consistency limits, free swell index, swell pressure of soil and relative density of sands
CO.4 Determine in situ density of soil by core cutter and sand replacement methods and coefficient of permeability by constant head and variable head methods
CO.5 Evaluate strength parameters of soils by Unconfined Compression test, Direct Shear test, Triaxial Compression test, Vane Shear test and CBR test
CO.6 Prepare consolidated report of index properties and strength properties of soil

4. Course Contents

1	Grain size analysis of soil sample- Sieve Analysis Grain size analysis of soil sample- Hydrometer Analysis
2	Consistency Limits- Liquid Limit (Casagrande and Cone Penetration Methods), Plastic Limit and Shrinkage Limit

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	Free Swell Index and Swell Pressure Test
3	Determination of relative density of sands by Sand Replacement method Determination of in situ density by Core Cutter method
4	Standard Proctor Compaction Test and Modified Proctor Compaction Test Coefficient of permeability by constant head and variable head methods
5	Strength Tests: a) Unconfined Compression Test b) Direct Shear Test c) Triaxial Compression Test (undrained) Consolidation Test- Determination of compression index and coefficient of consolidation
6	Laboratory vane shear test Determination of CBR value
7	Demonstration of miscellaneous equipment such as Augers, Samplers, Rapid Moisture, meter, Proctor's needle Preparing a consolidated report of index properties and strength properties of soil

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (Pos)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3		2					1				3	2	1
CO-2		3		2					1				3	2	1
CO-3		3		2					1				3	2	1
CO-4		3		2	2				1				3	2	1
CO-5		3	2	2	2				1				3	2	1
CO-6		2		2					1				2	2	1

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		
Demonstrations		
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	

3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**40**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment is presented in the Programme Specifications document pertaining to the B.Tech. (Civil Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

For Laboratory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Conduct of Experiments**	**Laboratory Report + Viva**	**Laboratory SEE**
CO-1	**x**	**x**	**x**
CO-2	**x**	**x**	**x**
CO-3	**x**	**x**	**x**
CO-4	**x**	**x**	**x**
CO-5	**x**	**x**	**x**
CO-6	**x**	**x**	**x**
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Laboratory instruction
2.	Understanding	Laboratory instructions and experiments
3.	Critical Skills	Laboratory work
4.	Analytical Skills	Laboratory work
5.	Problem Solving Skills	Laboratory work
6.	Practical Skills	Laboratory work
7.	Group Work	Laboratory work
8.	Self-Learning	Laboratory work
9.	Written Communication Skills	Laboratory work
10.	Verbal Communication Skills	Laboratory examination
11.	Presentation Skills	Laboratory examination
12.	Behavioral Skills	Laboratory instruction
13.	Information Management	Laboratory instruction
14.	Personal Management	Laboratory instruction
15.	Leadership Skills	Laboratory instruction

9. Course Resources

a. Essential Reading

1. Course notes
2. Laboratory manual
3. Shamsher Prakash and P K Jain, 2002, Engineering Soil Testing, Nemchand and Bros, Roorkee.
4. Braja M Das, Soil Mechanics Laboratory Manual, Eighth Edition, Oxford University Press.
5. Lambe, T.W., 1951. Soil testing for Engineers. John Wiley and Sons, INC
6. Bowles, J.E., 1986. Engineering properties of soil and their measurement. McGraw – Hill Book Company, New York.

b. Recommended Reading

1. Head, K.H., 1986. Manual of Soil Laboratory Testing-Vol. I, II, III. Princeton Press, London
2. Punmia, B.C., 2005. Soil Mechanics and Foundation Engineering. Laxmi Publications Co., New Delhi
3. Bureau of Indian Standards, New Delhi.

c. Magazines and Journals

1. International Journal for Numerical and Analytical Methods in Geomechanics, Wiley

d. Websites

e. Other Electronic Resources

1. https://nptel.ac.in

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Course Specifications: Extensive Survey Viva Voce

Course Title	Extensive Survey Viva Voce
Course Code	CEL308A
Course Type	Laboratory
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

1. Course Summary

An extensive survey training involves investigation and design of the new tank, old tank, highway, water supply and sanitary projects. This course deals with the road alignment, setting out curves, buildings, culverts and tanks. Examination of sources of water supply, calculation of quantity of water required based on existing and projected population are discussed. The students will be taught preliminary and detailed investigations to align a new road (min. 1 to 1.5 km stretch) between two obligatory points and topographic surveying.

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:1
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO 1.** Set out curves, buildings, culverts and tunnels
- **CO 2.** Plan a survey for applications such as road alignment and height of the building
- **CO 3.** Plan a survey for applications for new tank, old tank and highway project
- **CO 4.** Examine the sources of water supply, calculation of quantity of water required based on existing and projected population
- **CO 5.** Prepare village map by any suitable method of surveying
- **CO 6.** Locate sites for ground level and overhead tanks, underground drainage system and surveys for laying the sewers

4. Course Contents

1	**Unit 1:** An extensive survey training involving investigation and design of the following projects is to be conducted for 2 weeks (14 days). The student shall submit a project report consisting of designs and drawings. (Drawings should be done using AutoCAD). General instructions, Reconnaissance of the sites and fly leveling to establish bench marks.

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	• **New Tank Projects:** The work shall consist of i) Alignment of center line of the proposed bund, Longitudinal and cross sections of the Center line. ii) Capacity surveys. iii) Details of Waste weir and sluice points. iv) Canal alignment. (At least one of the above new tank projects should be done by using TOTAL STATION)
2	**Unit 2:** Water Supply and Sanitary Project: Examination of sources of water supply, Calculation of quantity of water required based on existing and projected population. Preparation of village map by any suitable method of surveying, location of sites for ground level and overhead tanks underground drainage system surveys for laying the sewers.
3	**Unit 3:** Highway Project: Preliminary and detailed investigations to align a new road (min. 1 to 1.5 km stretch) between two obligatory points. The investigations shall consist of topographic surveying of strip of land for considering alternate routes and for final alignment. Report should justify the selected alignment with details of all geometric designs for traffic and design speed assumed. Drawing shall include key plan, initial alignment, final alignment, longitudinal section along with the final alignment, typical cross sections of road.
4	**Unit 4:** Old Tank Projects: The work shall consist of: i) Alignment of center line of the existing bund, longitudinal section and cross sections of The center line. ii) Capacity surveys to explore the quantity. iii) Details of existing Waste weir and sluice points.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3										2	1	3		2
CO-2				3							2	1		3	2
CO-3			3								2	1	3		2
CO-4		2									2	1	2		2
CO-5			3								2	1	3		2
CO-6	2										2	1	2		2

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		
Demonstrations		00
1. Demonstration using Videos		

2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Numeracy		00
1. Solving Numerical Problems		
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory		
3. Engineering Workshop / Course Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		00
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Tests, Laboratory Examination / Written Examination,		10
Total Duration in Hours		40

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Civil Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

For Laboratory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Conduct of Experiments	Laboratory Report + Viva	Laboratory SEE
CO-1	X	X	X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
CO-5	X	X	X
CO-6	X	X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

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8. **Achieving Learning Outcomes**

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities	How imparted during the course
1.	Knowledge	Laboratory instruction
2.	Understanding	Laboratory instructions and experiments
3.	Critical Skills	Laboratory work
4.	Analytical Skills	Laboratory work
5.	Problem Solving Skills	Laboratory work
6.	Practical Skills	Laboratory work
7.	Group Work	Laboratory work
8.	Self-Learning	Laboratory work
9.	Written Communication Skills	Laboratory work, ,examination
10.	Verbal Communication Skills	Laboratory examination
11.	Presentation Skills	Viva Voce
12.	Behavioral Skills	Course work
13.	Information Management	Laboratory work
14.	Personal Management	Course work
15.	Leadership Skills	--

9. **Course Resources**

a. **Essential Reading**

1. Laboratory Manual
2. Duggal S.K., (2004), Surveying Vol. I and II, Tata McGraw Hill
3. Punmia B.C., (1994), Surveying Vol. I and II, Standard Publishers

b. **Recommended Reading**

1. Arora K. R., (1996), Surveying Vol. I and II, Standard Book House
2. Satheesh Gopi,(2007), Advanced Surveying, Pearson Education
3. Satheesh Gopi,(2005), The Global Positioning System and Surveying using GPS, Tata McGraw

c. **Magazines and Journals**

d. **Websites**

2. http://nptel.ac.in/

e. **Other Electronic Resources**

5. Electronic resources on the subject area are available on MSRUAS library

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Course Specifications: Seminar

Course Title	Seminar
Course Code	CES301A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to train the students on data collection, analysis and presentation about a chosen topic. In this course students are required to deliver seminars on various relevant topics from the broad areas mentioned in the course content. Students will be trained to prepare a brief report on the chosen seminar topic.

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:1
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Prepare and deliver a seminar on a given topic

CO 2. Write a report on the seminar topic

4. Course Contents

Food Security, Energy Crisis, National Water Management, Cyber-warfare, Genetically modified food, Technology innovation, Non-Proliferation Treaty (NPT), MSME and National Economy, Right To Information (RTI) Act, Right To Education (RTE), Foreign Direct Investment (FDI), Corporate Social Responsibility, Work Life Balance, Political stability and National growth, Demography, Impact of Science and Technology on society.of performance, presentation performance characteristics, Verification of results

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1												3			3
CO-2										2	3				3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

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6. Course Teaching and Learning Methods

Teaching and Learning Methods	Total Duration in Hours
Case Study Presentation	15
Industry / Field Visit	05
Term Tests, Laboratory Examination / Written Examination, Presentations	10
Total Duration in Hours	30

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only		
Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1 (50% Weightage)	Component 2: Seminar Report (50% Weightage)
Subcomponent Type ▶	Seminar Presentation	
CO-1	X	X
CO-2	X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.		

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Seminar
2.	Understanding	Seminar
3.	Critical Skills	Seminar
4.	Analytical Skills	Seminar
5.	Problem Solving Skills	Seminar
6.	Practical Skills	Seminar

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7.	Group Work	Seminar
8.	Self-Learning	Seminar
9.	Written Communication Skills	Seminar
10.	Verbal Communication Skills	Seminar
11.	Presentation Skills	Seminar presentation and viva voce
12.	Behavioral Skills	Seminar
13.	Information Management	Seminar
14.	Personal Management	Seminar
15.	Leadership Skills	Seminar

9. Course Resources

a. **Essential Reading**

1. Jerry Weissman, Presenting to Win
2. Cliff Atkinson, Beyond Bullet Points
3. Bruce R Gibrielle, Speaking Powerpoint
4. Garr Reynolds, Presentation Zen Design

b. **Recommended Reading**

1. Based on the topic chosen

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Course Specifications
(6^{th} Semester)

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Course Specifications: Geotechnical Engineering-II

Course Title	Geotechnical Engineering-II
Course Code	CEC311A
Course Type	Core Theory Course
Department	Civil Engineering
Faculty	Engineering and Technology

28.Course Summary

This course deals with subsurface exploration, drainage and dewatering, computation of stresses in soil, lateral earth pressure, stability of slopes, bearing capacity of soils and settlements of foundations. The lectures include an overview of Geotechnical site investigation methods, insitu tests on soil to estimate engineering parameters, study of failures in soil mass and the methods of computing critical failure planes.

Students are trained to calculate the stresses in soil due to overburden pressure and the applied loads. They are taught the application of Soil Mechanics in the analysis and design of shallow foundations and computation of lateral earth pressure on retaining walls. Different types of settlements and permissible settlements of different structures are also discussed.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	55
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 7. Identify and interpret different methods of subsurface exploration, lateral earth pressure, stability of slopes, bearing capacity of soils and settlement of foundations and evaluate parameters related to the above topics

CO 2 Discuss different methods of computing stresses in soil and estimate them for different load conditions

CO 3. Explain dewatering techniques applicable to different soil conditions and sketch phreatic line for an Earthern dam

CO 4. Solve the problems related to stresses in soil mass, earth pressure acting on retaining walls, Bearing capacity of soils, factors of safety in soil slopes, soil exploration.

CO 5. Predict the settlements for a given substructure and soil parameters and discuss the field Methods to determine them

Course Contents

Unit 1 (Subsurface Exploration and Site Investigation): Importance of exploration, Methods of exploration: Boring, Geophysical exploration methods, Seismic refraction, types of samples, design features controlling type of sample, samplers and sample disturbance Stabilization of boreholes - Typical bore log. Number and depth of borings for various Civil Engineering structures, soil exploration report.

Drainage and Dewatering: Determination of ground water table by Hvorselev's method, Control of ground water during excavation: Dewatering - Ditches and sumps, well point system, Vacuum method, Electro-Osmosis method.

Unit 2 (Computation of Stresses in Soils): Boussinesq's and Westergaard's theories for concentrated, circular and rectangular loads. Comparison of Boussinesq's and Westergaard's theory, Pressure distribution diagrams, Contact pressure, Newmark's chart.

Unit 3: (Lateral Earth Pressure): Active and Passive Earth pressures, Shear strength of soil: Concept of shear strength, Mohr-coulomb theory, Earth pressure at rest. Rankine's and Coulomb's Earth pressure theories- assumptions, Graphical solutions for active earth pressure and limitations, Culmann's and Rebhann's methods, Lateral earth pressure in cohesive and cohesion less soils, Earth pressure distribution.

Unit 4: **(Stability of Earth Slopes)**: Types of slopes, causes and type of failure of slopes, Definition of factor of safety, Stability of infinite slopes, Stability of finite slopes by Method of Slices and Friction Circle method, Taylor's stability number, Fellineous method

Unit 5: (Bearing Capacity of Soils): Definitions of ultimate, net and safe bearing capacities, Allowable bearing pressure.): Allowable Bearing Pressure, Factors influencing the selection of depth of foundation, Factors influencing Allowable Bearing Pressure, Factors influencing the choice of foundation, Terzaghi's and Brinch Hansen's bearing capacity equations, assumptions, equations, Bearing capacity of footings subjected to eccentric loading, Effect of ground water table on bearing capacity. Field methods of evaluation of bearing capacity, Plate load test, Standard penetration test and cone penetration test.

Unit 6:(Foundation Settlement). Importance and Concept of Settlement Analysis, Immediate, Consolidation and Secondary settlements, Permissible settlement, Tolerance. BIS specifications for total and differential settlements of footings and rafts.

Unit 7: **(Seepage and Flow nets)**: Laplace equation (no derivation) assumptions and limitations only, characteristics and uses of flownets, determination of phreatic line in earth dams with and without filter. Piping and protective filter. Demonstration of suitable software for different geotechnical applications

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5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3											3		
CO-2	3	3											3		
CO-3	3	3							1	1			3	1	1
CO-4	3	3	3		2				1	1			3	2	1
CO-5	3	3	3		1								3	1	1

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		05
1. Demonstration using Videos	01	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		20
1. Solving Numerical Problems	30	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**55**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

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The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	×	×	×
CO-2	×	×	×
CO-3	×	×	×
CO-4	×	×	×
CO-5		×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

ee. **Essential Reading**

1. Course notes
2. Arora, K. R., 2009, Soil Mechanics and Foundation Engineering, New Delhi, Standard Publishers

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3. Braja M Das, 2013, Fundamentals of Geotechnical Engineering, 4th Edition, Cengage Learning
4. Murthy V.N.S., 2009, Soil Mechanics and Foundation Engineering, New Delhi, CBS Publishers & Distributors,
5. Punmia, B.C., 2008, Soil Mechanics and Foundation Engg, 16th Edition New Delhi, Laxmi Publications Co.

ff. Recommended Reading

1. Bowles J. E., (1996). Foundation Analysis and Design, 5th Edition, McGraw Hill Pub. Co. New York.
2. Alam Singh and Chowdhary G. R.,(1994). Soil Engineering in Theory and Practice, CBS Publishers and Distributors Ltd., New Delhi.
3. Gopal Ranjan and Rao A. S. R.,(2000). Basic and Applied Soil Mechanics, New Age International (P) Ltd., Newe Delhi.
4. Donold P Coduto, Geotechnical Engineering, Phi Learning Private Limited, New Delhi
5. Shashi K. Gulathi and Manoj Datta, (2009). Geotechnical Engineering, Tata McGraw Hill.
6. Iqbal H. Khan, (2005). Text Book of Geotechnical Engineering, 2nd Edition, PHI, India.
7. Narasimha Rao A. V. and Venkatrahmaiah C., (2000). Numerical Problems, Examples and objective questions in Geotechnical Engineering, Universities Press., Hyderabad.

gg. Magazines and Journals

1.

hh. Websites

1. http://nptel.ac.in/
2. www.geotechnicalinfo.com
3. www.geoengineer.org
4. www.asce.org/geotechnical_engineering

ii. Other Electronic Resources

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Course Specifications: Design of Steel Elements

Course Title	Design of Steel Elements
Course Code	CEC312A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the concepts of plastic analysis for beams and simple frames, concepts of design for tension, compression & flexural members using simple and built-up sections. Students are taught the concepts of design of bolted, welded connections & design of base plate.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture:Tutorial:Practical)	2:1:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the concepts of plastic analysis and IS code practice for the design
- **CO-2.** Analyze the behavior and strength of bolted and welded connections
- **CO-3.** Calculate the strength of tension, compression and flexural members
- **CO-4.** Design the bolted and welded connection
- **CO-5.** Analyze and design the tension, compression, flexural members and column bases

4. Course Contents

Unit 1 (Plastic Analysis):
Plastic bending of beams – stages of bending, shape factor, load factor, plastic hinge and mechanism; Static and kinematic methods– upper and lower bound theorems, determination of collapse loads, plastic analysis of indeterminate beams and simple frames.
Introduction to steel structures and IS: 800-2007, Material specifications and section classification

Unit 2 (Compression members):
Slenderness ratio, Design of Simple and built-up sections, lacings and battens, design of column splices, column bases; slab bases, gusseted bases, and moment resistant base plates.

Unit 3 (Flexural members): Moment of resistance for laterally supported and unsupported flexural members, design of laterally supported flexural members.

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Unit 4:

Bolted connections: Design of eccentric connections, beam to beam and beam to column connection.

Welded connections: Design of eccentric connections, beam to beam and beam to column connection.

