CHRIST
(DEEMED TO BE UNIVERSITY)
BANGALORE · INDIA

SCHOOL OF ENGINEERING AND TECHNOLOGY

Department of Civil Engineering

SYLLABUS
M.TECH- STRUCTURAL

ENGINEERING 2020-22

CHRIST (Deemed to be University), Bengaluru
Karnataka, India
www.christuniversity.in

Syllabus for MTech-Structural Engineering-2020-22 prepared by the Department of Civil Engineering, Faculty of Engineering and approved by the Academic Council, CHRIST (Deemed to be University), Bengaluru, India.

Published by the Centre for Publications, CHRIST (Deemed to be University), Hosur Road, Bengaluru 560 029, India. publications@christuniversity.in

2020

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DEPARTMENT OVERVIEW

Civil engineering courses are designed to meet the needs of modern Civil Engineering fields like Construction Technology, Geo-Technical Engineering, Irrigation Engineering, Transportation Engineering, Structural Engineering, Environmental Engineering, etc. By the time students complete this course, they will be fully trained to analyze and design the complicated structures,

Program Outcomes of Civil Engineering Department

- An ability to apply knowledge of mathematics, science, and engineering.
- An ability to design and conduct experiments, as well as to analyze and interpret data
- An ability to design a system, component, or process to meet the desired needs.
- An ability to function on multi-disciplinary teams.
- An ability to identify, formulate and solve the engineering problems.
- An understanding of professional and ethical responsibilities.
- An ability to communicate effectively
- The broad education necessary to understand the impact of engineering solutions in a global and societal context
- Recognition of the need for and an ability to engage in life-long learning Knowledge of contemporary issues.
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

DEPARTMENT VISION

Serve and excel in the constantly changing societal needs with ethics and integrity.

DEPARTMENT MISSION

- To create awareness of societal needs and ethics in the dynamic environment.
- To impart contemporary knowledge to achieve excellence in academics and profession through the experience of lifelong learning.
- To carry out research in collaboration with research organizations and industry to add value to the profession and society at large.
- Instill leadership qualities, communication skills and team sprit to meet challenges in the global environment

Programme Specific Objectives: Graduates of the program will

1. Analyse and Design structural systems Statement: Analyse, design, construct and manage sustainable structural systems
2. Investigate civil engineering materials Statement: Investigate properties of civil engineering materials
3. Modern Surveying Statement: Plan for buildings, maps, and alignments for canals and roads using modern surveying instruments.

PROGRAMMES OFFERED

- **Undergraduate Programmes** (B. Tech, 8 Semester Program)
    - Bachelor of Technology in Automobile Engineering (AE)
    - Bachelor of Technology in Civil Engineering (CE)
    - Bachelor of Technology in Computer Science and Engineering (CSE)
    - Bachelor of Technology in Electronics and Communication Engineering (ECE)
    - Bachelor of Technology in Electrical and Electronics Engineering (EEE)
    - Bachelor of Technology in Information Technology (IT)
    - Bachelor of Technology in Mechanical Engineering (ME)

- **Postgraduate Programmes** (M. Tech, 4 Semester Program)
    - Master of Technology in Computer Science & Engg.
    - Master of Technology in Communication Systems
    - Master of Technology in Information Technology
    - Master of Technology in Machine Design
    - Master of Technology in Power Systems
    - Master of Technology in Structural Engineering

- **Doctoral Programmes (Ph.D.)** (Doctor of Philosophy)
    - Doctor of Philosophy (Ph.D.) in Computer Science and Engineering
    - Doctor of Philosophy (Ph.D.) in Electronics and Communication Engg.
    - Doctor of Philosophy (Ph.D.) in Civil Engineering
    - Doctor of Philosophy (Ph.D.) in Electrical and Electronics Engineering
    - Doctor of Philosophy (Ph.D.) in Mechanical Engineering
    - Doctor of Philosophy (Ph.D.) in Information Technology

1. ELIGIBLITY CRITERIA

❖ **For Undergraduate Programmes**

A pass in PUC (10+2) or equivalent with 50% marks in aggregate with Mathematics, Physics and Chemistry is the minimum eligibility for admission

Lateral Entry:

Candidates who have successfully completed 3 year diploma in Engineering are eligible to apply for lateral entry into:

- Automobile Engineering (AE)
- BTech Civil Engineering, (CE)
- BTech Mechanical Engineering, (ME)
- BTech Computer Science & Engineering, (CSE)
- BTech Electronics & Communication Engineering. (ECE)

- BTech Electrical and Electronics Engineering (EEE)
- BTech Information Technology (ITE)

Candidates will be admitted to second year of the programme only after appearing the Christ University selection process for engineering programmes.

- **For Postgraduate Programmes**:
  - For Master of Technology in Computer Science & Engineering
    - A Pass in B. Tech/B.E or M. Sc with 55% aggregate.
  - For Master of Technology in Communication Systems
    - A Pass in B. Tech/B.E or M. Sc in Electronics and VLSI Design with 55% aggregate.
  - For Master of Technology in Civil Engineering
    - A Pass in BE/BTech or M. Sc. in Civil with 55% aggregate.
  - For Master of Technology in Mechanical Engineering
    - A Pass in BE/BTech in mechanical engineering

- **For Doctoral Programmes (Ph.D.):**
  - A pass with 55% marks in post graduation and equivalent in the relevant subject from any recognized university.
  - A research proposal (Maximum 1500 words) has to be submitted along with the application.

2. SELECTION PROCESS

1) Candidates can process the admission based on the Undergraduate Entrance Test and Ranking by COMEDK.