Unit 5:

Tension members: Failure modes, design of simple and built-up sections.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	3											3			
CO-2	3	3											3			
CO-3	3	3											3			
CO-4	3	3	3										3			
CO-5	3	3	3										3			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.																

6. Course Teaching and LearningMethods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		00
1.Demonstration usingVideos	00	
2. Demonstration using PhysicalModels / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	

6. Discussing Possible Innovations	00	
Term Tests,Laboratory Examination/Written Examination,Presentations		10
	Total Duration in Hours	45

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	X	X	X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
CO-5		X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignments
2.	Understanding	Class room lectures, Assignments
3.	Critical Skills	Class room lectures, Assignments
4.	Analytical Skills	Class room lectures, Assignments
5.	Problem Solving Skills	Class room lectures, Assignments
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, examination
14.	Personal Management	Course work

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15.	Leadership Skills	--

9. CourseResources

a. **Essential Reading**

1. Class notes
2. Subramanian N., 2008, Design of Steel Structures, New Delhi, Oxford University Press
3. Anand S Arya and Awadesh, 2014, Design of steel structures, RoorkeeNemchand and Brothers
4. Bhavikatti, S.S., 2010, Design of Steel Structures, New Delhi, I.K. International Publishing House pvt. Ltd.
5. IS 800-2007, Code of practice for general construction in steel, New Delhi, Bureau of Indian Standards
6. SP6 (1) -1964, IS Hand Book for Structural Engineers, New Delhi Bureau of Indian Standards
7.

b. **Recommended Reading**

1. Arya, A. S. Ajmani A. L., 1992, Design of steel structures, Roorkee, Nemchand and Brothers
2. Punmia B. C., Ashok kumar jain, Arun kumar jain, 2010, Comprehensive Design of Steel Structures, New Delhi, Laxmi Publications Pvt. Ltd.
3. Dayaratnam P., 2003, Design of steel structures, New Delhi, S. Chand and Co.

c. **Magazines and Journals**

1. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campaus, Chennai

d. **Websites**

1. www.sciencedirect.com

e. **Other Electronic Resources**

1. Electronic resources on the course area are available on MSRUAS library

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Course Specifications: Estimation - Costing and Engineering Economics

Course Title	Estimation - Costing and Engineering Economics
Course Code	CEC313A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course covers the various aspects of estimation of quantities of the items involved in buildings, road, and irrigation works. It also deals with rate analysis, valuation of properties and preparation of reports for estimation of various items. Student will be trained in preparation of bill of quantities, specifications and tender documents. This course also covers engineering economics. Students will be made familiar with the concept of economics and their applications in construction sector.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	2:0:1
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Explain different types of estimates, units of measurement, and detailed specifications of common items of building works

CO-2. Prepare abstract and detailed estimates for various components of buildings and for other structures

CO-3. Perform rate analysis of various items of construction works.

CO-4. Describe important contractual terms, procedures, various types of contracts and valuation of properties

CO-5. Discuss accounting principles, financial statements, financial performance metrics, and inventory control for managing construction companies.

4. Course Contents

Unit 1 (Estimation Methods): Introduction, Definition, types of estimate, approximate estimate, units of measurement: IS: 1200, work charged establishment, plinth area, carpet area, important terms, units of measurement, abstract methods of taking out quantities and cost of building projects using center line method, long and short wall method or crossing method. Measurement of earth-work by cross-sections, spot levels, contours, mass diagram and its characteristics for highway projects.

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Unit 2 (Specification and Rate Analysis): Specification: Definition of specifications, objective of writing specifications, essentials in specifications, general and detail specifications of common items of works in buildings. Definition and Purpose, factors effecting, overhead charges, turn out of work, rate analysis for different items of building - earth work in different types of soils, cement concrete of different mixes, bricks and stone masonry, flooring, plastering, RCC works, centering and form work for different RCC items, wood and steel works for doors, windows and ventilators.

Unit 3 (Contract): Functioning and organization of PWD, tender, tender form and its notification, Documents and types, Earnest Money Deposit and Security deposit; Contract: Types of contract, essentials of contract agreement, legal aspects, breach of a contract, acceptance of contract documents, termination of contract, completion certificate, quality control, refund of deposit, Work's slip, qualification of contractor, responsibilities of engineer, owner, and contractor; Technical sanction, Different methods of execution of work, measurement book, nominal muster roll, running bill, agreement, and schedule rate; Arbitration.

Unit 4 (Valuation): Purpose of valuation, scrap value, salvage value, market value, factors which affect the value, sinking fund, year's purchase, depreciation, determination of depreciation, different methods of valuation, land and building method of valuation, calculation of standard rent, rental method of valuation; Mortgage, Lease. Principles of report preparation – report on estimation of residential building, culvert, Roads, water supply and sanitary installations, tube wells, open wells. Detailed Project Report (DPR).

Unit 5 (Engineering Economics): Introduction to the principles of microeconomics, familiarization with supply and demand concepts, understand shifts in supply and demand and their implications for price and quantity sold, Analysis on how consumers respond to a shift in the price of the goods they consume. Financial Accounting Purposes and Principles, The Accounting Cycle - Accrual and Cash Accounting, Introduction to Financial Statements of Sole Proprietorship Concerns.

Preparation of Financial statements - Trading account, P & L account and Balance Sheet - Simple problems with adjustments.

Company Balance Sheet - Horizontal and Vertical - Interpretation of all items of Company Balance Sheet: Sources and Applications of Funds, Capital Structure meaning and pattern – simple problems on calculation of Earning per Share (EPS). Appraisal of financial performance by financial statement analysis, Introduction to Ratio Analysis – Broad classification of Ratios, Problems on calculation of Liquidity, Solvency, Activity and Profitability Ratios. Budget and Budgeting – Types of Budget. Funds Flow and Cash Flow - Meaning, Distinction – Objectives. Sources, Advantages and Limitations of Funds Flow Statement. Problems on Preparation of Funds Flow Statement only.

Working Capital – Concept and meaning of working capital – Liquidity and profitability – identification of factors affecting working capital requirements – theories of working capital Problems on Computation of Working Capital. Cost - Concept - Fixed, Variable, Semi Variable Cost. Simple Problems on Preparation of Cost Sheet. Approaches to estimation of working capital – operating cycle approach. Management of inventories – determination of optimum inventory – lead time – Safety stock – EOQ approach

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5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1		2	3										3		
CO-2	3	2	2		3								3	3	
CO-3	3	2	2		3								3	3	
CO-4		3	3										3		
CO-5	3	3	2		2								3	2	
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		02
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		38
1. Solving Numerical Problems	38	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or

subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	×	×	×
CO-2	×	×	×
CO-3	×	×	×
CO-4	×	×	×
CO-5		×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes

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2. Chakraborti, M., (2003), Estimating, Costing, Specification and Valuation in Civil Engineering, Published by the Author, Sixteenth edition
3. Dutta, B. N.,(2000), Estimating and Costing in Civil Engineering, UBS Publishers and Distributors Ltd.
4. Perloff, J. M., (2012), Microeconomics, USA, Pearson

b. Recommended Reading

1. Kohli, D. D. and Kohli, R. C.,(2004), A Text Book of Estimating and Costing (Civil), S. Chand and Company Ltd.
2. Birde, G. S., Text book of Estimating and Costing, Dhanpath Rai and Sons, New Delhi
3. Patil, B. S.,(2006), Contracts and Estimates, University Press
4. CPWD., "Manual for Standard Specification and Rate Analysis"
5. IS 1200: Part 1 to 16: Method of measurement of building and civil engineering works
6. Mankiw, G. N., (2012), Principles of Microeconomics, USA, South-Western Cengage Learning
7. Pindyck, R. S. and Rubinfeld, D. L., (2013), Microeconomics, USA, Pearson

c. Magazines and Journals

1. Journal of Construction Engineering and Management, ASCE
2. Project Management Journal, PMI

d. Websites

1. https://cpwd.gov.in/Documents/cpwd_publication.aspx

e. Other Electronic Resources

1. http://nptel.ac.in/

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Course Specifications: DSM & Finite Element Analysis

Course Title	DSM & Finite Element Analysis
Course Code	CEC314A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the concepts and principles of strength of materials to enable the students to analyze the behavior of deformable structural elements, subjected to different types of loadings. Students are taught the concepts of stress, strain, deformation and their applications in solving general engineering problems. Students are trained to analyze the response of the simple structural components and determinate structures to applied forces and boundary conditions.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture:Tutorial:Practical)	2:0:1
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the studentwill be able to:

- **CO-1.** Explain basic concepts, direct stiffness method of analysis background review, theory of elasticity, energy concepts, equilibrium and energy methods for analyzing structures
- **CO-2.** Discuss and derive Interpolation models, shape function and Lagrange's shape functions in different coordinate system for one and two dimensional elements
- **CO-3.** Derive shape functions, strain displacement matrix and element stiffness matrices for DSM and finite element analysis
- **CO-4.** Solve one and two dimensional problems by Direct Stiffness Method and Finite element method
- **CO-5.** Recognize the scope for finite element analysis in sub-disciplines of civil engineering

4. Course Contents

Unit 1 (Matrix displacement formulation):
Introduction to the concepts of flexibility and stiffness-Introduction to direct stiffness method, local and global co-ordinate system, transformation of variables, transformation of the member displacement matrix, transformation of the member force matrix, transformation of the member stiffness matrix, transformation of the stiffness matrix of the member of a truss, transformation of the stiffness matrix of the member of the rigid frame, overall stiffness matrix, boundary conditions, computation of internal forces. Analysis of trusses and continuous beams by direct stiffness

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methodStrain Energy: Strain energy in tension - compression and shear - resilience -stresses due to gradual, impact and suddenly applied load.

Unit 2 (Basic concepts):

Background review, theory of elasticity, energy concepts, equilibrium and energy methods for analyzing structures.

Euler's Lagrange's equations of bar, beams, principal of a minimum potential energy, principle of virtual work, principle of Variance, variation method and minimization of energy approach of element formulation.

Unit 3 (Introduction FEA):

Approximate method of structural analysis, Raleigh - Ritz Method, Galerkin's method application in structural analysis, finite difference method, finite element method. Principles of finite element method, advantages & disadvantages, finite element procedure-engineering applications of finite element method

Unit 4 (Basic Procedure):

Discretization process, types of elements 1D, 2D and 3D elements, simplex, complex and multiplex elements, size of the elements, location of nodes, node numbering scheme, half bandwidth, properties of stiffness matrix, preprocessing, post processing. Finite elements used for one, two & three dimensional problems, Element aspect ratio, mesh refinement vs. higher order elements, Numbering of nodes to minimize band width.

Unit 5 (Meshing):

Interpolation models:

Selection of the order of the interpolation polynomial, convergence requirements, 2d Pascal triangle, nodal displacement parameters, convergence criterion, compatibility requirements, geometric invariance.

Higher order elements, p and h methods of mesh refinement, ill conditioned elements, discretization errors, auto and adaptive mesh generation techniques, error evaluation

Shape function:

Polynomial form of interpolation functions, linear, quadratic and cubic, linear interpolation polynomials in terms of global coordinates of bar, triangular (2D simplex) elements.

Linear interpolation polynomials in terms of local coordinates of bar, triangular (2D simplex) elements, CST element. Lagrange's shape functions in generalized and natural coordinates, serendipity family of elements, and Hermitian polynomials.

Unit 6 (Theory of isoparametric elements):

Isoparametric, sub-parametric and super- parametric elements, characteristics of isoparametric elements, validity of isoparametric elements, numerical integration, Jacobian transformation matrix.

Unit 7 (1- D element formulation and its applications):

Mathematical modeling of 1-D element for characteristics evaluation, extraction of shape functions in natural and global co-ordinates for higher order bar elements.

Derivation of element stiffness matrices and load vectors, under axial loading, concentrated and distributed loads for bar element.

Solution of bars, stepped bars, plane trusses for displacements, reactions and stresses by using elimination approach, penalty approach. Derivation of element stiffness matrices and load vectors for concentrated and distributed loads for beam element.

Application of FEM to analysis of continuous beams and frames, stiffness of truss members, analysis of truss, and stiffness of beam members, grid members, and finite element analysis of continuous beam, plane frame, grid and space frame.

Unit 8 (2-D element formulation and applications):

Plane -stress and plane-strain problems, formulation of triangular element and its higher orders, constant strain triangle, linear strain triangle, isoparametric formulation for triangular elements, stiffness matrices. Formulation of quadrilateral elements, rectangular elements and higher order

elements, isoparametric formulation, stiffness matrices.
Computation of Jacobian matrix, consistent load vector, stresses and strains for 2D elements.
Course Map (CO-PO-PSO Map)

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3		2									3	2	
CO-2	3	3											3		
CO-3	3	3											3		
CO-4	3	3	3	2	1				1	1			3	2	1
CO-5	3	3	3	3	1				1	1			3	3	1

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1.Demonstration usingVideos	02	
2. Demonstration using PhysicalModels / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		15
1. Solving Numerical Problems	30	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests,Laboratory Examination/Written Examination,Presentations		10
Total Duration in Hours		70

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

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The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	X	X	X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
CO-5		X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Bhavikatti S.S., 2010, Strength of materials, Oxford University Press, Edition
3. Subramanyam , 2008, Strength of Materials, Oxford University Press, Edition

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b. Recommended Reading

1. Rajput, R.K., 1996, Strength of Materials, New Delhi, S. Chand & Co,
2. Punmia B.C., Ashok Jain and Arun Jain, 2000, Mechanics of Materials, New Delhi, Lakshmi Publications,
3. Hibbeller R C, Mechanics of materials, NewYork, Prentice Hall.

c. Magazines and Journals

1. Journal of Fluid Mechanics

d. Websites

1. http://nptel.ac.in/
2. www.learnfluidmechanics.org
3. www.efluids.com

e. Other Electronic Resources

1. Electronic resources on the course area are available on MSRUAS library

Course Specifications: Design and Drawing of Transportation and Irrigation Structures

Course Title	Design and Drawing of Transportation and Irrigation Structures
Course Code	CEC315A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with design and drawing of irrigation structures, RC slab culvert, RC T Beam Bridge. Students will be taught design and drawing of irrigation structures such as surplus weir with stepped apron, Tank Plug sluice without tower head, Canal gate sluice without tower head and Notch type canal drop. Geometric design characteristics of highways, concept of hydraulic design, substructures and foundation are discussed in detail. Students are also taught the design and drawing of transportation structures such as RCC slab culvert, RCC Box culvert to cater to a given stream flow and for terrain condition.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	0:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the geometric design characteristics of highways, classification of bridges and standard loads, types of bridges, forces to be considered for the design, IRC standards
- **CO-2.** Describe components of hydraulic structures
- **CO-3.** Determine the design discharge, afflux, economic span, natural, artificial and linear water ways
- **CO-4.** Design and draw the details of surplus weir, tank plug sluice, notch type canal drop and canal cross regulator
- **CO-5.** Design and draw the details of a pier/abutment of a bridge, RC slab culvert and RC T beam bridge

4. Course Contents

Unit 1 (Irrigation Design and Drawing):

Design and Drawing with all the three views of: -

i. Surplus weir with stepped apron
ii. Tank plug sluice without tower head
iii. Notch type canal drop
iv. Canal cross regulator

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Unit 2 (Transportation Design and Drawing): Introduction
Bridge Preliminaries: Classification of bridges and standard loads, Bridge-definition, components of bridges, various classifications, types of bridges, forces to be considered for the design, IRC standards.
Hydraulic Design: Methods of finding design discharge, natural, artificial and linear water ways, afflux, economic span.

Unit 3 (Transportation Design and Drawing): Design and Drawing
Design of suitable foundation for a pier/abutment of a bridge;
Design and Drawing of RC Slab Culvert for IRC class-AA loading, & class A loading. Design and drawing of pipe culvert. Empirical design of bank connections.
Design and drawing of a RCC Box culvert to cater to a given stream flow and terrain condition
Design and Drawing of Reinforced Concrete T Beam Bridge with cross beams by Piegaud's and Courbon's method for class-AA loading, empirical design of substructures and foundations.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3						1	2				3		2
CO-2	3	3							2				3		2
CO-3	3	3		2			1		2				3	2	2
CO-4	3	3	3	2	3		1		2	2			3	3	2
CO-5	3	3	3	2	3		1		2	2			3	3	2
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		
Demonstrations		
1. Demonstration using Videos		
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Numeracy		20
1. Solving Numerical Problems	20	
Practical Work		40
1. Course Laboratory	00	
2. Computer Laboratory	40	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00

1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		70

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	**X**	**X**	**X**
CO-2	**X**	**X**	**X**
CO-3	**X**	**X**	**X**
CO-4	**X**	**X**	**X**
CO-5	**X**	**X**	**X**
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--

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8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class notes
2. Johnson Victor D., 2007, Essentials of Bridge Design, New Delhi, Oxford and IBH Publishing Co
3. Ponnuswamy .S, 2008, Bridge Engineering, New Delhi, Tata McGraw Hill
4. Satya Narayana Murthy C., 2002, Water Resources Engineering Principles and Practice, New Delhi, New age International Publishers

b. Recommended Reading

1. V. K. Raina, 2008, Concrete bridge practice – Analysis, Design and Economics, New Delhi, Tata McGraw Hill
2. Balasubramanya N., 2016, Hydraulic Structures & Irrigation Design Drawing, Bangalore, Sapna Book House (P) Ltd

c. Magazines and Journals

d. Websites

e. Other Electronic Resources

1. http://nptel.ac.in/

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Course Specifications: Design and Drawing of Geotechnical and Environmental Structures

Course Title	Design and Drawing of Geotechnical and Environmental Structures
Course Code	CEC316A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the geotechnical design of foundation and piles subjected to compression, lateral and uplift forces. It also deals with the design and detailing of retaining walls. In this course, students are also taught the geometric design of river intake structures, water treatment plants and pump house. Layout and hydraulic profile of water treatment plants, design of effluent treatment plant, septic tank, soakage pit, air pollution control systems, and particulate and gaseous pollutant control system will be discussed.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	0:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Describe the design concepts of sub structures

CO 2. Discuss the layout of water treatment plants, types of river intake structures and pump house

CO 3. Discuss the air pollution control systems, particulate and gaseous pollutant control

CO 4. Design and draw the retaining walls ,shallow and pile foundations

CO 5. Design and prepare drawings of components of water and effluent treatment plants

4. Course Contents

Unit 1: Design Considerations of Shallow Foundations

Introduction, loads for footing, design basis for limit state method, design of isolated square/rectangular footing, for axial load and uniaxial moment, design and detailing of pedestal and combined footings

Unit 2: Design and drawing of Retaining walls

Stability analysis of cantilever and counterfort retaining walls. Design and detailing of retaining walls.

Unit 3: Design Considerations of Deep Foundations:
Pile Foundations- General and geotechnical considerations of pile foundations, analysis, design, detailing of pile foundations.
Unit 4: Environmental Engineering: Design and drawing of different types of river intake structures and pump house.

Unit 5: Layout and Hydraulic Profile of water treatment plants
Design and drawing of water treatment plants: Mixing tank, Flocculator, Sedimentation tank, Rapid gravity filter, Wash water tank, and underground drainage system

Unit 6: Design and drawing of effluent treatment plant: Screening tank, Grit chamber, Primary clarifier, Trickling filter, Aeration tank, and Secondary clarifier. Design of septic tank and soak pit
Design of Air pollution Control Systems, Particulate and Gaseous pollutant control

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1		3		2									3	2	
CO-2			3	2		1							3	2	
CO-3			2			3							2	3	
CO-4		3											3		
CO-5		2	3										3		

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		05
Demonstrations		01
1. Demonstration using Videos	01	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		30
1. Solving Numerical Problems	30	
Practical Work		24
1. Course Laboratory	00	
2. Computer Laboratory	24	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	

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2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	X	X	X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
CO-5	X	X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study

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9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	--
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Bowles J E, 1988, Foundation Analysis & Design, New York , McGraw Hill Inc,
3. Nayak, Narayan V, 1985, Foundation Design Manual, New Delhi ,Dhanpatrai & Sons,
4. Kaniraj S R, 1988, Design Aids in Soil Mechanics & Foundation Engineering, New Delhi, Tata McGraw Hill Publishing Co.Ltd
5. Ramamrutham S. and Narayan R, 1993, Design of Reinforced Concrete Structures, New Delhi , Dhanpat Rai Publishing Company (P) Ltd
6. A.P.Sincero & G. Sincero, 1996,Environmental Engineering: A Design Approach, Prentice Hall
7. H. S. Peavy, D. R. Rowe & G. Tchobanoglous, 1985, Environmental Engg, New Delhi, Tata McGraw Hill Publishing Co.Ltd

b. Recommended Reading

1. Das B M, 1990, Principles of Foundation Engineering, Boston, , PWS Publishing Co.,
2. Barnes G E, 2000, Soil Mechanics, MacMillan, Principles and Practice
3. Terzaghi, Peck .and Mesri, 1999, Soil Mechanics in Engineering Practice, New York , Wiley
4. M. L Davis and D. A. Cornwell, 2012, , Introduction to Environmental Engg, New York , McGraw Hill Inc
5. G. Kiely, 1967, , Environmental Engineering, New York , McGraw Hill Inc

c. Magazines and Journals

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

Course Specifications: Design and Drawing of Steel Structures

Course Title	Design and Drawing of Steel Structures
Course Code	CEC317A
Course Type	Core Theory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the drawing and detailing of splices, column bases, framed and seated connections, and laced and battened columns. Students are taught design and drawing of steel structures such as gantry girder, plate girder and truss roof.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	1:0:1
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- CO-1. Draw the detailing of welded and bolted connections
- CO-2. Draw the detailing of splices, built-up columns and column bases
- CO-3. Analyze the Gantry girder, Plate girder and Roof truss
- CO-4. Design and detail the gantry girder, plate girder and truss roof

4. Course Contents

Unit 1 (Connections):
Design and detailing of bolted and welded connections (Lap and Butt joints); Laced and battened columns; column bases.

Unit 2 (Girders):
Design and drawing of Bolted and welded plate girder; Gantry girder.

Unit 3 (Connections):
Detailing of beam to beam and beam to column connections.

Unit 4 (Roof Truss):
Design and detailing of Roof Truss

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5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2		3				2	2	1		3	3	2
CO-2	3	3	2		3				2	2	1		3	3	2
CO-3	3	3	2	2	3		1	2	2	2	1		3	3	2
CO-4	3	3	2	2	3		1	2	2	2	1		3	3	2

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		15
Demonstrations		05
1. Demonstration using Videos	01	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	04	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		10
1. Course Laboratory	00	
2. Computer Laboratory	10	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**55**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

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For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	X	X	X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. N. Krishna Raju, 2016, Structural Design and drawing of steel structures, New Delhi, University Press
3. IS 800, 2007, Code of practice for general construction in steel, New Delhi, Bureau of Indian Standards
4. SP6 (1), 1964, IS Hand Book for Structural Engineers, New Delhi, Bureau of

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Indian Standards

b. **Recommended Reading**
   1. N. Subramanian, 2017, Design of Steel Structures, New Delhi, Oxford University Press
c. **Magazines and Journals**
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d. **Websites**
   1. http://www.sciencedirect.com
   2. http://www.concrete.org
   3. *https://onlinecourses.nptel.ac.in*
e. **Other Electronic Resources**
   1. https://nptel.ac.in

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Course Specifications: Computer Aided Design Laboratory

Course Title	Computer Aided Design Laboratory
Course Code	CEL318A
Course Type	Laboratory
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with solving civil engineering problems using numerical methods. Students are trained to develop computer programs to solve civil engineering problems numerically. In addition, course deals with computer aided analysis and design of RCC structures, steel structures, transportation structures. Analysis and design of structural elements using various software packages are discussed in detail and results are compared with manual calculations.

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	0:0:1
Total Hours of Interaction	30
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Develop computer programs to solve civil engineering problems
CO 2. Perform civil engineering calculations using spread sheets
CO 3. Analyze various civil engineering structure in suitable software
CO 4. Design various structural elements using suitable software
CO 5. Prepare design report for structural components

4. Course Contents

1	Develop MATLAB programme to determine shear force and bending moment of simply supported and cantilever beams, plot SFD and BMD, also develop MATLAB programme to determine and plot bending stress and shear stress diagrams.
2	Use of spread sheet for the following civil engineering problems: SFD and BMD for Cantilever and simply supported beam subjected to uniformly distributed and uniformly varying load acting throughout the span, design of singly reinforced and doubly reinforced rectangular beams, computation of earthwork, design of horizontal curve by offset method, design of super elevation.
3	Design of RC structures: Beam and slab floor system, staircases, column footings, retaining walls, circular and rectangular water tanks. Analysis and design of single

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	story public building.
4	Design of Steel structures: Trusses, beams, columns, plate girders, gantry girders, industrial buildings
5	Transportation Design of Structures: RC slab culvert, RC T beam bridge, composite bridge, substructures and foundations.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	2	1				1	1			3	2	1
CO-2	3	3	2	2	1				1	1			3	2	1
CO-3	3	3	2	3	3				1	1			3	3	1
CO-4	3	3	2	3	3				1	1			3	3	1
CO-5	3	3	2	3	3				1	1			3	3	1

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		00
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	00	
2. Computer Laboratory	30	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		40

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7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Civil Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

For Laboratory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Conduct of Experiments	Laboratory Report + Viva	Laboratory SEE
CO-1	X	X	X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
CO-5	X	X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--

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15.	Leadership Skills	--

9. Course Resources

a. **Essential Reading**

4. Class Notes
5. Dr M.N. Shesha Prakash, Dr.G.S. Suresh, Computer Aided Design Laboratory, Lakshmi Publications.
6. M.A. Jayaram, D.S. Rajendra Prasad, CAD Laboratory, Sapna Publications

b. **Recommended Reading**

1. Ramesh Bangia,(2002) Learning Excel, Khanna Book Publishing Co (P) Ltd.
2. V. L. Shah, S. R. Karve, Illustrated Reinforced Concrete Design, Structures Publication.

c. **Magazines and Journals**

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d. **Websites**

1. http://www.sciencedirect.com
2. http://www.concrete.org
3. *https://onlinecourses.nptel.ac.in*

e. **Other Electronic Resources**

1. https://nptel.ac.in
2. https://www.csiamerica.com/products/etabs
3. https://communities.bentley.com/products/ram-staad/w/structural_analysis_and_design__wiki/27659/online-training-resources-for-staad-pro
4. https://www.mathworks.com/support/learn-with-matlab-tutorials.html
5. Electronic resources on the course area are available on MSRUAS library

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Course Specifications: Traffic Engineering

Course Title	Traffic Engineering
Course Code	CEE311A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. **Course Summary**

This course deals with various traffic studies and their analysis. The students are taught about various components of road traffic, traffic studies like traffic volume, speed, origin and destination, traffic flow characteristics like density, flow, level of service, capacity of roadway etc. Design of various facilities like islands, intersections, bus bay, parking, etc. will also be addressed. Students are trained to design traffic signals and redesign existing signals.

2. **Course Size and Credits:**

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. **Course Outcomes (COs)**

After undergoing this course students will be able to:

CO1. Describe various components of road traffic and their characteristics
CO2. Explain data collection, analysis and interpretation of results for various traffic studies
CO3. Discuss various traffic regulations and traffic control devices
CO4. Design traffic signals and other traffic facilities
CO5. Plan various traffic management measures like one-way, reversible lanes, carpool lanes,etc.
CO6. Justify the application of Intelligent Transport System for present traffic scenario

4. **Course Contents**

Unit 1: Scope of traffic engineering & study of its elements - introduction - objectives and scope of traffic engineering - components of road traffic - vehicle, driver and road - road user and vehicle characteristics and their effect on road traffic

Unit 2: Traffic studies - data collection, analysis and interpretation of results of classified traffic volume, spot speed, speed and delay, origin and destination. Sampling in traffic studies – sampling techniques, sampling theory, accuracy and sample size. Accident characteristics, causes, studies, investigations and analysis of individual accidents, statistical analysis, measures to improve road safety, Problems on above

Unit 3: Traffic flow characteristics, traffic flow variables, speed – flow – density relationship, PCU values, level of service, factors influencing roadway capacity, capacity of roads at various levels of

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service, capacity of intersections
Traffic regulations and control - Regulation on vehicles, drivers and traffic flow, Traffic control devices – Types & objectives of markings, signs, signals and islands, delineators.

Unit 4: Design, regulation and management of traffic engineering facilities - control of traffic movements through time sharing and space sharing concepts - design of channelizing islands,T, Y, skewed, staggered, roundabout, mini-roundabout and other forms of at-grade crossings including provision for safe crossing of pedestrians and cyclists - grade separated intersections- their warrants and design features - bus stop location and bus bay design - road lighting - regulations on vehicles, drivers and traffic - planning and design of traffic management measures: one-way streets, reversible lanes and roadways, turn regulation, transit and carpool lanes – planning and design of pedestrian facilities, Design of on-street and off-street parking facilities and safety devices

Unit 5: Traffic control devices & environmental control - different methods of signal design - redesign of existing signals including case studies - signal coordination - air & noise pollution of different transport modes - visual impacts - impacts on land development - technological approaches to improving environment

Unit 6: Design features of expressways and different types of Urban Roads. Intelligent transport system: Definition, Necessities, Application in the present traffic scenario

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	
CO-1	3	2											3			
CO-2	3	3	2										3			
CO-3	3	3	2										3			
CO-4	3	2	3	2									3	2		
CO-5	3	3	3	2	3								3	3		
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.																

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	01	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop /	00	

Kitchen		
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Civil Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	**x**		**x**
CO-2	**x**		**x**
CO-3	**x**	**x**	**x**
CO-4	**x**	**x**	**x**
CO-5		**x**	**x**
CO-6		**x**	**x**
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

d. Essential Reading

1. Class Notes
2. Kadiyali L.R., (1983), Traffic Engineering and Transportation Planning, Khanna Publication, New Delhi
3. IRC: SP: 41-1994, IRC SP: 31-1992, IRC 43-1994, Indian Roads Congress

e. Recommended Reading

1. Nicholas J Garber, Lester A Hoel, (2008), Traffic & Highway Engineering- Third edition, Cengage Learning
2. MoRTH, Type Designs for Intersections on National Highways, Indian Roads Congress
3. MoRTH, Manual for Road Safety in Road Design, Indian Roads Congress
4. IRC3-1983,9-1972,62-1976,64-1990,65-1976,66-1976,67-2001,69-1977,70-1977, 73-1980,79-1981,80-1981,86-1983,92-1985,93-1985,99-1988,102-1988,103-1988, 106-1990,110-1996 Indian Roads Congress
5. Khanna and Justo, (2001), Highway Engineering, Nem Chand and Bros., Roorkee

f. Magazines and Journals

1. Transportation research board
2. Indian Road Congress

g. Websites

1. www.trb.org
2. www.sciencedirect.com

h. Other Electronic Resources

1. https://nptel.ac.in

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Information Modeling, Indoor Environment Quality, Water Efficiency and Sanitary Waste, Indian Green Building Council (IGBC) certification.

Unit 3 (Green Design, analysis and documentation): Green Design and Building Economics, Green Project Cost Monitoring and Closeout, Green Project Commissioning, Project Cost Analysis, Green Specifications and Documentation, Types of Building Contract Agreements, Green Business Development, Building Green Litigation and Liability Issues

Unit 4 (Modern Construction Materials): Types of steel and their properties, advantages of new alloy steels- properties and advantages of aluminum and its products, types of coatings and coatings to reinforcement, application of coatings; Types of plastics, non-weathering materials and their uses; Types of flooring and façade materials and their applications; Construction chemicals - Types and properties of water proofing compounds, sealants, engineering grouts, mortars, admixtures and adhesives; Smart materials- types and differences between smart and intelligent materials, special features, case studies showing the applications of smart and intelligent materials.

Unit 5 (Green and Alternative Building Materials): Green Building Materials and Products, Characteristics of building blocks for walls, Stones and Laterite blocks, Bricks and hollow clay blocks, Concrete blocks, Stabilized blocks: Mud Blocks, Steam Cured Blocks, Fal-G Blocks and Stone Masonry Block. Lime-Pozzolana Cements: Raw materials, Properties and uses, manufacturing process Fibre reinforced plastics, Matrix materials, Fibers: organic and synthetic with its properties and applications, Building materials from agro and industrial wastes, Types of agro wastes, Types of industrial and mine wastes with its properties and applications, Field quality control test methods.

Unit 6 (Equipment for Production of Alternative Materials): Equipment for production of stabilized blocks, Moulds required, and methods of production of precast elements.

Unit 7 (Alternative Building Technologies): Alternative for wall construction – types, construction methods, Masonry mortars – types, preparation and properties, Alternative roofing systems – concepts, filler slab, Composite beam panel roofs, Masonry walls and domes.

Unit 8 (Cost Effective Building Design): Cost concepts in buildings, Cost saving techniques in planning, design and construction, Cost Analysis: Case studies using alternative materials and processes.

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Course Specifications: Advanced Structural Analysis

Course Title	Advanced Structural Analysis
Course Code	CEE312A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the flexibility stiffness method of analysis of structures. Concepts of stiffness and flexibility methods will be discussed. Students are taught to Obtain element flexibility and element stiffness matrices for truss, beam and grid elements.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the concepts of stiffness and flexibility methods
- **CO-2.** Obtain element flexibility and element stiffness matrices for truss, beam and grid elements
- **CO-3.** Develop the force transformation and displacement transformation matrix for continuous beams, plane trusses and rigid plane frames
- **CO-4.** Analyse continuous beams, plane trusses and rigid plane frames by flexibility method and stiffness method
- **CO-5.** Validate FEA tools for analysis of structures

4. Course Contents

Unit 1 (Introduction):
Introduction: Static and kinematic indeterminacy, concepts of stiffness and flexibility. Introduction to flexibility and stiffness methods.

Unit 2 (Element Approach):
Element flexibility and element stiffness matrices for truss, beam and grid elements

Unit 3 (Force-Transformation Matrix):
Force-transformation matrix, development of global flexibility matrix for continuous beams, plane trusses and rigid plane frames

Unit 4 (Displacement-Transformation Matrix):
Displacement-transformation matrix, development of global stiffness matrix for continuous beams, plane trusses and rigid plane frames.

Unit 5(Application):
Analysis of continuous beams, plane trusses and rigid plane frames by flexibility method and stiffness method. Validate FEA tools for analysis of structures (number of unknowns should not be more than three).

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3							2				3		2
CO-2	3	3							2				3		2
CO-3	3	3							2				3		2
CO-4	3	3	3		2	1			2	2			3	2	2
CO-5	3	3	3		3	1			2	2			3	3	2
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		05
1. Demonstration using Videos	01	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		20
1. Solving Numerical Problems	20	
Practical Work		05
1. Course Laboratory	00	
2. Computer Laboratory	05	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10

	Total Duration in Hours	70

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Civil Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	X	X	X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
CO-5		X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment

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14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. **Essential Reading**
   1. Class Notes
   2. S.Rajasekaran,(2001), Computational StructuralMechanics, PHI,New Delhi
   3. C.S. Reddy,(2001) Basic Structural Analysis, TMH,New Delhi
   4. Kinney J. S., 1991. Indeterminate Structural Analysis, Narosa Publishing House, New Delhi.
   5. Ramamrutham R. and Narayan N., 1993. Theory of structures, Dhanpat Rai Publications.
   6. William Weaver, Jr & James M.Gere, 1995. Matrix analysis of framed structures, New Delhi. CBS Publishers & Distributors
   7. Pandit G.S. and Gupta S.P., 2006, Structural Analysis – A Matrix Approach, Tata McGraw Hill Publishing Company Ltd.
   8. Bhavikatti S. S, 2003, Structural Analysis, Vol.1 and 2, Vikas Publishing House Pvt Ltd.,

b. **Recommended Reading**
   2. Wang C. K., Indeterminate Structural Analysis, Auckland, Mc Graw- Hill.
   3. Hibbler R. C., 2007, Structural Analysis, New Delhi, LCE, Pearson Education.
   4. W.Weaver and J.H.Gere,(1980) Matrix Analysis of Framed Structures, Van Nastran

c. **Magazines and Journals**

d. **Websites**
   1. http://nptel.ac.in/

e. **Other Electronic Resources**
   1. Electronic resources on the course area are available on MSRUAS library

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Course Specifications: Advanced Surveying -Remote Sensing and GIS

Course Title	Advanced Surveying -Remote Sensing and GIS
Course Code	CEC313A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with basic concepts of remote sensing and GIS in the area of water resources engineering. Students are taught various digital image processing techniques and digital elevation modeling pertaining to remote sensing. Various data storage techniques and analysis required for GIS are also dealt with. Students are trained in application of remote sensing and GIS to evaluate and solve real world problem through suitable software.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Describe basic concepts of remote sensing and GIS
CO-2. Explain remote sensing system, raster and vector data structures, buffering and overlaying techniques
CO-3. Discuss image processing techniques, digital elevation model , raster and vector data structure, data storage and analysis in GIS
CO-4. Discuss applications of remote sensing and GIS in Civil Engineering
CO-5. Apply remote sensing and GIS techniques to evaluate and solve real world problems
CO-6. Use suitable software to train in applications of GIS

4. Course Contents

Unit1: Introduction and Basic Concepts: Introduction, Basic concepts of remote sensing, Airborne and space born sensors, Passive and active remote sensing; EMR Spectrum, Energy sources and radiation principles, Energy interactions in the atmosphere; Energy interactions with earth surface features, Spectral reflectance curves. Remote Sensing Systems: Satellites and orbits, Polar orbiting satellites, Spectral, radiometric and spatial resolutions, Temporal resolution of satellites, Multispectral, thermal and hyperspectral sensing. Global positioning System (GPS), GPS for ground truth collection.