OR

2) Christ University Selection Process as given below:

Process	Particulars	Date	Venue/Centre
Entrance Test	Christ University Entrance test for each candidate	As per the E- Admit Card	As per the E-Admit Card
Personal Interview	Personal interview for 15 minutes for each candidate by an expert	As per the E- Admit Card	As per the E-Admit Card
Academic Performance	Assessment of past performance in Class 10, Class 11/12 during	As per the E- Admit Card	As per the E-Admit Card

ADMISSION PROCESS

Candidates will be intimated about the Selection status (Selected/Wait Listed/Not Selected) through the University Notice Board/on the "Application Status" link on University website. The Selection results will be declared within 24 hours of Personal Interview session.

The selected candidates must process admission at **Office of Admissions, Central Block, Christ University within 3 working days of declaration of Selection Process results/as per the stipulated date and time mentioned by Office of Admissions.**

Selected candidates should collect the Fee Challan from the Office of Admissions and remit the Annual fee at the South Indian Bank, Christ University Branch. The **Offer of Admission** will stand cancelled, if failing to remit the fee within the stipulated date and time. **Admission will not be processed without the presence of the candidate and the mandatory original documents mentioned below;**

1. The Offer of Admission Card (E-Admission Card/Mail)
2. Class 10 Marks Statement
3. Class 11 Marks Statement, if Candidate is pursuing class 12 and appearing for final examination during March-April Month
4. Class 12 Marks Statement, if candidate has appeared and passed the Class 12 examination

The University ID card is a smart card, which is both an ID card as well as a South Indian Bank ATM card with a chip containing the student personal details. All transactions within the University campus after commencement of classes, including fees payment will be processed only through this card. It is also an access card for Library and other restricted places. Candidates are advised to collect the South Indian Bank account opening form along with fees challan and process it at the Bank branch within the University premises.

Candidates who fall under International student category (ISC), If selected, should register with the Foreigner Regional Registration Officer (FRRO/FRO) of the Local Police in Bangalore, India within 14 working days from the date of admission or arriving in Bangalore. All International student category (ISC) candidates if studied in India should obtain an NOC from the previous qualifying institution.

GENERAL RULES

- There is a grading scheme for each paper and for all the courses.
- All marks will indicate the marks, percentage obtained, grade and grade point average.
- The grade point average will be calculated as follows: for each subject, multiply the grade point with the number of credits; divide the sum of product by the total number of credits.
- The CGPA [Cumulative GPA] is calculated by adding the total number of earned points [GP x Cr] for all semesters and dividing by the total number of credit hours for all semesters.

$$\text{CGPA} = \frac{\sum[\text{GPA} \times \text{Cr}]}{\sum \text{Cr}}$$

GRADING SCHEME FOR EACH PAPER: POSTGRADUATE COURSES

Percentag	Grad	Grade	Interpretation	Class
80 and	A+	4.0	Excellent	First Class with
70-79	A	3.5	Very Good	
65-69	B+	3.0	Good	First Class
60-64	B	2.5	Above Average	
55-59	C+	2.0	Average	Second Class
50-54	C	1.5	Satisfactory	
40-49	C-	1.0	Exempted if aggregate is more	Pass Class
39 and	F	0	Fails	Fail

3. PROGRAMME OVERVIEW

Post Graduate Education and Research in Engineering and Technology has become important in the context of challenges and opportunities in National development. CHRIST (Deemed to be University) subscribes to the view that a master's degree is primarily industry-focused, though it can be used as a steppingstone for research as well. The decision whether the degree is to be pursued for skill and knowledge up-gradation or also for building research skills should rest with the student

An educational institution that does not respond to the present requirement and changes and does not lead to research will remain on the wayside of the higher education missing the opportunities for going beyond. The advances in engineering sciences and their applications has made paradigm shift from undergraduate to post graduate level education in engineering and technology. The advances in engineering sciences and their applications has made paradigm shift from undergraduate to post graduate level education in engineering and technology. The knowledge, skills and competency of engineers required by industry for enhancing their competitiveness in the market need to be developed from post graduate education and research in engineering and technology

An educational institution that does not respond to the present requirement and changes and does not lead to research will remain on the wayside of the higher education missing the opportunities for going beyond. Keeping our vision "Excellence and Service", Engineering Science introduces student model PG curriculum developed by AICTE as it has feedback from experts from industry, research organizations and other eminent engineers to make it relevant, dynamic and updated.

PROGRAMME OBJECTIVE:

The M. Tech. course aims to fulfill the following broad objectives:

1. Student will be able to carry out research /investigation and development work to solve practical problems independently
2. Student will be able to write and present a substantial technical report/document
3. Students will be able to demonstrate a degree of mastery over the structural engineering

During the course students will learn to balance between the development of understanding and mastering of solution techniques with emphasis being on the development of student's ability to use Science and Mathematics with understanding to solve Engineering problems by retaining the philosophy of "learning by doing".

TEACHING PEDAGOGY

Our teaching methodology ensures that students are being exposed to a holistic education experience in an active and dynamic learning environment, giving them the opportunity to identify and realize their potential, and to achieve excellence. In order to realize the objectives, a methodology based on the combination of the following will be adopted:

- Team/Classroom teaching.
- PowerPoint presentations and handouts.
- Simulated situations and role-plays.
- Video films on actual situations.
- Assignments.
- Case Studies.
- Exercises are solved hands on.
- Seminars
- Industry / Field visits.
- Information and Communication Technology.
- Project work.
- Learning Management System.

ASSESSMENT RULES:

Assessment is based on the performance of the student throughout the semester.

Assessment of each paper

- Continuous Internal Assessment (CIA) for Theory papers: 50% (50 marks out of 100 marks)
- End Semester Examination (ESE) : 50% (50 marks out of 100 marks)

Components of the CIA

CIA I: Assignments	: 10 marks
CIA II: Mid Semester Examination (Theory)	: 25 marks
CIA III: Quizzes/Seminar/Case Studies/Project Work	: 10 marks
Attendance	: 05 marks
Total	**: 50 marks**

For subjects having practical as part of the subject

End semester practical examination	: 25 marks
Records	: 05 marks
Mid semester examination	: 10 marks
Class work	: 10 marks
Total	**: 50 marks**

Mid semester practical examination will be conducted during regular practical hour with prior intimation to all candidates. End semester practical examination will have two examiners an internal and external examiner.