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Unit 2: Introduction to digital image processing: Introduction to image restoration, image extraction, image enhancement techniques

Unit 3: Introduction to GIS: Basic Concept and Components, Hardware, Software, Data Spatial and non-spatial, Georeferencing,Map Projection, Types of Projection, Simple Analysis, Data retrieval and querying

Unit 4: Data storage and analysis:_Database, Raster and Vector data structures, Data storage, Run length, Chain and Block coding, Vector data storage, Topology, GIS Modeling, Raster and Vector data analysis, Buffering and overlaying techniques, Network Analysis, Spatial Analysis

Unit 5: Remote sensing and GIS applications:_Watershed management, Rainfall-runoff modeling, Irrigation management, Flood mapping, Drought assessment, Environmental monitoring, other civil engineering applications

Unit 6: Hands on training on GIS software

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3												3		
CO-3	3	2	1										3		
CO-4	3	2	1										3		
CO-5			3	1	1								3	1	
CO-6					3	1						1		3	
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		25
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	00	
2. Computer Laboratory	30	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	

Others		
1. Case Study Presentation	00	00
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	X	X	X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
CO-5		X	X
CO-6		X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures, Assignment
2.	Understanding	Classroom lectures, Assignment, Self-study
3.	Critical Skills	Classroom lectures, Assignment
4.	Analytical Skills	Classroom lectures, Assignment

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5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	Assignment, Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, Examination
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class notes
2. Lilesand T. M. and Kiefer R.W., 2000, Remote Sensing and Image Interpretation, Singapore, John Willey & Sons
3. Tor Bernhardsen, 2002, Geographic Information Systems: An Introduction, New Delhi, Wiley India

b. Recommended Reading

1. J.B. Cambell, 2002, Introduction to Remote Sensing, UK, Taylor & Francis
2. Ian Heywood, Sarah Cornelius and Steve Carver, 2012, An Introduction to Geographical Information Systems, Pearson

c. Magazines and Journals

d. Websites

e. Other Electronic Resources

1. http://nptel.ac.in

Course Specifications: Advanced Concrete Technology

Course Title	Advanced Concrete Technology
Course Code	CEE314A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with fresh and hardened concretes. Topics like Importance of Bogue's components, chemical admixtures, mineral admixtures and mix design will be taught. Durability of concrete, Ready Mix Concrete, Fiber reinforced concrete and light weight concrete are discussed. Students are taught the design of concrete mix by IS: 10262-2004, ACI and BS methods. The students will also be taught about tests on hardened concrete and NDT tests

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Identify the different components of concrete and discuss their properties

CO 2. Compare and contrast different technologies involved in the process of manufacture of concrete, the concreting process along with durability aspects of concrete

CO 3. Explain the principles, methods and factors involved in the mix proportioning of concrete and their influence on mix design

CO 4. Discuss the different types of destructive and nondestructive tests on hardened concrete

CO 5. Design different mixes of concrete as per IS, ACI and BS Codes for both insitu and ready mix concretes

CO 6. Recommend suitable type of concrete for a given set of conditions and propose relevant special concretes

4. Course Contents

Unit 1: (Introduction and Overview of Concrete): Importance of Bogue's compounds, structure of a hydrated cement paste, volume of hydrated product, porosity of paste and concrete, transition zone, elastic modulus, factors affecting strength and elasticity of concrete, rheology of concrete in terms of Bingham's parameter.

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Unit 2: (Chemical Admixtures): Mechanism of chemical admixtures, plasticizers and super plasticizers and their effect on concrete property in fresh and hardened state, Marsh cone test for optimum dosage of super plasticizer, retarder, accelerator, air-entraining admixtures, new generation superplasticiser.

Unit 3: (Mineral Admixtures): Fly ash, silica fume, GGBS and their effect on concrete property in fresh state and hardened state.

Unit 4: (Concrete Mix Design): Factors affecting mix design, design of concrete mix by BIS method using IS:10262:2019, current American (ACI) and British (BS) methods.

Unit 5: **(Durability of Concrete):** Introduction, permeability of concrete, chemical attack, acid attack, efflorescence, corrosion in concrete. Thermal conductivity, thermal diffusivity, specific heat, alkali aggregate reaction, IS:456-2000 requirements for durability.

Unit 6: (Ready Mix Concrete): Manufacture, precautions, Methods of concreting- Pumping, under water concreting, shotcrete, high volume fly ash concrete concept, properties, typical mix. Self compacting concrete concept, materials, tests, properties and application.

Unit 7: (Tests on Hardened concrete): Effect of end condition of specimen, capping, H/D ratio, rate of loading, moisture condition. Compression, tension and flexure tests. Tests on composition of hardened concrete-cement content, original w/c ratio. NDT tests concepts-Rebound hammer, pulse velocity methods.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3		2									3	2	
CO-2	3	3											3		
CO-3	3	3											3		
CO-4	3	3	3	2	1				1	1			3	2	1
CO-5	3	3	3	2	1				1	1			3	2	1
CO-6	3	3	3										3		
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	

2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	00
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Civil Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	x	x	x
CO-2	x	x	x
CO-3	x	x	x
CO-4	x	x	x
CO-5	x	x	x
CO-6		x	x
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following

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teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Neville, A.M, Properties of Concrete, ELBS Edition, Longman Ltd., London
3. M.S. Shetty, Concrete Technology
4. John Newman, Ban Seng Choo, Advanced Concrete Technology Processes, London

b. Recommended Reading

1. N. Krishna Raju, Concrete Mix Design, Sehgal Publishers.
2. Gambhir M.L, Concrete Manual, Dhanpat Rai & Sons, New Delhi
3. J. Prasad, C G K Nair, Non-Destructive Test and Evaluation of Materials, Mc Graw Hill
4. P.K. Mehta, P J M Monteiro, Concrete, Prentice Hall, New Jersey

c. Magazines and Journals

1. Indian Concrete Journal
2. Journal of Structural Engineering, CSIR-Structural Engineering Research
3. Centre, CSIR Campus, Chennai
4. he concrete portal

d. Websites

1. http://www.sciencedirect.com
2. http://nptel.ac.in/courses/105102012/
3. http://www.theconcreteportal.com/

e. Other Electronic Resources

1. http://nptel.ac.in/

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Course Specifications: **Solid Waste Management**

Course Title	Solid Waste Management
Course Code	CEE315A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with solid waste, its sources and its management. Topics on collection and transportation of solid waste along with its processing are dealt. Different methods of treating solid waste such as incineration and composting processes are discussed. Different disposal methods of solid waste along with its recycle and reuse are also dealt.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Define solid waste and land pollution.
CO-2. Describe sources, collection and transportation of solid waste.
CO-3. Explain treatment / processing techniques of solid waste, disposal methods, recycle and reuse of solid waste.
CO-4. Explain the concept of incineration and composting process.
CO-5. Design incineration chambers and sanitary land fillings.

4. Course Contents

Unit 1(Introduction and sources): Definition, Land Pollution – scope and importance of solid waste management, functional elements of solid waste management. Composition of municipal solid waste. Classification and characteristics and handling – municipal, commercial & industrial wastes. Methods of quantification.

Unit 2(Collection and Transportation and Treatment / Processing Techniques): Systems of collection, collection equipment, garbage chutes, transfer stations – bailing and compacting, route optimization techniques and problems – Analysis of collection systems; Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems – solving. Objectives of waste processing – Physical Processing techniques and Equipment; Components

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separation, volume reduction, size reduction, chemical reduction and biological processing problems.

Unit 3(Incineration and Composting): Process – 3 T's, factors affecting incineration process, incinerators – types, prevention of air pollution, pyrolysis, design criteria for incineration. Energy recovery from incineration process. Aerobic and anaerobic composting, factors affecting composting, Indore and Bangalore processes, mechanical and semi mechanical composting processes. Vermicomposting.

Unit 4(Sanitary Land Filling and Disposal Methods): Different types, trench area, Ramp and pit method, site selection, basic steps involved, cell design, prevention of site pollution, leachate & gas collection and control methods, geosynthetic fabrics in sanitary landfills. Dumpsite Rehabilitation. Open dumping – selection of site, ocean disposal, feeding to hogs, incineration, pyrolysis, composting, sanitary land filling, merits and demerits, biomedical wastes and disposal.

Unit 5 (Recycle and Reuse): Material and energy recovery operations, reuse in other industries, plastic wastes ,environmental significance and reuse.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)	
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3					3							3	3
CO-2	3					3	3						3	3
CO-3	3					3	3						3	3
CO-4	3				2		3						3	3
CO-5	3					3	3						3	3
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.														

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	

5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	X	X	X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
CO-5		X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignments
2.	Understanding	Class room lectures, Assignments
3.	Critical Skills	Class room lectures, Assignments

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4.	Analytical Skills	Class room lectures, Assignments
5.	Problem Solving Skills	Class room lectures, Assignments
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, examination
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class notes
2. Tchobanoglous, G., Theisen, H., Vigil, S. A., (1993), Integrated Solid Waste Management, McGraw Hill.
3. Tchobanoglous, G. and Kreith, F., (2002), Handbook of Solid Waste Management, Mc Graw Hill, New York.
4. Garg, S. K., (2008), Environmental Engineering: Sewage Disposal and Air Pollution Engineering– Vol II, Khanna Publishers.
5. Williams P. T., (2005), Waste Treatment and Disposal, 2nd Edition, John Wiley and Sons.
6. Worrel, W. A. and Vesilind, P. A., (2011), Solid Waste Engineering, 2nd Edition, CL Engineering.

b. Recommended Reading

1. Bhide, A. D. and Sundaresan, B.B., (1983) Solid Waste Management in Developing Countries,Indian National Scientific Documentation Centre.
2. Pavoni J. L., (1975) Hand Book on Solid Waste Disposal, Van Nostrand Reinhold Co.
3. Peavy, H. S., Rowe, D. R. and Tchobanoglous, G., (1985) Environmental Engineering, Mc Graw Hill.

c. Magazines and Journals

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d. Websites

https://nptel.ac.in

e. Other Electronic Resources

Electronic resources on the course area are available on MSRUAS library

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Course Specifications: Ground Improvement Techniques

Course Title	Ground Improvement Techniques
Course Code	CEE316A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the necessity for ground improvement with emphasis on various types of ground modification techniques. Students will be taught the significance of ground improvement techniques as more and more structures are being built on soft soils /problematic soils or reclaimed land. They will be trained to adopt the best suitable method for the ground improvement in the field depending upon the soil conditions.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After undergoing this course students will be able to:

CO 1. Describe the problems associated with the problematic soils and their significance in design
CO 2. Outline the various soil improvement techniques adopted in the field
CO 3. Discuss the concept of preloading and prefabricated vertical drains(PVDs)
CO 4. Explain the concept of reinforced earth, its mechanism and strength development
CO 5. Apply the various ground improvement techniques to problematic soils

4. Course Contents

Unit 1: Introduction to ground improvement: Types of problematic soils and the significance of ground improvement in foundation engineering, major soil types and soil distribution in India Classification of ground improvement techniques: Mechanical modifications, Chemical modifications and Hydraulic Modification for cohesion less and cohesive soils

Unit 2: Densification and Compactions: Mechanical Modification, Compaction, principles, Shallow surface compaction using rollers, Deep compaction, vibro-compaction and vibro-replacement (Stone columns), compaction piles, Blast densification.

Unit 3: Preloading and Drainage: Hydraulic modification, Principles, single and multistage well point, vacuum dewatering, drainage of slopes, electro kinetic dewatering, Introduction to preloading and vertical drains, Need for preloading, preloading with and without vertical drains, properties of

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vertical drains, Natural Prefabricated Vertical Drains (NPVD) and Polymer Prefabricated Vertical Drains

Unit 4: Physical modification: Grouting, Heating, Freezing, Vitrification, Grouting techniques, permeation grouting, compaction technique, jet grouting, varieties of grout materials, grouting in difficult conditions, grouting technology, grouting applications

Unit 5: Soil stabilization with admixtures: Chemical stabilization: Lime stabilization, its principles, suitability, effects on properties, calcium and sodium chlorides, Cement stabilization, Bituminous stabilization, stabilization using industrial wastes.

Unit 6: Soil Reinforcement: Reinforced earth: Introduction, Materials used and the failure modes, Design procedures, Geosynthetics – Introduction, Types, Functions, Material and Fibre Properties, Mechanical Properties, Hydraulic properties, Design of geotextiles, Applications of geo-synthetics.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	
CO-1	3	2											3			
CO-2	3	3	2										3			
CO-3	3	2	2										3			
CO-4	3	2	3	2									3	2		
CO-5	3	2	2	2	3								3	3		

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00

1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	X	X	X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
CO-5		X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--

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8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

7. Class Notes
8. Hausmann M. R., (2002), Engineering Principles of Ground Modification, 3rd Edition,
McGraw-Hill International Edition
9. Purushothama Raj P., (2016), Ground Improvement Techniques, Laxmi Publications (P)
Ltd., New Delhi
10. Jayarami Reddy, (2007), A Text Book Of Hydrology, Laksmi Publications, New Delhi.

b. Recommended Reading

3. Moseley M. P., (2007), Ground Improvement, 2nd Edition, Blackie Academic and Professional, Boca Taton, Florida, USA.
4. Xanthakos P. P., Abramson L. W., Brucwe D. A., (2000), Ground Control and Improvement, 5th Edition, John Wiley and Sons, New York, USA.

c. Magazines and Journals

3. International Journal of Geosynthetics and Ground Engineering
4. Ground improvement

d. Websites

3. https://www.icevirtuallibrary.com/toc/jgrim/current
4. https://www.springer.com/journal/40891/

e. Other Electronic Resources

1. https://nptel.ac.in

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Course Specifications: Probability and Statistics

Course Title	Probability and Statistics
Course Code	MTE301A
Course Type	Professional Core Elective
Department	Mathematics and Statistics
Faculty	Engineering and Technology

1. Course Summary

The aim of the course is to provide an understanding of probability and statistics. Students are taught the concepts of mean, median and standard deviation in discrete and continuous probability distribution. The course introduces students to the basic definitions and concepts of inferential statistics. Students are taught the concepts of confidence intervals for mean, variance and standard deviation. This course discusses the hypothesis testing for mean, variance and standard deviation

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Mathematics and Statistics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Explain the concepts of random variables, probability distribution, joint probability distribution and sampling distribution
- **CO-2.** Explain the principles of convex optimization, regression, confidence interval and hypothesis testing
- **CO-3.** Solve simple problems associated with probability distribution, regression, confidence interval and hypothesis testing
- **CO-4.** Model real word problems by using probability distribution and regression
- **CO-5.** Solve complex problems associated with probability distribution, regression, confidence interval and hypothesis testing

4. Course Contents

Unit 1 (Random variables and Discrete Probability Distributions): Discrete and continuous. Definitions, illustrations and properties of random variables, univariate transformations with illustrations. Probability density function, cumulative distribution function, expected values, variance and their properties. Mean, variance, standard deviation of Binomial, Poisson, Uniform and Negatives Binomial along with their characteristic properties and limiting/approximation cases.

Unit 2 (Continuous Probability Distributions and Joint Probability Distribution): Probability density function, cumulative distribution function, mean, Variance, Standard Deviation of Uniform, Normal and Exponential distributions. The Normal Approximation to Binomial Distribution. Limiting/approximation cases. Introduction, Joint Probability density function, marginal probability density function, independent random variables, mathematical expectation.

Unit 3 (Sampling Distribution and Convex Optimization Algorithms): The sampling distribution of sample mean, sample proportions and sample variance. Central limit theorem. Steepest descent and conjugate gradient.

Unit 4 (Regression and Estimation): Multivariate linear and non-linear regression. Correlation and covariance. Point estimation and interval estimation. Point Estimation: Unbiased estimation, consistent estimators and simple problems. Method of moments and maximum likelihood estimation. Confidence intervals for the mean for small and large samples. Confidence intervals for population proportions.

Unit 5 (Hypothesis Testing): Tests concerning means: Single population, two population and bivariate population. Tests concerning proportion: Single population, two population. Tests concerning variance: Single population, two population. χ^2 -test for goodness of fit and test for independence of attributes.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2							1			3		1
CO-2	3	3	1							1			3		1
CO-3	3	3	2	2						2			3	2	2
CO-4	3	3	2	2						2			3	2	2
CO-5	3	3	2	2						2			3	2	2
		3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop /	00	

Kitchen		
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	00
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Civil Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	**X**		**X**
CO-2	**X**		**X**
CO-3	**X**		**X**
CO-4		**X**	**X**
CO-5		**X**	**X**
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

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S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. **Course Resources**

a. **Essential Reading**

1. Class notes
2. Sheldon Ross, 2010, A First Course in Probability, 8th edition, Pearson

b. **Recommended Reading**

1. Vijay K. Rohatgi, A. K. Md. Ehsanes Saleh, An Introduction to Probability and Statistics, Wiley
2. Harold J. Larson, Introduction to Probability Theory and Statistical Inference, John Wiley & Sons
3. Hogg, Tannis, Rao, 1997, Probability and Statistical Inference, 7h Edition Pearson Publication
4. Pradeep Kumar Sahu. Santi Ranjan Pal, Ajit Kumar Das, 2015, Estimation and inferential Statistics, Springer International Publishing A.G.
5. A. Agresti and C. Franklin, 2012, Statistics: The Art and Science of Learning from Data, 3rd edition, Prentice Hall

c. **Magazines and Journals**

d. **Websites**

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. **Other Electronic Resources**

1. https://ocw.mit.edu/index.htm
2. https://www.khanacademy.org/
3. tutorial.math.lamar.edu/

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Course Specifications
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Course Specifications: Pavement Materials, Equipment and Construction

Course Title	Pavement Materials, Equipment and Construction
Course Code	CEE411A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

29. Course Summary

This course deals with the study on engineering properties of various pavement materials, Construction of various pavement components and their relevant quality checks as per specifications. The course also deals with the discussion on working principle, operation and management of various pavement construction equipment

30. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

31. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-26. Discuss the basics of soil, aggregates and bituminous materials required for pavement engineers

CO-27. Explain the various engineering properties of soil, aggregates and bituminous materials required as per specifications

CO-28. Discuss the construction steps, techniques and quality checks involved in pavement construction as per standard specifications

CO-29. Discuss the working principle, operation and management of various pavement construction equipment

32. Course Contents

Unit 1 (Soil Engineering for Pavement Engineers):

Elements of Soil Engineering- Importance of soil engineering in road construction, Formation of soil, Soil profile, Particle size and shape, Grading, Clay minerals, Consistency and plasticity of fine grained soils, need for soil classification, Popular soil classification systems practiced, Phases in soils, Theory of soil compaction, Strength and other engineering properties of soils Embankment Design and Construction- Need of adequate design and construction, Elements of embankment design, Selection of embankment dimension, Stability analysis, Settlement analysis of embankments on weak startas, Special design features in problematic areas, Selection of materials, Construction practices, Modern soil reinforcing techniques, Gabion structures

Unit 2 (Soil Stabilization):
Purpose, Types of stabilization techniques, Mechanical stabilization, Soil – Lime stabilization, Soil-Cement stabilization, Chloride stabilization, Soil – Bitumen stabilization, Other modern stabilization techniques practiced (All the above as per latest IRC and MORT&H specifications)

Unit 3 (Stone Aggregates):
Origin, classification, requirements, properties and tests on road aggregates, concepts of size and gradation – design gradation, maximum aggregate size, aggregate blending by different methods to meets specification, Recent trends in alternate materials used as road aggregates as an initiative towards green construction (All the above as per latest IRC and MORT&H specifications)

Unit 4 (Bituminous Materials):
Bitumen, Tar, Modified Binders, Types of bituminous courses, Interface treatment, Surface dressing, General requirements of bituminous mixes, Mix design techniques and tests, OGPC, BUSG, Coated macadam, Penetration macadam, Bituminous concrete, Mix Seal surfacing, Sheet, Rolled and Mastic asphalt, SMA, CMA, WMA, RAP, Superpave, Foamed bitumen, MAC (All the above as per latest IRC and MORT&H specifications)

Unit 5 (Pavement Construction):
Construction and Quality control checks as per latest IRC and MORT&H specifications of - subgrade, soil stabilized pavements, Granular sub base and surface courses, brick, stone and cement concrete block pavements, Cement concrete pavements, semi rigid and roller compacted concrete pavements, White toping, Discussion on recent trends in modern pavement construction techniques

Unit 6 (Pavement Construction Equipments and their Management):
Heavy earth moving equipment, Shovels and cranes, Grading equipment, Compaction equipment, Aggregate production-screening and mixing equipment, Asphalt and Cement concrete mixing-laying-hauling and concreting equipment, Discussion on recent trends in pavement construction equipments

33. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2											3		
CO-2	3	2	3	2									3	2	
CO-3	3	2	2	2		3							3	3	
CO-4	3	3					2						3	2	

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

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34. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Mid Term Examination, Laboratory Examination/Written Examination, Presentations		10
	Total Duration in Hours	70

35. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	×	×	×
CO-2	×	×	×
CO-3	×	×	×
CO-4	×	×	×

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

36. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures
3.	Critical Skills	Classroom lectures, Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Classroom lectures, Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	Classroom lectures, Assignment
8.	Self-Learning	Self-study, Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	Classroom lectures
11.	Presentation Skills	Classroom lectures
12.	Behavioral Skills	Classroom lectures
13.	Information Management	Assignment
14.	Personal Management	Classroom lectures, Assignment
15.	Leadership Skills	Classroom lectures

37. Course Resources

jj. Essential Reading

1. Class Notes
2. Highway Engineering, Dr. C E G Justo & S K Khanna, Dr. A Veeraraghavan; Nemchand and Bros, Roorkee

kk. Recommended Reading

1. Construction Equipment and its Management; S C Sharma; Khanna Publishers
2. Principles and Practices of Highway Engineering; Dr. L R Kadiyali and Dr. N B Lal; Khanna Publishers Delhi

ll. Magazines and Journals

5. Indian Road Congress (IRC)
6. The Institution of Engineers India
7. Transportation Research Board (TRB)

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8. ASCE (American Society of Civil Engineers)

mm. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/
3. www.irc.nic.in
4. www.trb.org
5. www.ieindia.org

nn. Other Electronic Resources

1. https://ocw.mit.edu/index.htm
2. Electronic resources on the course area are available on MSRUAS library

Course Specifications: Pre-stressed Concrete Technology

Course Title	Pre-stressed Concrete Technology
Course Code	CEE412A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course defines the fundamentals of prestressing and its applications to concrete structural elements. It also describes the principles of the structural behaviour and design criteria of Prestressed Concrete Structures. The current technology available to prestress the concrete structures is taught. The students will be able to compute the initial and time-dependent losses, deflections for different types of beams and structures. They will be able to design members for shear, bond and torsion and design the end blocks.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the basic mechanisms of prestressing and types of prestressing
- **CO-2.** Calculate the internal forces due to the prestressing in a prestressed concrete structure, and to identify the primary and secondary components of the total internal forces
- **CO-3.** Compute the initial and time dependent losses in prestressing members
- **CO-4.** Analyse the stress, deflections, flexural and shear strength and apply it for the design of prestressing structures
- **CO-5.** Evaluate the prestressing force needed and its eccentricity for beams
- **CO-6.** Propose an appropriate system to prestress a particular structure and recommend suitable type of concrete for a given set of conditions

4. Course Contents

Unit 1 (Introduction and Concepts of Prestressing): Materials : High strength concrete and steel, stress-strain characteristics and properties. Basic principles of Prestressing- Prestressing technology, steel products and technologies for prestressing (strands, tendons,) anchorage systems, ducts,couplers technological requirements for the prestressing layouts, load balancing concept, stress concept, centre of thrust. Pre-tensioning and post - tensioning systems, tensioning methods and end anchorages.

Unit 2 (Flexural Analysis of members): Stresses in concrete due to pre-stress and loads, stresses in steel due to loads, cable profiles.

Unit 3 (Deflections of prestressed member): Calculation of deflection, deflection due to gravity loads, deflection due to prestressing force, total deflection, limits of deflection, determination of moment of inertia, limits of span-to-effective depth ratio, calculation of crack width, method of calculation, limits of crack width short term and long term deflections, elastic deflections under transfer loads and due to different cable profiles. Deflection limits as per IS 1343. Effect of creep on deflection, load verses deflection curve, methods of reducing deflection

Unit 4 (Limit state of Collapse): Flexure -IS Code recommendations –ultimate flexural strength of sections. Analysis for ultimate strength, variation of stress in steel, condition at ultimate limit state, analysis of rectangular sections and flanged sections.

Unit 5 (Limit state of collapse): Shear-IS code recommendations, introduction stress in an uncracked beam, types of cracks, components of shear resistance, modes of failure, effect of prestressing force, shear resistance of sections, shear reinforcement. Limit state of serviceability – control of deflections and cracking.

Unit 6 (Design of beams): Design of Pre-tensioned and Post-tensioned symmetrical and asymmetrical sections. Permissible stress, design of Prestressing force and eccentricity, limiting zone of prestressing force and eccentricity, limiting zone of pre-stressing force cable profile.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)														
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	3											3		
CO-2		2	3										3		
CO-3		1	3										3		
CO-4		1	2										2		
CO-5	2	2	3										3		
CO-6				1										1	
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00

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1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	**X**		**X**
CO-2	**X**	**X**	**X**
CO-3	**X**	**X**	**X**
CO-4	**X**	**X**	**X**
CO-5	**X**	**X**	**X**
CO-6		**X**	**X**
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

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8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignments
2.	Understanding	Class room lectures, Assignments
3.	Critical Skills	Class room lectures, Assignments
4.	Analytical Skills	Class room lectures, Assignments
5.	Problem Solving Skills	Class room lectures, Assignments
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, examination
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. N. Krisna Raju, (2008), Pre-stressed Concrete, Tata Mc.Graw Publishers, New Delhi
3. P. Dayarathman, (2013), Pre-stressed Concrete, Oxford and IBH Publishing Co.
4. T.Y. Lin and Ned, (2010), Design of Pre-stressed concrete structures ,Wiley Publishers.

b. Recommended Reading

1. N. C. Sinha & S. K. Roy, (2013), Fundamental of pre-stressed concrete, S. Chand Publishing
2. N. Rajgopalan, (2005), Pre-stressed Concrete, AlphaScience International

c. Magazines and Journals

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d. Websites

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e. Other Electronic Resources

1. htpps://nptel.ac.in/

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Course Specifications: Advanced Hydrology

Course Title	Advanced Hydrology
Course Code	CEE413A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with atmospheric, surface and sub-surface hydrology at advanced level. Students will be taught hydrologic cycle, hydrologic processes and unit hydrograph analysis. Students will be trained in statistical methods applied in hydrology. Students will be able to develop hydrologic simulation models that can be applied to real world problem.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe hydrologic cycle, water budget equation and hydrologic processes
- **CO-2.** Explain atmospheric, surface and sub-surface hydrology
- **CO-3.** Discuss unit hydrograph method and hydrologic statistics
- **CO-4.** Develop hydrologic simulation model to address real world problem
- **CO-5.** Apply knowledge of hydrology to field problems

4. Course Contents

Unit 1: Introduction: Hydrologic cycle, water budget equation, world water quantities, residence time, systems concept, transfer function operators, hydrologic model classification. Hydrologic Processes: Reynold's Transport Theorem, continuity equation, momentum equation, energy equation, discrete time continuity.

Unit 2: Atmospheric Hydrology: Atmospheric circulation, water vapor, formation of rainfall, types and forms of precipitation, precipitable water, monsoon characteristics in India, rainfall measurement, density and adequacy of rain gauges; Thunderstorm Cell model, IDF relationships, spatial averaging methods of rainfall; Factors affecting evaporation, estimation and measurement of evaporation, energy balance method, aerodynamic method, Priestly-Taylor method, and pan evaporation.

Unit 3: Sub-surface Water: Soil moisture, porosity, saturated and unsaturated flow; Richard's equation, infiltration, Horton's Phillip's, and Green Ampt methods, parameter estimation, ponding time concepts. Surface Water: Catchment storage concept, Hortonian and saturation overland flow, streamflow hydrographs, base-flow separation. Phi-index, ERH & DRH, algorithm for abstraction using Green-Ampt equation, SCS method, overland and channel flow modeling, time area concepts, and stream networks

Unit 4: Unit Hydrograph: General hydrologic system model, response functions of a linear hydrologic systems and their inter-relationships, convolution equation; definition and limitations of a UH; UH derivation from single and complex storms; UH optimization using regression. matrix, and LP methods; Synthetic unit hydrograph, S-Curve, IUH.

Unit 5: Hydrologic Statistics: Probability concepts, random variables, laws of probability, PDFs & CDFs; Normal and Binomial distributions; Statistical parameters: expected value, variance, skewness, and peakedness; Fitting of a probability distribution, methods of moments and maximum likelihood: Testing the goodness of fit, Chi-square test; Frequency analysis: return period, probability plotting, Extreme value distributions, frequency factors, Log-Pearson distribution, confidence limits.

Unit 6: Hydrologic Simulation Models - steps in watershed modeling, major hydrologic models.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3												3		
CO-3	3	2											3		
CO-4		3	3			1	1						3	1	
CO-5			3			1							3	1	

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

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6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	X		X
CO-2	X		X
CO-3	X	X	X
CO-4		X	X
CO-5		X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures, Assignment
2.	Understanding	Classroom lectures, Assignment, Self-study
3.	Critical Skills	Classroom lectures, Assignment
4.	Analytical Skills	Classroom lectures, Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	Assignment, Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, Examination
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class notes
2. Van Te Chow, David R. Maidment, Larry W. Mays, 1988, Applied Hydrology, New Delhi, Tata Mcgraw Hill
3. V. P. Singh, 1991, Elementary Hydrology, New Jersey, Prentice Hall.
4. Subramanya K.,2008, Engineering Hydrology, New Delhi, Tata Mcgraw Hill

b. Recommended Reading

1. B.C. Punmia, Ashok. K. Jain, Arun K. Jain, B. L. Pande, 2016, Irrigation and Water Power Engineering, New Delhi, Laxmi publications
2. Jayarami Reddy, 2016, A Text Book of Hydrology, New Delhi, Laxmi publications
3. Madan Mohan Das, Mimi Das Saikia, 2011, Irrigation and Water Power Engineering, New Delhi, PHI Learning Pvt. Ltd.
4. Modi P. N., 2008, Irrigation, water Resources and water power Engineering, New Delhi, Standard book house

c. Magazines and Journals

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d. **Websites**

e. **Other Electronic Resources**

   1. http://nptel.ac.in

Course Specifications: Advanced Hydrology

Course Title	Advanced Hydrology
Course Code	CEE413A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with atmospheric, surface and sub-surface hydrology at advanced level. Students will be taught hydrologic cycle, hydrologic processes and unit hydrograph analysis. Students will be trained in statistical methods applied in hydrology. Students will be able to develop hydrologic simulation models that can be applied to real world problem.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-6. Describe hydrologic cycle, water budget equation and hydrologic processes
CO-7. Explain atmospheric, surface and sub-surface hydrology
CO-8. Discuss unit hydrograph method and hydrologic statistics
CO-9. Develop hydrologic simulation model to address real world problem
CO-10. Apply knowledge of hydrology to field problems

4. Course Contents

Unit 1: Introduction: Hydrologic cycle, water budget equation, world water quantities, residence time, systems concept, transfer function operators, hydrologic model classification. Hydrologic Processes: Reynold's Transport Theorem, continuity equation, momentum equation, energy equation, discrete time continuity.

Unit 2: Atmospheric Hydrology: Atmospheric circulation, water vapor, formation of rainfall, types and forms of precipitation, precipitable water, monsoon characteristics in India, rainfall measurement, density and adequacy of rain gauges; Thunderstorm Cell model, IDF relationships, spatial averaging methods of rainfall; Factors affecting evaporation, estimation and measurement of evaporation, energy balance method, aerodynamic method, Priestly-Taylor method, and pan evaporation.

Unit 3: Sub-surface Water: Soil moisture, porosity, saturated and unsaturated flow; Richard's equation, infiltration, Horton's Phillip's, and Green Ampt methods, parameter estimation, ponding time concepts. Surface Water: Catchment storage concept, Hortonian and saturation overland flow, streamflow hydrographs, base-flow separation. Phi-index, ERH & DRH, algorithm for abstraction using Green-Ampt equation, SCS method, overland and channel flow modeling, time area concepts, and stream networks

Unit 4: Unit Hydrograph: General hydrologic system model, response functions of a linear hydrologic systems and their inter-relationships, convolution equation; definition and limitations of a UH; UH derivation from single and complex storms; UH optimization using regression. matrix, and LP methods; Synthetic unit hydrograph, S-Curve, IUH.

Unit 5: Hydrologic Statistics: Probability concepts, random variables, laws of probability, PDFs & CDFs; Normal and Binomial distributions; Statistical parameters: expected value, variance, skewness, and peakedness; Fitting of a probability distribution, methods of moments and maximum likelihood: Testing the goodness of fit, Chi-square test; Frequency analysis: return period, probability plotting, Extreme value distributions, frequency factors, Log-Pearson distribution, confidence limits.

Unit 6: Hydrologic Simulation Models - steps in watershed modeling, major hydrologic models.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3												3		
CO-3	3	2											3		
CO-4		3	3			1	1						3	1	
CO-5			3			1							3	1	
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop /	00	

Kitchen		
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	x		x
CO-2	x		x
CO-3	x	x	x
CO-4		x	x
CO-5		x	x
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

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S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures, Assignment
2.	Understanding	Classroom lectures, Assignment, Self-study
3.	Critical Skills	Classroom lectures, Assignment
4.	Analytical Skills	Classroom lectures, Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	Assignment, Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, Examination
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class notes
2. Van Te Chow, David R. Maidment, Larry W. Mays, 1988, Applied Hydrology, New Delhi, Tata Mcgraw Hill
3. V. P. Singh, 1991, Elementary Hydrology, New Jersey, Prentice Hall.
4. Subramanya K.,2008, Engineering Hydrology, New Delhi, Tata Mcgraw Hill

b. Recommended Reading

1. B.C. Punmia, Ashok. K. Jain, Arun K. Jain, B. L. Pande, 2016, Irrigation and Water Power Engineering, New Delhi, Laxmi publications
2. Jayarami Reddy, 2016, A Text Book of Hydrology, New Delhi, Laxmi publications
3. Madan Mohan Das, Mimi Das Saikia, 2011, Irrigation and Water Power Engineering, New Delhi, PHI Learning Pvt. Ltd.
4. Modi P. N., 2008, Irrigation, water Resources and water power Engineering, New Delhi, Standard book house

c. Magazines and Journals

d. Websites

e. Other Electronic Resources

1. http://nptel.ac.in

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Course Specifications: Green Construction and Alternate Building Materials

Course Title	Green Construction and Alternate Building Materials
Course Code	CEE414A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. **Course Summary**

This course emphasizes on green building delivery and life cycle which includes need analysis, building planning, design review and post-occupancy evaluation. The students are taught building design which involve ecology, architecture, community health and building environment aspects. Sustainability in building resources like alternate and green building materials and processes are also dealt.