Assessment of Project Work (Phase I)

- Continuous Internal Assessment:100 Marks
  - Presentation assessed by Panel Members
  - Guide
  - Mid-semester Project Report

Assessment of Project Work (Phase II) and Dissertation

- Continuous Internal Assessment:100 Marks
  - Presentation assessed by Panel Members

- Guide
- Mid semester Project Report

- End Semester Examination:100 Marks
  - Viva Voce
  - Demo
  - Project Report
- Dissertation (Exclusive assessment of Project Report): 100 Marks
  - Internal Review: 50 Marks
  - External Review: 50 Marks

Assessment of Seminar

- Continuous Internal Assessment: 50 Marks
  - Presentation assessed by Panel Members

Assessment of Internship (M. Tech)

All students should complete internship either in Industry/Research labs before 3rd semester. This component carries 2 credits.

- Continuous Internal Assessment: 2 credits
  - Presentation assessed by Panel Members

QUESTION PAPER PATTERN:

End Semester Examination (ESE):

Theory Papers:

The ESE is conducted for 100 marks of 3 hours duration.

The syllabus for the theory papers is divided into FIVE units and each unit carries equal weightage in terms of marks distribution.

Question paper pattern is as follows.

Two full questions with either or choice will be drawn from each unit. Each question carries 20 marks. There could be a maximum of three subdivisions in a question. The emphasis on the questions is broadly based on the following criteria:

- 50 % - To test the objectiveness of the concept
- 30 % - To test the analytical skill of the concept
- 20 % - To test the application skill of the concept

Laboratory / Practical Papers:

The ESE is conducted for 50 marks of 3 hours duration. Writing, Execution and Viva – voce will carry weightage of 20, 20 and 10 respectively.

Mid Semester Examination (MSE):

Theory Papers:

The MSE is conducted for 50 marks of 2 hours duration.

Question paper pattern; Two parts Part A and Part B. Part A has 4 questions which has to be answered fully and in Part B One Question out of Two Questions. Each question carries 10 marks.

Laboratory / Practical Papers:

The ESE is conducted for 50 marks of 2 hours duration. Writing, Execution and Viva – voce will carry weight age of 20, 20 and 10 respectively.

COURSE STRUCTURE:
Batch 2020-2022

I Semester

Sl. No	Type	Code	Course Name	L Hrs.	T Hrs.	P Hrs.	Credits
1	PCC	MTCE131	Advanced Structural Analysis	3	0	0	3
2	PCC	MTCE132	Advanced Solid	3	0	0	3
3	PEC	MTCE133	Elective – I	3	0	0	3
4	PEC	MTCE134	Elective – II	3	0	0	3
5	PCC	MTCE151	Structural Design Lab	0	0	2	2
6	PCC	MTCE152	Advanced Concrete Lab	0	0	2	2
7	MLC	MLC136	Research Methodology and	2	0	0	2
8	Audi	AC131	Audit Course I	2	0	0	0
9	MC	HE171	Holistic education	1	0	0	1
			Total				**19**

II Semester

Sl. No	Type	Code	Course Name	L Hrs.	T Hrs.	P Hrs.	Credits
1	PCC	MTCE231	FEM in Structural	3	0	0	3
2	PCC	MTCE232	Structural Dynamics	3	0	0	3
3	PEC	MTCE233	Elective – III	3	0	0	3
4	PEC	MTCE234	Elective – IV	3	0	0	3
5	PCC	MTCE251	Model Testing Lab	0	0	2	2
6	PCC	MTCE252	Numerical Analysis Lab	0	0	2	2
7	PCC	MTCE272	Mini Project	0	0	4	2
8	Audit	AC231	Audit Course-2	2	0	0	0
9	MC	HE271	Holistic education	1	0	0	1
			Total				**19**

III Semester

Sl. No	Type	Code	Course Name	L Hrs.	T Hrs.	P Hrs.	Credits
1	PEC	MTCE331	Elective – V	3	0	0	3
2	OEC	MTCE332	Open Elective	3	0	0	3
3	PROJ	MTCE371	Dissertation Phase – I	0	0	0	10
			Total				**16**

IV Semester

Sl. No	Type	Code	Course Name	L Hrs.	T Hr	P Hrs.	Credits
1	PROJ	MTCE471	Project Work (Phase II) and Dissertation	3	0	32	16
			Total				**16**

Elective – I
A. 1. Theory of Thin Plates and Shells
B. 2. Theory and Applications of Cement Composites
C. 3. Theory of Structural Stability

Elective – II
1. Analytical and Numerical Methods for Structural Engineering
2. Structural Health Monitoring
3. Structural Optimization

Elective – III
1. Advanced Steel Design
2. Design of Formwork
3. Design of High-Rise Structures
4. Design of Masonry Structures

Elective – IV
1. Design of Advanced Concrete Structures
2. Advanced Design of Foundations
3. Soil Structure Interaction
4. Design of Industrial Structure

Elective – V

1. Design of Plates and Shells
2. Analytical and Finite Element Analysis of Laminated Composite
3. Fracture Mechanics of Concrete Structures
4. Design of Prestressed Concrete Structure

Open Elective
1. Business Analytics
2. Industrial Safety
3. Operations Research
4. Cost Management of Engineering Projects
5. Composite Materials
6. Waste to Energy

Audit Course 1 & 2
1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

III Semester

Sl. No	Type	Code	Course Name	L Hrs.	T Hrs.	P Hrs.	Credits
1	PEC	MTCE331	Elective – V	3	0	0	3
2	OEC	MTCE332	Open Elective	3	0	0	3
3	PROJ	MTCE371	Dissertation Phase – I	0	0	0	10
			Total				**16**