2. **Course Size and Credits:**

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. **Course Outcomes (COs)**

After undergoing this module students will be able to:

CO 1. Discuss the green concepts, components of sustainable design and construction, modern, green and alternate building materials.
CO 2. Discuss building economics and cost-effective design for green construction
CO 3. Apply sustainable techniques in planning and execution of construction projects
CO 4. Compare and contrast different equipment's and construction techniques adopted in the construction of substructures, superstructures and special structures
CO 5. Compare and choose different alternate building materials and technologies suitable for a particular construction projects
CO 6. Design green building and construction process

4. **Course Contents**

Unit 1 (Introduction): Energy in building materials, Impact of Energy and Atmosphere, Environmental issues concerned to building materials, Global warming and construction industry, environmentally friendly and cost-effective building technologies, Requirements for building of different climatic regions, Traditional building methods and vernacular architecture.

Unit 2 (Introduction to Green Construction): Green Concepts and Vocabulary, Components of Sustainable Design and Construction, Green Design and the Construction Process, Building

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2												2		
CO-2			3										3		
CO-3				3										3	
CO-4					2				1					2	1
CO-5			3										3		
CO-6			3										3		

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or

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subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	X		X
CO-2	X		X
CO-3	X	X	X
CO-4	X	X	X
CO-5	X	X	X
CO-6		X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Kubba S., (2012) Handbook of Green Building Design, and Construction, Butterworth-Heinemann

3. Sabnis G. M., (2012) Green Building with Concrete: Sustainable Design and Construction, CRC Press Deodhar S.V.,(2010) Construction Equipment and Job Planning, Khanna Publishers, New Delhi

b. Recommended Reading

1. Cheshire D., (2016) Building Revolutions: Applying the Circular Economy to the Built Environment, RIBA Publishing
2. Hall K., (2008) The Green Building Bible Volume 1 & 2, Green Building Press
3. Johnston D., Gibson S., (2008) Green from the ground up: a builder's guide : sustainable, healthy, and energy-efficient home construction, Taunton Press

c. Magazines and Journals

1. ACI Materials Journal, American Concrete Institute
2. Engineering Construction and Architectural Management, Wiley

d. Other Electronic Resources

1. http://nptel.ac.in/
2. Coursera

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Course Specifications: Air Pollution and Control

Course Title	Air Pollution and Control
Course Code	CEE415A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the air pollution, its effects and its control. Sampling, analysis and control of air pollution, emerging trends in air pollution control are dealt. They will be also taught to deal with air pollution control in compliance with environmental legislation.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After undergoing this course students will be able to:

CO 8. Explain formation pollutants and classify air pollutants
CO 9. Describe meteorology, sampling, analysis and control
CO 10. Explain effects of air pollution on environment and Human along with case studies.
CO 11. Explain emerging trends in air pollution and its control
CO 12. Identify and explain burning environmental issues along with environmental Legislation.

4. Course Contents

Unit 1 (Introduction): The structure of the atmosphere. Definition – Classification and Characterization of Air Pollutants, Emission Sources, Indoor air pollution, Behavior and Fate of air Pollutants, Chemical Reactions in the Atmosphere, Photo-chemical Smog, Coal-induced smog, Air Pollution Inventories. Effects of Air Pollution: On Human Health, Animals, Plants and Materials, Global issues and Air pollution – Ambient air quality and emission standards – Air pollution indices – Indoor Air Pollutants – Major Environmental Air Pollution Episodes – London Smog, Los Angeles Smog & Bhopal Gas Tragedy.

Unit 2 (Meteorology): Introduction, meteorological variables, Primary and Secondary Lapse Rate, Inversions, Stability Conditions, windrose, General Characteristics of Stack Plumes, meteorological models. Factors to be considered in Industrial Plant Location and Planning Noise pollution –sources, measurement units, effects and control.

Unit 3 (Sampling, Analysis and Control):

Sampling and Measurement of Gaseous and Particulate matter, Stack Sampling, Analysis of Air Pollutants, Smoke and Smoke Measurement, Air Pollution Control Methods –Particulate

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Emission Control, Gravitational Settling Chambers, Cyclone Separators, Fabric-Filters, Electrostatic Precipitators, Wet Scrubbers, Selection of a Particulate Collecting Equipment, Control of Gaseous Emissions, Adsorption by Liquids, Adsorption by Solids, Combustion. Odours and their control.

Unit 4 (Air Pollution Due to Automobiles): Air Pollution due to Gasoline Driven and Diesel Driven Engines, Effects, Direct and Indirect Methods of control.

Unit 5 (Emerging Trends): Radioactive pollution and its control – Ultra violet photolysis – High efficiency Particulate Air Filters – Control of Indoor Air Quality.
Burning Environmental Issues:
1. Acid Rain
2. Global Warming
3. Ozone Depletion in Stratosphere
4. Indoor Air Pollution

Unit 6 (Environmental Legislation): Environmental Policy, Environmental Acts, Water, Air and Noise Pollution Standards., definitions, crop seasons of India, water requirements of a crop, duty, delta, base period. Consumptive use and its determination. Irrigation efficiencies. Assessment of irrigation water.

5. **Course Map (CO-PO-PSO Map)**

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3												3		
CO-2	3	2											3		
CO-3						2	2							2	
CO-4						2	2							2	
CO-5						3								3	

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. **Course Teaching and Learning Methods**

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		20
1. Solving Numerical Problems	20	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop /	00	

Kitchen		
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	X	X	X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
CO-5	X	X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

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S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. **Course Resources**

i. **Essential Reading**

1. Class Notes
2. Boubel, R.W., Donald, L.F., Turner, D.B. and Stern, A.C., (1994), Fundamentals of Air
3. Pollution, Academic Press.
4. Rao C.S., (1996), Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Delhi. Anjaneyulu, Y., (2002), Air Pollution and Control Technologies, Allied Publishers, Chennai.
5. Cooper, D. C., Alley, F. C., (2011), Air Pollution Control: A Design Approach, Waveland Press.

j. **Recommended Reading**

5. Crawford, M., (1980), Air Pollution Control Theory, TMH Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
6. Perkins, H.C., (1980), Air Pollution, Mc Graw Hill.
7. Peavy, H. S., Rowe, D. R., and Tchobanoglous, G., (1986), Environmental Engineering, Mc Graw Hill.
8. Sincero, A. P. and Sincero, G.A., (1999), Environmental Engineering – A Design Approach, Prentice Hall India.
9. Wark, K., Warner, C.F. and Davies, W.T., (1998), Air Pollution - Its Origin and Control, Harper and Row Publishers, New York.

k. **Other Electronic Resources**

3. https://nptel.ac.in

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Course Specifications: Advanced Foundation Engineering

Course Title	Advanced Foundation Engineering
Course Code	CEE416A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the design of deep foundations. Students will be taught to apply the principles of soil mechanics and analytical techniques for various deep foundations. It also deals with the analysis of machine foundations.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Relate the significance of soil exploration and the types of foundation in practice
- **CO-2.** Summarize the concepts of soil dynamics and its application in machine foundations
- **CO-3.** Outline the problems of foundations in expansive soils and recommend solutions
- **CO-4.** Discuss the concept of Mechanically Stabilized Earth and earth retaining structures
- **CO-5.** Solve problems on ultimate load bearing capacity of vertical and laterally loaded piles, earth pressures and machine foundations

4. Course Contents

Unit 1: Soil exploration and its significance: SPT, CPT and Geophysical exploration

Unit 2: Deep foundations: Types of pile foundations based on purpose, installation, Load transfer mechanism, Ultimate load bearing capacity of piles, Analysis of single piles subjected to vertical loads, Uplift resistance, Under-reamed Piles, Pile load tests

Unit 3: Pile groups in cohesive and cohesionless soils, settlement of piles and pile groups, Negative friction, Anchor piles, Uplift capacity, Laterally-loaded piles, Winkler's hypothesis, Coefficient of subgrade reaction, Ultimate lateral resistance of piles

Unit 4: Well foundations and its components, Sinking of wells and associated problems, Stability of well foundations, Foundations on expansive soils: Introduction, Characteristics of expansive soils, Foundations in expansive soils, Elimination of swelling

Unit 5: Mechanically Stabilized Earth (MSE) walls, Backfill and Reinforcing materials, Design of an MSE wall, Sheet pile walls, struts, tieback excavations, Soil Nailing

Unit 6: Loads due to Machines, Free and forced vibration, Analysis methods of machine foundation, Types of machines, Design Criteria, Tuning of Foundation, DOF of Block Foundation, Soil Mass Participation, Effect of Embedment, Vibration Isolation, IS-2974

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3												3			
CO-2	3												3			
CO-3			3										3			
CO-4			3										3			
CO-5	3	3	3										3			

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		03
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		25
1. Solving Numerical Problems	30	
Practical Work		02
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	

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Term Tests, Laboratory Examination/Written Examination, Presentations	10
Total Duration in Hours	**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	x	x	x
CO-2	x	x	x
CO-3	x	x	x
CO-4	x	x	x
CO-5	x	x	x
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--

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13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. **Essential Reading**
1. Course notes
2. Bowles J.E., (2007), Foundation Analysis and Design, McGraw Hill Co-Singapore.
3. Swami, S., (1999), Soil Dynamics and Machine Foundation, Galgotia Publications Pvt. Ltd., New Delhi s

b. **Recommended Reading**
1. Leonards. G.A., (2001), Foundation Engineering, McGraw Hill Co-Singapore.
2. Tschebotoriff. G.P, (1997), Foundations, Retaining and Earth Structures, McGraw Hill.
3. Srinivasulu. P. and Vaidyanathan, V., (1980), Handbook of Machine Foundations, Tata McGraw-Hill.

c. **Magazines and Journals**
1. Indian Geotechnical Journal
2. Journal of Geotechnical and Geological Engineering
3. International Journal of Geotechnical Engineering

d. **Websites**

e. **Other Electronic Resources**
1. http://nptel.ac.in/

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Course Specifications: Data Sciences Foundation

Course Title	Data Sciences Foundation
Course Code	CSE411A
Course Type	Professional Core Elective
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

This course aims to teach Python programming platform facilities—features, constructs, idioms, patterns and packages—for data science tasks. Facilities for data storage and processing using Python collections and operations are covered. Parallel programming in Python for performance and scalability of data processing is detailed. Testing and advanced programming constructs are discussed. Students are trained to design and develop Python scripts and programs for data science tasks and applications.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe the facilities—features, constructs, idioms, patterns and packages—of Python programming platform for building data science tasks
- **CO-2.** Explain the applicability of the Python programming constructs for a given task
- **CO-3.** Choose/recommend appropriate facilities of Python for data science tasks
- **CO-4.** Design data science tasks using the facilities of Python platform
- **CO-5.** Use parallelization and advanced programming constructs in the design of data science tasks
- **CO-6.** Synthesize and test data science tasks employing the Python platform facilities

4. Course Contents

Unit 1 (Introduction): Python language platform and programming ecosystem: Python core, its standard library, external libraries, Zen of python. Python core language: Review of syntax and core constructs. Python for data science: An overview of the facilities of Python platform for building data science tasks and workflows. Development: Edit-Compile-Run and Execute-Explore approaches using IDEs and notebooks. Deployment.

Unit 2 (Facilities for Data Processing): Core collections (tuple, list, dict and set), advanced collections (namedtuple, OrderedDict, counter, heapq, ChainMap, etc.), Operations and use in data storage and processing. Comprehensions: List, set and dict comprehensions, Nested comprehensions. Data processing applications. Functions: Namespaces and scopes, returning multiple values, functions as objects, anonymous (lambda) functions, currying. Generators: Iterator protocol, iterators, generators, generator expressions, Itertools module. Exception handling: Try-except block, Exception class and writing own exceptions. Filesystem and OS interface: File I/O, working with the filesystem, binary and text (Unicode) mode file data handling. Visualisation: Plotting 2D charts and plots, Surface 3D plots and Square Map plots using matplotlib and other plotting packages. Interactive visualisations: IPython notebooks, packages such as Bokeh.

Unit 3 (Libraries for Data Science Applications): Data modelling, processing and visualization packages/libraries: E.g., matplotlib and others, interactive visualisation packages, SQLAlchemy, NumPy, Pandas, SciPy, scikit-learn and statsmodels.

Unit 4 (Parallel Programming): Python support for parallel programming for data science tasks. CPU bound threads, GIL bottleneck and workarounds. Thread pooling. Process oriented parallelism: Multiprocessing communication support. Support for host based and distributed Inter Process Communication (IPC). Distributed computation: Distributed task queue, task scheduling, message transport brokers. Asynchronous operations: select, poll and epoll. Event loops. Coroutines and futures.

Unit 5 (Testing): Python Unit Testing module, Acceptance Testing of python software, Test Driven Development (TDD) and Behaviour Driven Development (BDD). Virtual environments for testing. Debugging and Python debugger, pdb.

Unit 6 (Advanced Python Programming): Functional Programming: Decorators, Context Managers, Generators and Iterators. Applications. zip and map. OO Programming: Magic methods, operator overloading, Collections, Python object model, Metaclasses, metaclass programming, inspection and other uses. Class Factories and run time attributes. Abstract Base Classes (ABCs) and protocol declaration.

Tutorials: Demonstrations and Case studies, Data Science Application design and scripting

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	1		2				1			1	2	2	2	2
CO-2	2	1	3					1			1	2	3		2
CO-3	2	1	3					1			1	2	3	2	2
CO-4	2	1	3	2	2	2		1			1	2	3	2	2
CO-5	2	1	3	2	2	2		1			1	2	3	2	2
CO-6	2	1	3	2	2	2		1			1	2	3	2	2

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6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		05
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		20
1. Solving Numerical Problems	20	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		05
1. Case Study Presentation	03	
2. Guest Lecture	02	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Tech. (Computer Science and Engineering) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3, SC4), COs are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	X		X
CO-2	X		X
CO-3	X		X
CO-4	X	X	X
CO-5		X	X
CO-6		X	X
The details of number of tests and assignments to be conducted are presented in			

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the Academic Regulations and Programme Specifications Document.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Face to Face Lectures, Tutorials, Assignments
2.	Understanding	Face to Face Lectures, Tutorials
3.	Critical Skills	Class Work, Tutorials, Assignments
4.	Analytical Skills	Class Work, Tutorials
5.	Problem Solving Skills	Class Work, Tutorials, Assignments
6.	Practical Skills	Tutorials, Assignments
7.	Group Work	Tutorials
8.	Self-Learning	Assignments, Home Work
9.	Written Communication Skills	Examinations, Assignments
10.	Verbal Communication Skills	Classroom interactions, Tutorials
11.	Presentation Skills	--
12.	Behavioral Skills	Class Work, Tutorials
13.	Information Management	Assignments
14.	Personal Management	Assignments, Examinations
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Handouts from books and published literature.

b. Recommended Reading

1. Padmanabhan, T. R., 2016, Programming Python, Springer Nature.
2. McKinney, W., 2018, Python for Data Analysis, 2nd edn., O'Reilly.
3. Palash, J., 2014, Parallel Programming with Python, Packt Publishing.
4. Sneeringer, L., 2016, Professional Python, Wrox Press.
5. van Hatten, R., 2016, Mastering Python, Packt Publishing..

c. Magazines and Journals

1. Journal of Big Data, a Springer Open Journal

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d. **Websites**
1. Python website: www.python.org
2. Data Science Central: www.datasciencecentral.com
3. Knowledge Discovery Nuggets: www.kdnuggets.com
4. Data Science Weekly: www.datascienceweekly.org

e. **Other Electronic Resources**
1. KDNuggets: Data Sets for Data Mining and Data Science, www.kdnuggets.com/datasets/index.html
2. Quora: www.quora.com

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Course Specifications: Urban Transport Planning

Course Title	Urban Transport Planning
Course Code	CEE421A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with basics of urban transportation planning process and concepts. Students are taught the role of transportation, urban travel characteristics, transportation planning process, travel demand estimation processes, delineation of study area and traffic zones, collection and checking of data, trip generation analysis, trip distribution analysis, mode split analysis and route split analysis.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Describe the role & characteristics of transportation and the concepts of travel demand
CO-2. Analyze trip generation through interviews and models
CO-3. Analyze trip distribution through various models
CO-4. Perform trip assignment and mode split analysis through different methods

4. Course Contents

Unit 1 (Urban Transportation Planning Process & Concepts): Role of transportation - Transportation problems - Scope of transportation planning - Urban travel characteristics - Evolution of transportation planning process - Interdependence of land use and traffic – Systems approach in transport planning – Stages in transport planning – Survey and analysis of existing conditions – Forecast analysis of future conditions and plan synthesis – Evaluation – Programme adoption and implementation – Continuing study – Citizen participation – Difficulties in transportation planning process – Relevance of transportation planning process to less developed countries – Computer applications in transport planning.

Unit 2 (Transportation Survey): Importance of transportation survey for transport planning –

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Study area – Zoning – Types of surveys: Home interview – Commercial survey – Taxi – Road side interview – Post card questionnaire – Registration number – Tag on vehicle – Public transport – Inventory of transport facilities, land use and economic activities – expansion of data from samples.

Unit 3 (Trip Generation Analysis): Introduction and definitions – trip purposes – Factors governing trip generation and attraction rates – Multiple linear regression analysis – Category analysis.