IV Semester

Sl. No	Type	Code	Course Name	L Hrs.	T Hr	P Hrs.	Credits
1	PROJ	MTCE471	Project Work (Phase II) and Dissertation	3	0	32	16
			Total				**16**

2019 Batch

Elective – I
A. 1. Theory of Thin Plates and Shells
B. 2. Theory and Applications of Cement Composites
C. 3. Theory of Structural Stability

Elective – II
1. Analytical and Numerical Methods for Structural Engineering
2. Structural Health Monitoring
3. Structural Optimization

Elective – III
1. Advanced Steel Design
2. Design of Formwork
3. Design of High-Rise Structures
4. Design of Masonry Structures

Elective – IV
1. Design of Advanced Concrete Structures
2. Advanced Design of Foundations
3. Soil Structure Interaction
4. Design of Industrial Structure

Elective – IV
1. Design of Advanced Concrete Structures
2. Advanced Design of Foundations
3. Soil Structure Interaction
4. Design of Industrial Structure

Elective – V
1. Design of Plates and Shells
2. Analytical and Finite Element Analysis of Laminated Composite
3. Fracture Mechanics of Concrete Structures
4. Design of Prestressed Concrete Structure

Open Elective
1. Business Analytics
2. Industrial Safety

3. Operations Research
4. Cost Management of Engineering Projects
5. Composite Materials
6. Waste to Energy

Audit Course 1 & 2
1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

DETAILED SYLLABUS

Course Name: Advanced Structural Analysis					
Course Code: MTCE131					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam**	**3**
Course objectives: The objective of this course to analyse the structures using stiffness method and approximate methods.					
Prerequisites: Structural Analysis-I and Structural Analysis-II					

Units	**Teaching**
Unit-1 Matrix Flexibility Method	
Introduction: Structural Engineering, steps involved in structural engineering. Concepts of stiffness and flexibility. **FLEXIBILITY METHOD:** Force-transformation matrix – Development of global flexibility matrix for continuous beams, plane trusses and rigid plane frames (having not more than six co-ordinates – 6 x 6 flexibility matrix). Analysis of continuous beams, plane trusses and rigid plane frames by flexibility method (having not more than 3 coordinates – 3 x 3 flexibility matrix) Effects of temperature change and lack of fit. Related numerical problems by flexibility method.	9
Unit-2 Matrix Stiffness Method	
Stiffness method: Displacement-transformation matrix – Development of global stiffness matrix for continuous beams, plane trusses and rigid plane frames (having not more than six co-ordinates – 6 x 6 stiffness matrix). Analysis of continuous beams, plane trusses and rigid plane frames by stiffness method (having not more than 3 coordinates – 3 x 3 stiffness matrix) Effects of temperature change and lack of fit. Related numerical problems	9
Unit-3 Curved Beams	
Curved beams: Introduction to curved beams &assumptions, WINKLER BACH equations, Limitation, Radius of neutral surface of rectangular, triangular sections, Trapezoidal and circular sections, Stress distribution on open curved members, hooks. Stress distribution in closed rings, Deformations of open, thin curved members, problems on thin curved members, Deformations of closed thin curved members such as rings, ,	9
Unit-4 Beams on Elastic Foundation	
Beams on elastic foundations: Differential equation of elastic line, interpretation of constants of integration, infinite beam with concentrated load, infinite beam with moment UDL, infinite beam problems, semi-	10

concentrated load and moment, semi-infinite beam with fixed and hinged conditions, problems on semi-infinite beams, finite beams with symmetrical load, problems on symmetrical load, finite beams with unsymmetrical load, problems on unsymmetrical load.	
Unit-5 Tension Coefficient Method	
Tension coefficient method: introduction to tension coefficient method. Application of TCM to 2D frames, Application of TCM to 3D frames, problems on 3D frames.	8
Self-study: Nil	
Site/Industrial Visits : Nil	
Course outcomes: At the end of the course, students will be able to **CO1. Analyze the skeletal structures using flexibility method** **CO2. Analyze the skeletal structures using stiffness methods** **CO3. Analyse curved beam** **CO4: Analyse beam on elastic foundation** **CO5: Analyse space frame by tension coefficient method**	
Reference Books: R1. Matrix Analysis of Framed Structures, Weaver and Gere. R2. The Finite Element Method, Lewis P. E. and WardJ. P., Addison-Wesley Publication Co. R3. Computer Methods in Structural Analysis, MeekJ. L., E and FN, Span Publication. R4. The Finite Element Method, Desai and Able, CBS Publication.	
Online Resources: W1. https://nptel.ac.in/courses/122102004/5 W2. https://nptel.ac.in/downloads/105101085	

Course Name: Advanced Solid Mechanics

Course Code: MTCE132

	L	T	P	Category	PCC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam**	3

Course objectives: The objective of this course is to make students to learn principles of Analysis of Stress and Strain, to predict the stress-strain behaviour of continuum. To evaluate the stress and strain parameters and their inter relations of the continuum.

Prerequisites: Engineering Mathematic, Strength of Materials

Units	**Teaching**
Unit-1 Introduction to Elasticity:	
Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity. *Strain and Stress Field:* Elementary Concept of Strain, Stain at a Point, Principal Strains and Principal Axes, Compatibility Conditions,	9
Unit-2 Strain and Stress Field :	
Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic and Deviatoric Components. *Equations of Elasticity:* Equations of Equilibrium, Stress- Strain relations, Strain Displacement and Compatibility Relations, Boundary Value Problems, Co- axialIty of the Principal Directions.	9
Unit-3 Two-Dimensional Problems of Elasticity	
Plane Stress and Plane Strain Problems, Airy's stress Function, Two-Dimensional Problems in Polar Coordinates.	9
Unit-4 Torsion of Prismatic Bars	
Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, Torsion of Thin Tubes.	9
Unit-5 Plastic Deformation	
Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.	9

Self-study: Modern developments: thermo elasticity, electromagnet elasticity, micro-elasticity

Site/Industrial Visits: Nil

Course outcomes:

CO1: **Apply** the classical theory of Elasticity in two and three dimensional state of stress. (L3)

CO2: **Analyze** the behavior of solids under different loads in Cartesian coordinate system. (L4)

CO3: **Evaluate** the stress and strain in two and three dimensional problems in polar coordinate systems.(L5)

CO4: **Analyze** the behavior of different shapes of solids under torsion.(L4)

CO5: **Apply** the classical theory of plasticity in two and three dimensional state of stress.