Unit 4 (Trip Distribution Analysis): Introduction and definitions – Methods of trip distribution – Growth factor methods- Synthetic methods (Problems on each method)

Unit 5 (Trip Assignment): Purpose of traffic assignment – Principles – Assignment techniques: All or Nothing – Multiple Route – Capacity Restraint – Diversion Curves. (Problems on each method)

Unit 6 (Mode Split Analysis): General considerations – Factors influencing Modal Split – Modal split in transport planning process – Recent developments in Modal split analysis.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2										3		
CO-2	3	3		2	2						1		3	2	1
CO-3	3	3		2	2						1		3	2	1
CO-4	3	3		2	2						1		3	2	1

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		38
Demonstrations		02
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		20
1. Solving Numerical Problems	20	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	

Others		
1. Case Study Presentation	00	00
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	×	×	×
CO-2	×	×	×
CO-3	×	×	×
CO-4		×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Classroom lectures, Assignment
4.	Analytical Skills	Assignment

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5.	Problem Solving Skills	Classroom lectures, Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	Classroom lectures, Assignment
8.	Self-Learning	Self-study, Assignment
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	Classroom lectures
11.	Presentation Skills	Classroom lectures
12.	Behavioral Skills	Classroom lectures
13.	Information Management	Assignment
14.	Personal Management	Classroom lectures
15.	Leadership Skills	Classroom lectures

9. Course Resources

a. Essential Reading

19. Class Notes
20. Dr. L R Kadiyali., 2009, Traffic Engineering and Transport Planning, Khanna Publishers.
21. Nicholas J. Garber and Lester A. Hoel, 2009, Traffic and Highway Engineering, Cengage Learning USA.
22. Jotin Khisty C., Kent Lall B., 2003, Transportation Engineering - An Introduction, Prentice Hall

b. Recommended Reading

20. Bruton M. J., 1975, Introduction to Transportation Planning, Hutchinson, London
21. Dickey J. W., 1975, Metropolitan Transportation Planning, Tata McGraw Hill, New Delhi

c. Magazines and Journals

9. Indian Road Congress (IRC)
10. The Institution of Engineers India
11. Transportation Research Board (TRB)
12. ASCE (American Society of Civil Engineers)

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/
3. www.irc.nic.in
4. www.trb.org
5. www.ieindia.org

e. Other Electronic Resources

1. https://ocw.mit.edu/index.htm
2. Electronic resources on the course area are available on MSRUAS library

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Course Specifications: Advanced Design of Reinforced Concrete Structures

Course Title	Advanced Design of Reinforced Concrete Structures
Course Code	CEE422A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

The main objective of the course is to introduce dynamic loading and the dynamic performance of the structures to the students. Different types of dynamic loading also to be discussed. The detailed study on the performance of structures under earthquake loading is also one of the focus of the course.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO1.** Describe design procedures for RCC structures
- **CO2.** Explain IS code practice for the design of RC structures
- **CO3.** Analyze Silos and bunkers using Janssen's Theory and Airy's Theory
- **CO4.** Analyze slabs by virtual work and equilibrium methods of analysis
- **CO5.** Design RCC structures like Deep beams, Chimneys, Flat slabs, Grid floor slabs and simple cylinderical shell

4. Course Contents

Unit 1: Design of silos, bunkers using Janssen's Theory and Airy's Theory.

Unit 2: RCC deep beams-Introduction, steps of designing deep beams, design by IS 456.

Unit 3: Design of RCC Chimneys; Grid Floors Slabs; Flat slabs.

Unit 4: Introduction to shell and folded plate roofs, their forms and structural behavior. Design of simple cylindrical shell roof by beam theory.

Unit 5: Yield line analysis of slabs- virtual work and equilibrium method of analysis.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	2	3											3			
CO-2		3											3			
CO-3		3	2	2	1	1							3	2		
CO-4			3	2									3	2		
CO-5	2	3	2	2	1								3	2		
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.																

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		28
Demonstrations		02
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		30
1. Solving Numerical Problems	30	
Practical Work		0
1. Course Laboratory	00	
2. Computer Laboratory	30	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or

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subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	×	×	×
CO-2	×	×	×
CO-3	×	×	×
CO-4	×	×	×
CO-5		×	×
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	--
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. **Essential Reading**
   1. Class Notes

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2. Varghese P. C., (2011), Advanced Reinforced Concrete Design, PHI learning private Limited, New Delhi.
3. Krishna Raju., (2008), Advanced R C Design, CBSRD, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
4. Bhavikatti S. S., (2008), Advanced RCC Design, New age international Pvt. Ltd.

b. Recommended Reading

1. Fintel., (2004), Handbook of Concrete Engineering, Van Nostrand Publications.
2. Punmia B. C., (2006), Reinforced concrete structures Vol. 1 and 2, Standard Publications.

c. Magazines and Journals

d. Websites

1. https://www.coursera.org/
2. http://nptel.ac.in/

e. Other Electronic Resources

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Course Specifications: Watershed Management

Course Title	Watershed Management
Course Code	CEE423A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals various aspects related to watershed management with main focus on effective utilization of all available watershed resources for better environment. The students will be taught integrated approach of watershed and water resources management. The students will be able to model various hydrological processes and able to design urban drainage system. Students will be sensitized to social aspects of watershed management. The students will able to address problems related to water quality, draught and come with solutions with perspective on recycle and reuse.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Describe basic concepts in watershed management
- **CO-2.** Explain sustainable integrated watershed and water resources management and watershed management practices with case studies
- **CO-3.** Discuss various hydrological process models, management of water quality, storm water, flood and draught with prospective of water recycle and reuse
- **CO-4.** Design urban drainage system
- **CO-5.** Discuss social aspects of watershed management with case studies

4. Course Contents

Unit 1 (Introduction and Basic Concepts): Concept of watershed, introduction to watershed management, different stakeholders and their relative importance, watershed management policies and decision making.

Unit 2 (Sustainable Watershed Approach & Watershed Management Practices): Sustainable Watershed Approach & Watershed Management Practices: Sustainable integrated watershed management, natural resources management, agricultural practices, integrated farming, Soil erosion and conservation; Watershed Management Practices in Arid and Semiarid Regions, Case studies, short term and long term strategic planning.

Unit 3 (Integrated Watershed Management): Introduction to integrated approach, Integrated water resources management, conjunctive use of water resources, rainwater harvesting; roof catchment system.

Unit 4 (Watershed Modeling): Standard modeling approaches and classifications, system concept for watershed modeling, overall description of different hydrologic processes, modeling of rainfall-runoff process, subsurface flows and groundwater flow.

Unit 5 (Social Aspects of Watershed Management): Community participation, Private sector participation, Institutional issues, Socio-economy, Integrated development, Water legislation and implementations, Case studies.

Unit 6 (Use of modern techniques in watershed management): Applications of Geographical Information System and Remote Sensing in Watershed Management, Role of Decision Support System in Watershed Management.

Unit 7 (Management of Water Quality): Water quality and pollution, types and Sources of pollution, water quality modeling, environmental guidelines for water quality. Storm Water and Flood Management: Storm water management, design of drainage system, flood routing through channels and reservoir, flood control and reservoir operation, case studies on flood damage. Drought Management: Drought assessment and classification, drought analysis techniques, drought mitigation planning.

Unit 8 (Water Conservation and Recycling): Perspective on recycle and reuse, Waste water reclamation.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1			3				2						3	2		
CO-2			3				2						3	2		
CO-3	3	2	3	2			3						3	3		
CO-4	2	2	3				2						3	2		
CO-5			3			3							3	3		

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

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6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		20
1. Solving Numerical Problems	20	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	×		×
CO-2	×	×	×
CO-3	×	×	×
CO-4	×	×	×
CO-5		×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

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The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.
Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. J. Krecek, M. Haigh, G. S. Rajwar, 2010, Integrated Watershed Management: Perspectives and Problems, Netherlands, Springer publication
3. Black Peter E., 1991, Watershed Hydrology, London, Prentice Hall

b. Recommended Reading

1. Murthy, J.V.S., 1994, Watershed Management in India, New Delhi, Wiley
2. American Society of Civil Engineers, 1975, Watershed Management, New York, American Society of Civil Engineers
3. Kenneth N. Brooks, Peter F. Ffolliott, Joseph A. Magner, Hydrology and the Management of Watersheds, New Delhi, Wiley

c. Magazines and Journals

d. Websites

e. Other Electronic Resources

1. Electronic resources on the course area are available on MSRUAS library

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Course Specifications: Construction Management and Engineering Economics

Course Title	Construction Management and Engineering Economics
Course Code	CEE424A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with various aspects of construction project management and their significance. Planning, scheduling and contractual procedures involved in a Civil Engineering project are also dealt. Student will be made familiar with the contract procedures and laws to be followed in the various stages of a construction project.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Identify and explain the concepts of construction projects, project management functions, Legal and regulatory requirements, and administration of contract
- **CO-2.** Solve scheduling and tracking problems of a construction project using suitable techniques
- **CO-3.** Discuss the procedures involved in undertaking technical, financial, economic and ecological feasibility studies for the preparation of construction project report.
- **CO-4.** Evaluate a construction project using economical methods like present worth, annual worth and future worth to develop the scope of work, plan various activities involved in a construction project, and optimize the construction projects using Big-M method
- **CO-5.** Optimize the construction projects using Simplex and transportation techniques
- **CO-6.** Prepare the tendering and contracting documents for infrastructure development projects covering technical, commercial and legal aspects

4. Course Contents

Unit 1 (Project Management): Construction projects- concepts, project categories, characteristics of projects, project life cycle phases; Project management function-selection of professional services, construction contractors, role of a project manager; Legal and regulatory requirements.

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Unit 2 (Construction Planning): Project formulation, capital investments, generation and screening of project ideas; Project identification, preliminary analysis, market, technical, financial, economic and ecological, prefeasibility report and its clearance; Basic concepts in the development of construction plans, choice of technology and construction method, organizational structure, project management tools, defining work tasks, defining precedence relationships among activities, estimating activity durations, estimating resource requirements for work activities, coding systems; Project control and review.

Unit 3 (Planning Process): Objectives, types of project plans, resource planning process; Project feasibility reports- introduction, significance of feasibility report- technical analysis, financial analysis, economic analysis, ecological analysis, flow diagram for feasibility study of a project; Detailed project report; Different project clearances required; Analysis of risk, different methods, selection of a project and risk analysis in practice.

Unit 4 (Scheduling Procedures and Techniques): Construction schedules- Critical Path Method, PERT, scheduling calculations, float, presenting project schedules, scheduling for Activity-on-Node and with leads-lags and windows.

Unit 5 (Economics for evaluating alternatives): Economics for evaluating alternatives- Present worth method, Annual worth method, Future worth method, Benefit-cost analysis, Breakeven analysis. Inventory Models: Deterministic and probabilistic inventory models.

Unit 6 (Optimization Techniques): Linear programming - application to production scheduling, material transportation and work assignment problems.

Unit 7 (Construction Contracts): Definitions, essentials for a legally valid contract, salient features of a contract, discharging of a contract; Documents for an engineering contract, International Contract Document, Standard Contract Document; Classification based on tendering process, economic consideration, tasks involved; Main and subcontracts, features, merits, demerits, applicability of various types of contract; Indian Contracts Act, design of contract, laws of torts.

Unit 8 (Tenders): Definitions, list of documents, Earnest Money Deposit, Security Deposit, preparation of enquiry documents; Invitation of tenders and sale of document, preparation of tender documents and its submission, receipt of tender documents and its opening, evaluation of tender from technical, contractual and commercial points of view, contract formation and interpretation. Issues in tendering process: Pre-registration, pre-qualification, nominated tendering, rejection of tenders, repeat orders, revocation of tenders, unbalanced bidding, cartel and collusion in tendering. Administration/ Performance of Contract: Responsibilities (duties and liabilities) of principal and contractor, monitoring and quality control/ assurance; Settlement of claims, advances, bills, extension of time, extras and variations, cost escalations, retention money, performance bond, liquidated damages, penalties; Statutory requirements, social obligations/ responsibilities, labour welfare, reports, records, files. Breach of Contract: Definition and classification, common breaches by – principal, contractor, damage assessment, claims for damages, Quantum Meruit, Force Majeure or frustration.

Unit 9 (Dispute Resolution): General methods of dispute resolution- negotiation, mediation, conciliation, dispute resolution boards, arbitration, litigation/adjudication by courts; Conciliation- appointment of conciliator, role of conciliator, special features of conciliation; Dispute Resolution Boards(DRB): Arbitration- comparison of actions and laws, agreements, module matter, violations, appointment of arbitrators, conditions of arbitrations, powers and duties of arbitrator, rules of evidence, enforcement of award, costs.

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Unit 10 (Legal requirements): Insurance and bonding, laws governing sale, purchase and use of urban and rural land, land revenue codes, tax laws, income tax, sales tax, excise and customs duties and their influence on construction costs, local government laws for approval; Labour regulations-social security, welfare legislation, laws relating to wages and bonuses, labour administration, insurance and safety regulations, Workmen's Compensation Act.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1			2			3							2	3		
CO-2	3	3	1		3								3	3		
CO-3					2	2								2		
CO-4	3	3			3								3	3		
CO-5	3	3			3								3	3		
CO-6						3								3		
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.																

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		38
Demonstrations		02
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		20
1. Solving Numerical Problems	20	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10

	Total Duration in Hours	70

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1	×		×
CO-2	×	×	×
CO-3	×	×	×
CO-4	×	×	×
CO-5	×	×	×
CO-6		×	×
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--

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15.	Leadership Skills	--

9. **Course Resources**

a. **Essential Reading**
   1. Class Notes
   2. Punmia B.C. and Khandelwal K.K., 2002 Project Planning and Control with PERT and CPM. Firewall Media.
   3. Hinze J., 2001, Construction Contracts, McGraw Hill.

b. **Recommended Reading**
   1. Feigenbaum L., 2002, Construction Scheduling with Primavera Project Planner Prentice
   2. Patil B.S., 2006, Civil Engineering Contracts and Estimates, Universities Press (India) Private Limited.
   3. Prakash V. A., 1997, Contracts Management in Civil Engineering Projects, NICMAR.
   4. John G. B., 1993, Engineering Contracts, McGraw Hills.

c. **Magazines and Journals**
   1. Engineering Construction and Architectural Management, Wiley
   2. Project Management Journal, Project Management Institute

d. **Websites**
   1. https://www.sciencedirect.com

e. **Other Electronic Resources**
   1. htpps://nptel.ac.in/

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Course Specifications: Environmental Impact Assessment

Course Title	Environmental Impact Assessment
Course Code	CEE425A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with the Environmental Impact Assessment (EIA). Students are taught concepts of environmental impact analysis, concept of planning and management of environmental impact studies, Environmental impact factors, Prediction and assessment of visual impacts and impacts on the socio-economic setting, Status of EIA in India, LCA. This course aims to train students in EIA, so they have general understanding of the process and sufficient knowledge to be involved professionally.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO 1.** Define and describe the concept of environmental impact and Life cycle Assessment.
- **CO 2.** Describe methods for impact Identification along with Environmental indices and indicators.
- **CO 3.** Explain the factors considered in impact assessment of water related projects, waste water treatment facilities.
- **CO 4.** Explain status of EIA in India and carbon trading.
- **CO 5.** Discuss prediction, assessment and it's on environment including visual impacts along with case studies.

4. Course Contents

Unit 1: Concepts of environmental impact assessment (EIA) - key features of the National Environmental Policy Act and its implementation, screening in the EIA process, role of the United State Environmental Protection Agency (USEPA), environmental protection and EIA at the national level, utility and scope of the EIA process

Unit 2: Planning and management of environmental impact studies Environmental impact - factors for consideration in assessing the impacts of water related projects, power projects, waste water treatment facilities etc.

Unit 3: Concepts and terms in the impact assessment process, socioeconomic impact analysis. Simple methods for impact identification – matrices, networks and checklists. Description of the environmental setting, Environmental indices and indicators for describing the affected environment.

Unit 4: Prediction and assessment of the impact on surface water, soil, groundwater, air, water quality, vegetation and wild life and biological environments. Case studies and examples.

Unit 5: Prediction and assessment of visual impacts and impacts on the socio-economic setting, decision methods for evaluation of alternatives, public participation in decision-making
Preparing the EIA document, Environmental monitoring.

Unit 6: Status of EIA in India: EIA Regulations in India, TOR for Hydropower Projects and other projects.
Case studies from hydropower projects, hazardous industries and mining.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3						3						3	3	
CO-2		3					3						3	3	
CO-3							3	3			3			3	3
CO-4							3							3	
CO-5	3	3					3						3	3	
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		35
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		10
1. Solving Numerical Problems	10	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	

5. Hospital	00	
6. Model Studio	00	
Others		10
1. Case Study Presentation	10	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
	Total Duration in Hours	**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	×		×
CO-2	×	×	×
CO-3	×	×	×
CO-4	×	×	×
CO-5		×	×
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	**Curriculum and Capabilities Skills**	**How imparted during the course**
1.	Knowledge	Class room lectures, Assignments
2.	Understanding	Class room lectures, Assignments

3.	Critical Skills	Class room lectures, Assignments
4.	Analytical Skills	Class room lectures, Assignments
5.	Problem Solving Skills	Class room lectures, Assignments
6.	Practical Skills	Class room lectures, Assignments
7.	Group Work	Class room lectures, Assignments
8.	Self-Learning	--
9.	Written Communication Skills	Assignment
10.	Verbal Communication Skills	Assignment
11.	Presentation Skills	Assignment, examination
12.	Behavioral Skills	--
13.	Information Management	--
14.	Personal Management	Course work
15.	Leadership Skills	Assignment, examination

9. Course Resources

a. Essential Reading

1. Class Notes
2. Arbara., Caroll., (2009), Environmental Impact Assessment Handbook: A Practical guide for Planners, Developers and Communities, Thomas Telford Ltd, London.
3. Evan K. Paleologos., Ian Lerche., (2001), Environmental Risk Analysis, McGraw Hill Inc.
4. Barrow C.J., (2002), Environmental & Social Impact Assessment – An Introduction, Edward Arnold Publication.
5. Peter Morris., Riki Therivel., Carpenter T.G., (2001), Environmental Impact Assessment, Routledge, London.

b. Recommended Reading

1. Larry W Canter., (1996), Environmental Impact Assessment, McGraw Hill, Inc.
2. Betty Bowers Marriot., (1997), Environmental Impact Assessment A Practical Guide, McGraw Hill, Inc.

c. Magazines and Journals

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d. Websites

https://nptel.ac.in

e. Other Electronic Resources

Electronic resources on the course area are available on MSRUAS library

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Course Specifications: Reinforced Soil Structures

Course Title	Reinforced Soil Structures
Course Code	CEE426A
Course Type	Professional Core Elective
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

This course deals with fundamentals of reinforced soil construction, basic mechanism and the various components. The basic concepts of Geosynthetics, their functions and applications are dealt with. Students are taught design philosophies and designs of reinforced soil retaining walls, reinforced soil foundation, soil nailing and in pavements. Filter design requirements and Geosynthetics for roads and slopes are also dealt in this course.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	70
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Describe basics of reinforced soil construction, mechanism, components and applications
CO-2. Explain Geosynthetics, their functions and applications
CO-3. Analyse and design a soil nailed structure
CO-4. Discuss the design philosophies of reinforced soil retaining wall, reinforced soil foundation and design them
CO-5. Discuss the filter criteria of Geosynthetics and their role in Landfills
CO-6. Design reinforced soil slopes and reinforced soil pavements

4. Course Contents

Unit 1 (Introduction): Fundamentals of reinforced earth construction-definition, historical background, components, mechanism and concept, advantages and disadvantages of reinforced earth construction.

Unit 2 (Geosynthetics and their functions): Geosynthetics and their functions- historical developments, recent developments, manufacturing process woven & non-woven, raw materials – polypropylene (polyolefin),polyethylene (polyoefin), polyester, polyvinyl chloride, elastomers, classification based on materials type – metallic and non-metallic, natural and

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man-made, geosynthetics – geotextiles, geogrids, geomembranes, geocomposites, geonets, geofoam, geomats, geomeshes, geowebs etc.

Unit 3 (Design of Retaining walls and foundations): Design of reinforced earth retaining walls - concept of reinforced earth retaining wall, internal and external stability, selection of materials, typical design problems

Design of reinforced earth foundations and embankments foundations - modes of failure of foundation, determination of force induced in reinforcement ties – location of failure surface, tension failure and pull out resistance, length of tie and its curtailment, bearing capacity improvement in soft soils, general guidelines. embankments - concept of reinforced embankments, internal and external stability, selection of materials, typical design problems

Unit 4 (Soil nailing): Soil nailing techniques - concept, advantages & limitations of soil nailing techniques, comparison of soil nailing with reinforced soil, methods of soil nailing, construction sequence, components of system, design aspects and precautions to be taken.

Unit 5 (Geosynthetics for landfills): Geosynthetics - filter, drain and landfills- filter & drain – conventional granular filter design criteria, geosynthetics filter design requirements, drain and filter properties, design criteria –soil retention, geosynthetic permeability, anticlogging, survivability and durability. Landfills –typical design of landfills – landfill liner & cover, EPA guidelines, barrier walls for existing landfills and abandoned dumps

Unit 6 (Geosynthetics for roads and slopes): Applications to temporary and permanent roads, role Of geosynthetic in enhancing properties of road, control of mud pumping, enhancing properties of subgrade, design requirements slopes – causes for slope failure, improvement of slope stability with geosynthetic, drainage requirements, construction technique.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)														
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	3											3		
CO-2		2											2		
CO-3	1	2		3									2	3	
CO-4	1		3										3		
CO-5	2	2	3			3						2	3	3	
CO-6			3										3		

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15

1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		**Component 2: SEE (40% Weightage)**
Subcomponent Type ▶	**Terms Tests**	**Assignments**	
CO-1	X		X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
CO-5	X	X	X
CO-6		X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

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8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignments
2.	Understanding	Class room lectures, Assignments
3.	Critical Skills	Class room lectures, Assignments
4.	Analytical Skills	Class room lectures, Assignments
5.	Problem Solving Skills	Class room lectures, Assignments
6.	Practical Skills	--
7.	Group Work	Assignment
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	Course work
13.	Information Management	Assignment, examination
14.	Personal Management	Course work
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Koerner. R.M., (2005), Design with Geosynthetics, Prince Hall Publication
3. Koerner. R.M. and Wesh, J.P., (1980), Construction and Geotechnical Engineering using Synthetic Fabrics, Wiley Inter Science, New York
4. Sivakumar Babu G. L., (2006), An Introduction to Soil Reinforcement and Geosynthetics, Universities Press, Hyderabad.
5. Swami Saran, I. K.(2010), Reinforced Soil and its Engineering Applications, International Pvt. Ltd, New Delhi
6. Venkattappa Rao, G., and Suryanarayana Raju, Engineering with Geosynthetics, TataMc Graw Hill publishing Company Limited., New Delhi.

b. Recommended Reading

1. Jones CJEP., (2008), Earth Reinforcement and Soil Structure, Butterworths, London
2. Ingold, T.S. & Millar K.S., Geotextile Hand Book, Thomas Telford, London.
3. Hidetoshi Óctial, Shigenori Hayshi & Jen Otani., (1992), Earth Reinforcement Practices Vol. I, Rotterdam
4. Bell F.G., (1987), Ground Engineer's Reference Book, Butterworths, London
5. Ingold. T.S., Reinforced Earth, Thomas, Telford, London.
6. Geosynthetics in Civil Engineering,(2007) Editor Sarsby R W, Woodhead Publishing Ltd. CRC Press

c. Magazines and Journals

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d. Websites

e. Other Electronic Resources

1. htpps://nptel.ac.in/

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Course Specifications: Data Analytics

Course Title	Data Analytics
Course Code	CSE431A
Course Type	Professional Core Elective
Department	Computer Science and Engineering
Faculty	Engineering and Technology

1. Course Summary

This course enables the students to design, develop, analyze and evaluate Data Analytics applications employing appropriate techniques, methods and technology. The role and application of Data Analytics in various application domains of computing is discussed. Knowledge Representation and modern Data Warehousing techniques and technologies are dealt in detail.
Machine Learning and Data Mining methods are employed for Knowledge Discovery in textual and other forms of structured and unstructured data. Students are trained in the use of modern techniques and technologies to develop Data Analytics applications.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:1:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Computer Science and Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Discuss data analytics application development using knowledge representation, data warehousing, machine learning and data mining techniques.
CO-2. Choose appropriate techniques and technology for data warehousing, machine learningand Da
CO-3. Design data analytics processes using data warehousing, machine learning and data mining techniques for knowledge representation and discovery.
CO-4. Analyze the data andthe performance of data analytics applications.
CO-4. Synthesize data analytics applications using machine learning and data

mining techniquesand enterprise platforms.

CO-6. Solve problems associated with large scale data analysis, machine learning and data

mining.

4. **Course Contents**

Unit 1 (Introduction): Data Analytics and its role in Business Intelligence and Knowledge Discovery.Data Analytics processes (Life Cycle): Preparation, Warehousing, Analysis, Mining, Validation and Performance Evaluation. Data Analytics tools and platforms

Unit 2 (Data Management):Data Definitions and Analysis Techniques, Elements, Variables, andData categorization, Levels of Measurement, Data management and indexing, Measures of centraltendency, Measures of location of dispersions, Normalization techniques.

Unit 3 (Big Data Processing): Traditional Data Base systems for data storage and processing. DataWarehousing and Analysis, Big Data. Modern platforms for data storage and processing: Cloud computing.

Unit 4: (Data Analysis Techniques): Regression analysis, Classification techniques, Clustering, Association rules analysis, Artificial neural networks, Handling of outliers and Anomalies, cross-validation and sensitivity analysis.

Unit 5: (Data Visualization): Text Mining, Mining other forms of data. Data Visualization andReporting: Concepts, methods and tools for enterprise data visualization and reporting.

5. **Course Map (CO-PO-PSO Map)**

	Programme Outcomes (POs)														
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	2	1		2		2		1					2		
CO-2	2	1				2		1					2		
CO-3	2	1				2		1			1	2	2		
CO-4	2	1	3	2	2	2		1			1	2	2		
CO-5	2	1	3	2	2	2		1			1	2	2	2	2
CO-6	2	1	3	2	2	2		1			1	2	2	2	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

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6. **Course Teaching and Learning Methods**

Teaching and Learning Methods	Duration in hours	Total Durationin Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	01	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	03	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
	Total Duration in Hours	**70**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type	Terms Tests	Assignments	
CO-1	X		X
CO-2	X		X
CO-3	X		X
CO-4		X	X
CO-5		X	X
CO-6		X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginningof the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching andlearning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--

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8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Course notes
2. Data Mining and Analysis, Mohammed J. Zaki, Wagner Meira, Cambridge, 2012.

b. Recommended Reading

1. Probability & Statistics for Engineers & Scientists (9th Edn.), Ronald E. Walpole,Raymond H. Myers, Sharon L. Myers and Keying Ye, Prentice Hall Inc.
2. The Elements of Statistical Learning, Data Mining, Inference, and Prediction (2ndEdn.), Trevor Hastie Robert Tibshirani Jerome Friedman, Springer, 2014
3. An Introduction to Statistical Learning: with Applications in R, G James, D. Witten,T Hastie, and R. Tibshirani, Springer, 2013
4. Mining Massive Data Sets, A. Rajaraman and J. Ullman, Cambridge UniversityPress, 2012
5. Advances in Complex Data Modeling and Computational Methods in Statistics,Anna Maria Paganoni and Piercesare Secchi, Springer, 2013
6. Hadoop: The Definitive Guide (2nd Edn.) by Tom White, O'Reilly, 2014.

c. Magazines and Journals

1. Analytics Magazine from INFORMS
2. Big Data Open Access Journal

d. Websites

1. http://flowingdata.com/Abbott Analytics
2. http://abbottanalytics.blogspot.com/

e. Other Electronic Resources

1. How it works: Analytics: http://youtu.be/_HbjsNaUJ2A
2. A brief history of intelligence: http://youtu.be/yVIcIRcAhxc
3. What can Business Analytics Do for You? http://youtu.be/uP89kaDU40c

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Course Specifications: Internship

Course Title	Internship
Course Code	CEI401A
Course Type	Internship
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

Student can undergo internship in an industry, business organization, research organization or any other university on a topic of relevance during vacation after 6th semester with prior approval from the department head and faculty dean.

2. Course Size and Credits:

Number of Credits	0
Credit Structure (Lecture: Tutorial: Practical)	0:0:4
Total Hours of Interaction	120
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Write a report on experiences during internship
CO-2. Make a presentation to a panel of examiners

4. Course Contents

Collection of relevant literature and review of literature

Interaction with the users and collection of data

Data Analysis, Formulation of a problem of suitable size

Writing down the design specifications
Detail design calculations

Choosing a modelling environment, learning the appropriate tools and techniques

Modelling, simulation and analysis of design

Defining performance parameters, Evaluation of performance, presentation performance characteristics, Verification of results

Demonstration to the defined audience and making a presentation to the assessing team

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5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1												3			3
CO-2											3				3
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Total Duration in Hours
Literature collection, Review of literature, Deciding the sample for data collection, Developing a questionnaire, Data collection, Analysis of data, Problem formulation and Defining specifications	20
Development of design concept, Basic design calculations	20
Selection of tools, techniques and learning on how to use them	20
Modelling, Simulation, Analysis	20
Evaluation, Verification of results	20
Demonstration, Presentation and Technical Report Writing	30
Total duration in hours	130

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

For Theory Courses Only		
Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: (50% Weightage)	Component 2: Internship Report (50% Weightage)
Subcomponent Type ▶	Internship Presentation	
CO-1	x	x
CO-2	x	x
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.		

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

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8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Internship work
2.	Understanding	
3.	Critical Skills	Internship work
4.	Analytical Skills	Internship work
5.	Problem Solving Skills	Internship work
6.	Practical Skills	Internship work
7.	Group Work	Internship work
8.	Self-Learning	Internship work
9.	Written Communication Skills	Internship work
10.	Verbal Communication Skills	Internship work
11.	Presentation Skills	Internship work presentation and viva voce
12.	Behavioral Skills	Internship work
13.	Information Management	Internship work
14.	Personal Management	Internship work
15.	Leadership Skills	Internship work

9. Course Resources

a. Essential Reading

1. Presentations made by the Head of the Department on "Importance of Internship and The Methodology to be followed for successful Completion of Internship"

b. Recommended Reading

1. Course Notes, Manuals of Tools and Techniques Chosen to Solve the Design Problem.

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Course Specifications: Project Work - 1

Course Title	Project Work - 1
Course Code	CEP401A
Course Type	Project
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

Student can undergo internship in an industry, business organization, research organization or any other university on a topic of relevance during vacation after 6th semester with prior approval from the department head and faculty dean.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	0:0:4
Total Hours of Interaction	120
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (Cos)

After the successful completion of this course, the student will be able to:

- **CO-1.** Recognise the need for developing a new or improving an existing engineering product/system through an organised survey of literature
- **CO-2.** Define engineering design specifications
- **CO-3.** Design, model, solve, analyse the product/system to meet the design specifications
- **CO-4.** Evaluate the performance of the modelled system and justify its performance
- **CO-5.** Demonstrate the system working in a virtual environment and make a presentation
- **CO-6.** Write a technical report

4. Course Contents

Collection of relevant literature and review of literature

Interaction with the users and collection of data

Data Analysis, Formulation of a problem of suitable size

Writing down the design specifications
Detail design calculations

Choosing a modelling environment, learning the appropriate tools and techniques

Modelling, simulation and analysis of design

Defining performance parameters, Evaluation of performance, presentation performance characteristics, Verification of results

Demonstration to the defined audience and making a presentation to the assessing team

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (Pos)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1		3				2						3	3	2	
CO-2	3												3		2
CO-3		3	2	2				2			1		3	2	2
CO-4				3	2						1			3	1
CO-5									3	3	3				3
CO-6										3					3
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Total Duration in Hours
Literature collection, Review of literature, Deciding the sample for data collection, Developing a questionnaire, Data collection, Analysis of data, Problem formulation and Defining specifications	20
Development of design concept, Basic design calculations	20
Selection of tools, techniques and learning on how to use them	20
Modelling, Simulation, Analysis	20
Evaluation, Verification of results	20
Demonstration, Presentation and Technical Report Writing	30
Total duration in hours	130

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

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For Theory Courses Only		
Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: (50% Weightage)	Component 2: Project Report (50% Weightage)
Subcomponent Type ▶	Project Presentation	
CO-1	X	X
CO-2	X	X
CO-3	X	X
CO-4	X	X
CO-5	X	X
CO-6	X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.		

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Project work
2.	Understanding	Project work
3.	Critical Skills	Project work
4.	Analytical Skills	Project work
5.	Problem Solving Skills	Project work
6.	Practical Skills	Project work
7.	Group Work	Project work
8.	Self-Learning	Project work
9.	Written Communication Skills	Project work
10.	Verbal Communication Skills	Project work
11.	Presentation Skills	Project work presentation and viva voce
12.	Behavioral Skills	Project work
13.	Information Management	Project work
14.	Personal Management	Project work
15.	Leadership Skills	Project work

9. Course Resources

a. **Essential Reading**

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1. Presentations made by the Head of the Department on "Importance of Project work and The Methodology to be followed for successful Completion of Project work"

b. Recommended Reading

1. Course Notes, Manuals of Tools and Techniques Chosen to Solve the Design Problem.

Course Specifications
(8th Semester)

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Course Specifications: Project Work - 2

Course Title	Project Work - 2
Course Code	CEP402A
Course Type	Project
Department	Civil Engineering
Faculty	Engineering and Technology

1. Course Summary

Student can undergo internship in an industry, business organization, research organization or any other university on a topic of relevance during vacation after 6th semester with prior approval from the department head and faculty dean.

2. Course Size and Credits:

Number of Credits	12
Credit Structure (Lecture: Tutorial: Practical)	0:0:12
Total Hours of Interaction	360
Number of Weeks in a Semester	15
Department Responsible	Civil Engineering
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (Cos)

After the successful completion of this course, the student will be able to:

CO-1. Recognise the need for developing a new or improving an existing engineering product/system through an organised survey of literature
CO-2. Define engineering design specifications
CO-3. Design, model, solve, analyse the product/system to meet the design specifications
CO-4. Evaluate the performance of the modelled system and justify its performance
CO-5. Demonstrate the system working in a virtual environment and make a presentation
CO-6. Write a technical report

4. Course Contents

Collection of relevant literature and review of literature

Interaction with the users and collection of data

Data Analysis, Formulation of a problem of suitable size

Writing down the design specifications
Detail design calculations

Choosing a modelling environment, learning the appropriate tools and techniques

Modelling, simulation and analysis of design

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Defining performance parameters, Evaluation of performance, presentation performance characteristics, Verification of results

Demonstration to the defined audience and making a presentation to the assessing team

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (Pos)												Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1		3				2						3	3	2	
CO-2	3												3		
CO-3		3		2							1	2	3	2	2
CO-4				3	2						1			3	1
CO-5									1	3	1				3
CO-6										3					3

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Total Duration in Hours
Literature collection, Review of literature, Deciding the sample for data collection, Developing a questionnaire, Data collection, Analysis of data, Problem formulation and Defining specifications	40
Development of design concept, Basic design calculations	40
Selection of tools, techniques and learning on how to use them	40
Modelling, Simulation, Analysis	40
Evaluation, Verification of results	40
Demonstration, Presentation and Technical Report Writing	50
Total duration in hours	250

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the B. Tech. Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

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For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (50 % Weightage)		Component 2: Project Report (40% Weightage)
Subcomponent Type ▶	Interim Presentation	Final Presentation	
CO-1	X	X	X
CO-2	X	X	X
CO-3	X	X	X
CO-4	X	X	X
CO-5	X	X	X
CO-6	X	X	X
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Project work
2.	Understanding	Project work
3.	Critical Skills	Project work
4.	Analytical Skills	Project work
5.	Problem Solving Skills	Project work
6.	Practical Skills	Project work
7.	Group Work	Project work
8.	Self-Learning	Project work
9.	Written Communication Skills	Project work
10.	Verbal Communication Skills	Project work
11.	Presentation Skills	Project work presentation and viva voce
12.	Behavioral Skills	Project work
13.	Information Management	Project work
14.	Personal Management	Project work
15.	Leadership Skills	Project work

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9. **Course Resources**

   a. **Essential Reading**
   Presentations made by the Head of the Department on "Importance of Project work and The Methodology to be followed for successful Completion of Project work"

   b. **Recommended Reading**
   Course Notes, Manuals of Tools and Techniques Chosen to Solve the Design Problem.

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