Reference Books:

R1. Timoshenko, S. and Goodier T.N. "*Theory of Elasticity*", McGraw Hill International Editions, New Delhi, Third Edition, 1970.

R2. Srinath. L.S, *"Advanced Mechanics of Solids"*, Tata McGraw Hill, New Delhi, Third Edition, 2011.

R3. Sadhu Singh, "*Theory of Elasticity*", Khanna Publishers, Khanna Publishers, New Delhi.

R4. Chenn, W.P. and Henry D.J. "*Plasticity for Structural Engineers*", Springer Verlag New York 1988

R5. Valliappan C, *"Continuum Mechanics Fundamentals"*, Oxford IBH Publishing Co. Ltd, New Delhi.

R6. Xi Lu, *"Theory of Elasticity"*, John Wiley, New Delhi.

R7. Sadhu Singh. *"Applied Stress Analysis"*, Khanna Publishers, New Delhi

R8. Verma. P.D.S, *"Theory of Elasticity"*,Vikas,Publishing House, NeW Delhi, 1997.

R9. Sadd. M. H, *"Elasticity Theory, Applications and Numerics"*, Elsevier, New Delhi, 2nd Edition, 2012.

R10. Saada. A.S, *"Elasticity Theory and Applications"*, Cengage Learning, New Delhi, 2014.

R11. Landau. L. D and Lifshitz. E. M, *"Theory of Elasticity"*, Elsevier, Gurgaon, Third Edition, 2010.

R12. Sitharam. T.G and GovindaRaju. L, *"Applied Elasticity"*, Interline Publishing, Bangalore, 2005.

R13. PDS, "*Theory of Elasticity*",Vikas Publishing Pvt. Ltd. New Delhi -
997. R14. Singh. S, "*Theory of Plasticity*", Khanna Publishers, New Delhi
1988.

R15. Valliappan C, *"Continuum Mechanics Fundamentals"*, Oxford IBH Publishing Co. Ltd, New Delhi.

R16.Engineering Solid Mechanics, RagabA.R., BayoumiS.E., CRC Press,1999.

R17. Computational Elasticity, AmeenM., Narosa,2005.

R18. Solid Mechanics, Kazimi S. M. A., Tata McGraw Hill,1994.

Online Resources:

W1. www.nptel.ac.in

W2.
www.coursera.org

W3. www.ocw.mit.edu

Course Name: Theory of Thin Plates and Shells					
Course Code: MTCE133A					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	3

Course objectives: The objective of this course is to make students to learn different methods of analysis and design of plates and shells, to critically detail the plates, folded plates and shells. To evaluate the performance of spatial structures.

Prerequisites: Advanced Engineering Mathematics, Strength of Materials

Units	**Teaching Hours**
Unit-1 Prismatic Folded Plates	
Analysis and design of Prismatic folded Plate Systems.	9
Unit-2 Analysis of Shells	
Analysis Shell Equations, Approximate Solutions.	9
Unit-3 Doubly Curved Shells	
Analysis and Design of Cylindrical Shells. Approximate Design methods for Doubly Curved Shells.	9
Unit-4 Cylindrical Shells	
Analysis and Design of Cylindrical Shells.	9
Unit-5 Doubly Curved Shells	
Approximate Design methods for Doubly Curved Shells.	9

Self-study: Understanding of recent technical paper and case studies

Site/Industrial Visits: Nil

Course outcomes:

CO1. Design the prismatic folded plate systems.(L6)
CO2. Analyze the shells using approximate solutions.(L4)
CO3. Design the doubly curved Shells .(L6)
CO4. Design the Cylindrical Shells (L6)
CO5. Design the Doubly Curved Shells (L6)

Reference Books:

R1. Theory of Plates and Shells, Timoshenko and Woinowsky-Krieger S., Tata Mc Graw Hill Edition, 2010.
R2. Design and Construction of Concrete Shell Roofs, Ramaswamy G. S., 1st Edition, 2005.
R3. Design of Reinforced Concrete Shells & Folded Plate, Varghese P. C., 1st Edition, PHI. R4. Design of Plate and Shell Structures, Jawad Maan H., Springer Science

Course Name: Theory and Applications of Cement Composites					
Course Code: MTCE133B					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	70
Contact Hrs./Sem.	45	0	0	**ESE Marks**	30
Credits.	3	0	0	**Exam**	**3**
Course objectives: The objective of this course to understand the behaviour of composite materials, Cement composites and application of cement composites.					
Prerequisites: Concrete Technology and Special Concretes.					

Units	**Teaching**
Unit-1 Introduction	
Classification and Characteristics of Composite Materials Basic Terminology, Advantages. Stress-Strain Relations- Orthotropic and Anisotropic Materials, Engineering, Constants for Orthotropic Materials, Restrictions on Elastic Constants, Plane Stress Problem, Biaxial Strength, Theories for an Orthotropic Lamina.	9
Unit- 2,Mechanical Behaviour	
Mechanics of Materials Approach to Stiffness- Determination of Relations between Elastic Constants, Elasticity Approach to Stiffness- Bounding Techniques of Elasticity, Exact Solutions – Elasticity Solutions with Continuity, Halpin, Tsai Equations, Comparison of approaches to Stiffness**.**	9
Unit-3 Cement Composites & Mechanical Properties	
Types of Cement Composites, Terminology, Constituent Materials and their Properties, Construction Techniques for Fibre Reinforced Concrete - Ferrocement, SIFCON, Polymer Concretes, Preparation of Reinforcement, Casting and Curing. *Mechanical Properties of Cement Composites:* Behaviour of Ferrocement, Fiber Reinforced Concrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion.	9
Unit-4 Application of Cement Composites:	
FRC and Ferrocement- Housing, Water Storage, Boats and Miscellaneous Structures. Composite Materials- Orthotropic and Anisotropic behaviour, Constitutive relationship, Elastic Constants.	9
Unit-5 Analysis and Design of Cement Composite Structural Elements	
Ferrocement, SIFCON and Fibre Reinforced Concrete.	9
Self-study: Introduction to composite materials and cement composites.	
Site/Industrial Visits: Nil	

Course outcomes:

CO1: Understand Characteristics of Composite Materials

CO2 Formulate constitutive behaviour of composite materials – Ferrocement, SIFCON and Fibre Reinforced Concrete - by understanding their strain- stress behaviour. (L2, L3)

CO3: Classify the materials as per orthotropic and anisotropic behaviour.(L1)

CO4: Estimate strain constants using theories applicable to composite materials. (L2)

CO5: Analyse and design structural elements made of cement composites. (L3)

Reference Books:

1. Mechanics of Composite Materials, Jones R. M,2nd Ed., Taylor and Francis, BSP Books, 1998.
2. Ferrocement – Theory and Applications, Pama R. P., IFIC, 1980.
3. New Concrete Materials, Swamy R.N., 1stEd., Blackie, Academic and Professional, Chapman & Hall, 1983.

Online Resources:

W1. https://nptel.ac.in/courses/112107146/ W2. https://nptel.ac.in/courses/101104010/

Course Name: Theory of Structural Stability					
Course Code: MTCE131C					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam**	3

Course objectives: This course provides a concise introduction to the principles and applications of structural stability for their practical use in the design of steel frame structures. Concepts of elastic and plastic theories are introduced. Stability problems of structural members including columns, beam-columns, rigid frames, and beams are studied. Approaches in evaluating stability problems, including energy and numerical methods, are also addressed

Prerequisites: Advance engineering mathematics, strength of materials, structural

Units	**Teaching**
Unit-1 Criteria for Design of Structures	
Stability, Strength, and Stiffness, Classical Concept of Stability of Discrete and Continuous Systems, Linear and nonlinear behaviour.	9
Unit-2 Stability of Columns	
: Axial and Flexural Buckling, Lateral Bracing of Columns, Combined Axial, Flexural and Torsion Buckling	9
Unit-3 Stability of Frames	
Member Buckling versus Global Buckling, Slenderness Ratio of Frame Members.	9
Unit-4 Stability of Beams and Plates	
Lateral buckling of beams – differential equation – pure bending – cantilever beam with point load – simply supported beam of I – section subjected to central concentrated load. Pure torsion of thin – walled bars of open cross section. Non- uniform torsion of thin – walled bars of open cross section, buckling of plates under combined loads. Plates simply supported on all edges and subjected to constant compression in one or two directions; Plates simply supported along two opposite sides perpendicular to the direction of compression and having various edge conditions along the other two sides	9
Unit-5 Introduction to Inelastic Buckling and Dynamic Stability	
Introduction to Inelastic Buckling and Dynamic Stability Inelastic buckling. Dynamic analysis of stability. Parametric instabilities and stability under nonconservative forces. Divergence and flutter.	9

Self-study: Applications and stability problems in civil engineering

Site/Industrial Visits: None

Course outcomes: Students will be able to

CO1: Compute buckling load of columns with different boundary conditions

(L3) CO2: Compute critical load of built up column (L3)

CO3: Analyse the frame for the instability (L3)

CO4: Compute critical load of beam under LTB

(L3)

Reference Books:

1.Timoshenko and Gere, "Theory of elastic stability", Tata Mc Graw Hill,1981

2.Alexander Chajes, "Principles of Structural Stability Theory", Prentice Hall, New Jersey,

3.Iyengar, N. G. R., "Structural Stability of columns and plates", Eastern west press Pvt. Ltd.

4.Rajashekaran S, "Computations and Structural Mechanics"-Prentice – Hall, India.

5.Bulson P S " Stability of Flat Plates" Windus and Chatos, London, 1984

6.Strength of Metal Structures, Bleich F. Bucking, Tata McGraw Hill, New York.

7.An introduction to the elastic stability of structures, G J Simitses, Prentice Hall, NJ, 1976

8.Buckling of bars, plates and shells, D O Brush and B O Almoroth, 1975

9.J M T Thompson and G W Hunt, " A general theory of elastic stability", John Wiley, London, 1973

10.George J. Simitses and Dewey H. Hodges,"Fundamentals of Structural Stability", Elsevier Inc.,2006

Online Resources:

W1.

W2.

Course Name: Analytical and Numerical Methods for Structural Engineering					
Course Code :MTCE134A					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam**	3
Course objectives: To learn fundamentals of numerical and analytical methods and apply the knowledge to solve structural engineering problems.					
Prerequisites: Engineering Mathematics,					
Units					**Teaching**
Unit-1 FUNDAMENTALS OF NUMERICAL METHODS:					
Error Analysis, Polynomial Approximations and Interpolations, Curve Fitting, Interpolation and extrapolation.					9
Unit-2 ELEMENTS OF MATRIX ALGEBRA					
Solution of Systems of Linear Equations, Eigen Value Problems. Solution of Nonlinear Algebraic and Transcendental Equations.					9
Unit-3 NUMERICAL CALCULUS					
Solution of Ordinary and Partial Differential Equations. Numerical integration.					9
Unit-4 FINITE DIFFERENCE SCHEME					
Implicit & Explicit scheme.					9
Unit-5 COMPUTER ALGORITHMS					
Numerical Solutions for Different Structural Problems, Fuzzy Logic and Neural Network.					9
Self-study: Nil					
Site/Industrial Visits: Nil					
Course outcomes: Upon completion of this course, the students will be able to: CO1: Understand basics of error analysis and approximations (L2) CO2: Solve structural engineering problems using numerical and analytical methods. (L3) CO3: Understand basics of Finite Difference Method (L2) CCO4: Solve ordinary differential equations and partial differential equations in structural mechanics using numerical techniques. (L3) CO4: Write a computer program to solve structural engineering problems. (L3)					

Reference Books:

1. Atkinson K.E, "An Introduction to Numerical Analysis", J. Wiley and Sons, 1989.
2. Scheid F, "Theory and Problems of Numerical Analysis" McGraw Hill Book Company,
3. 1988.
4. Sastry S. S, "Introductory Methods of Numerical Analysis", Prentice Hall of India, 1998.

Online Resources:

W1. https://nptel.ac.in/courses/105105043/

Course Name: Structural Health Monitoring

Course Code: MTCE134B

	L	T	P	Category	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam**	3

Course objectives: Learn the fundamentals of structural health monitoring and study the various vibration-based techniques for structural health monitoring. Learn the structural health monitoring using fiber-optic and Piezoelectric sensors. Study the structural health monitoring using electrical resistance and electromagnetic techniques.

Prerequisites: Basic Electronics, Strength of materials, Material testing lab

Units	**Teaching**
Unit-1 Structural Health Monitoring	
Factors affecting Health of Structures, Causes of Distress, Regular Maintenance. *Structural Health Monitoring*: Concepts, Various Measures, Structural Safety in Alteration.	9
Unit-2 Structural Audit	
Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.	9
Unit-3 Static Field Testing	
Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.	9
Unit-4 Dynamic Field Testing	
Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.	9
Unit-5 Introduction to Repairs of Structures	
Case Studies, piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.	9

Self-study: Nil

Site/Industrial Visits: Nil

Course outcomes: Students will be able to

CO1: Diagnose the distress in the structure by understanding the causes and factors (L3)
CO2: Assess the health of structure using static field methods(L3)
CO3: Assess the health of structure using dynamic field tests(L4)
CO4: Suggest repairs and rehabilitation measures of the structure(L4)
CO5: To recommend repairs and rehabilitation measures of the structure (L4)

Reference Books:

1.Structural Health Monitoring Daniel Balageas, Claus-Peter Fritzen and Alfredo Güemes, John Wiley-ISTE, London, 2006.
2.Health Monitoring of Structural Materials and Components - Methods with
3.Applications, Douglas E Adams, John Wiley & Sons, New York, 2007.
4.Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z.
5.D. Duan, Taylor and Francis Group, London, UK, 2006.
6.Structural Health Monitoring and Intelligent Infrastructure", Vol.-1,J.P. Ou, H. Li and
7.Z. D. Duan, Taylor & Francis, London, 2006.
8.Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc., 2007.
9.Smart Materials and Structures, M.V. Gandhi and B.D. Thompson, Springer, 1992.
10. Structural Health Monitoring: Current Status and Perspectives, Fu Ko Chang, Technomic, Lancaster, 1997.

Online Resources:

W1. https://onlinecourses.nptel.ac.in/noc18_oe05/preview W2. http://shm.sagepub.com/cgi/content/abstract/2/3/257

Course Name: Structural Optimization

Course Code: MTCE134C

	L	T	P	Category	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam**	3

Course objectives: At the end of this course the student shall be able to know usefulness of optimization techniques and its applications in analysis and design of complicated civil engineering structures.

Prerequisites: Engineering mathematics and Operation research

Units	**Teaching**
Unit-1 Introduction	
History of Optimization, Introduction to optimization, engineering applications of optimization, Formulation of structural optimization problems as programming problems, Simultaneous Failure Mode and Design, Classical External Problems.	9
Unit-2 Calculus of Variation & Optimization techniques	
Variational Principles with Constraints Classical optimization techniques, single variable optimization, multivariable optimization with no constraints, unconstrained minimization techniques	9
Unit-3 Linear programming & Dynamic programming	
Linear programming, standard form of linear programming, geometry of linear programming problems, solution of a system of linear simultaneous equations. Dynamic programming conversion of NLP as a sequence of LP/ Dynamic programming.	9
Unit-4 Non-linear programming & Geometric programming	
Non-linear programming, one dimensional minimization methods, elimination methods, Fibonacci method, golden section method, interpolation methods Geometric programming, conversion of NLP as a sequence of LP/ geometric programming and stochastic programming	9
Unit-5 Applications	
Structural Steel and Concrete Members, Trusses and Frames. *Design:* Frequency Constraint, Design of Layouts	9

Self-study:

Site/Industrial Visits:

Course outcomes: Students will be able to

CO1: Formulate the objective function by choosing the variables and define the constraints for a given problem. (L2)

CO2: Solve a linear programming problem,

CO3: Solve a simplex, revised simplex and duality methods or non-linear programming problem by various techniques studied including geometric and dynamic programming problems. (L3)

CO4: Apply optimization techniques to structural steel and concrete members. (L3) CO5: Design using frequency constraint. (L3)

Reference Books:

1.Ganguli. R, "*Engineering Optimization – A modern approach*", University Press, Hyderabad, 2011.

2.Mital. K.V and Mohan. C, "*Optimization Methods in Operations Research and Systems*

3.*Analysis*", New Age International Publishers, New Delhi, Revised Third Edition, 2011.

4.Joshi. M. C and Moudgalya.K, "*Optimization – Theory and Practice*", Narosa, New Delhi, 2013.

5.Brinkhuis. J and Tikhomirov. V, "*Optimization: Insights and Applications*", New Age Publishers, New Delhi, 2010.

6.Christensen. P. W and Klarbring. A, "*An Introduction to Structural Optimization*",

7.Springer, Sewden, 2009.

8.Bhavikatti S.S. "*Structural optimization Using Sequential Linear Programming*"-Vikas publishing house, New Delhi, 2003.

9.Rao S. S., "*Engineering Optimization – Theory and Practice*", New Age International Publishers, New Delhi, Third Enlarged Edition, 2012.

10.Belegundu. A. D, Chanrupatla. T. R, "*Optimization Concepts and Applications in Engineering*", Cambridge University Press, New Delhi, Second Edition, 2011.

11.Chandra. S, Jayadeva, Mehra. A, "*Numerical Optimization with Applications*", Narosa, New Delhi, 2011.

12.Ravindran. A, Ragsdell. K.M and Reklaitis, "*Engineering Optimization – Methods and*

13.*Applications*", Wiley India, New Delhi, Second Edition, 2011.

14.Chong. E. K. P and Zak. S. H, "*An Introduction to Optimization*" Wiley India, New Delhi, Second Edition, 2010.

15. Fletcher. R, "*Practical Methods of Optimisation*", Wiley India, New Delhi, Second Edition, 2006.

Online Resources:

Course Name: Structural Design Lab					
Course Code: MTCE151					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	0	0	2	**CIA Marks**	50
Contact Hrs./Sem.	0	0	30	**ESE Marks**	50
Credits.	-	-	2	**Exam**	3

Course objectives:

- To integrate the theoretical design concepts with practical approach of design.
- To analyse and design RCC multi storey buildings using relevant IS codes.
- To give students hands on experience of structural engineering software STAAD- PRO and ETABS

Prerequisites: Structural analysis, Design of RCC elements and Basics of AUTO CAD

Units	**Teaching**
Unit-1 Manual analysis and design of RCC elements	
Types of buildings, Loads on a multistoried building, introduction to IS 875 part 1 and part 2, Basic concept of analysis and design, design procedure of slab, beam, column, footing and stair case.	4
Unit-2 Architectural and structural drawings	
Architectural plan, section and elevation, deciding column location, structural framing plan and centerline.	4
Unit-3 Building modeling using ETABS	
Local axis, global axis, coordinates, centerline grids, defining material properties like concrete and steel, defining member properties of slabs, beams, columns and shear wall. Modeling the multistoried building, application of dead load, live load, superimposed dead load. Introduction to IS 1893 and application of seismic loads.	12
Unit-4 Analysis using ETABS	
Analysis for gravity and seismic loadings. Member forces, bending moment, shear force, torsion, support reactions and exporting report.	4
Unit-5 Design and detailing of multistoried building	
Design of beams and columns using ETABS. Detailing of structural elements as per SP 34 and IS 13920.	6

Self-study : Nil

Site/Industrial Visits : Nil

Course outcomes: Upon completing this course students will be able to
CO1: Compute the loads on a multistoried building – L3 & L4
CO2: Decide column location and structural framing plan for simple residential buildings - L4
CO3: Analyse and design a multi storey building using ETABS – L5 & L6

Reference Books:

Subramanian N, "Design of Reinforced Concrete Structures", Oxford University Press, New Delhi, 2014.
Varghese P. C, "Limit state Design of Reinforced Concrete", PHI Learning, 2013.
IS 875 (Part 1): 1987, "Code of practice for design loads – Dead loads (other than earthquake for buildings and structures)"
IS 875 (Part 2): 1987, "Code of practice for design loads – Live loads (other than earthquake for buildings and structures)"
IS 456: 2000, "Plain and reinforced concrete – code of practice"
SP 16: 1980, "Design aids for reinforced concrete to IS 456: 1978."
SP 34: 1987, "Hand book on concrete reinforcement and detailing"

Online Resources:

W1. http://www.iitk.ac.in/nicee/IITK-GSDMA/EQ26.pdf

Course Name: Advanced Concrete Lab

Course Code: MTCE152

	L	T	P	Category	PCC
Contact Hrs./Week	0	0	2	**CIA Marks**	50
Contact Hrs./Sem.	0	0	30	**ESE Marks**	50
Credits.	0	0	2	**Exam**	3

Course objectives: To study the details of concrete mix design and properties of fresh and hardened concrete with the help of various lab tests on sample specimen.

Prerequisites: Building Materials & Concrete Technology

List of Experiments	**Practical**
1. Study of stress-strain curve of high strength concrete, Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.	6
2. Effect of cyclic loading on steel.	2
3. Non-Destructive testing of existing concrete members	2
4. Behaviour of Beams under flexure, Shear and Torsion.	6
5. Influence of Different Chemical Admixtures on Concrete	2
6. Workability Tests on Fresh Self-Compacting Concrete	4
7. Water Permeability of Hardened Concrete	2
8. Durability Test of Concrete	4
9. Influence of W/C Ratio on Strength and Aggregate / Cement Ratio on Workability and Strength	2

Course outcomes::At the end of the course, students will be able to

CO1: Design high grade concrete and study the parameters affecting its performance. (L2, L4, L6)

CO2: Conduct Non –Destructive Tests on existing concrete structures. (L2, L4, L6)

CO3: Apply engineering principles to understand behavior of structural elements (L2, L4)

Reference Books:

R1. Ken D, James A and Barry H, "Concrete Mix Design, Quality Control and Specification", CRC Press, Fourth Edition, 2013.

R2.Irving K, "Engineered Concrete", CRC Press, Second Edition, 2009

T3.M S Shetty, "Concrete Technology – Theory & Practice", S Chand & Co Limited, New Delhi.

R4.A.M Neville, "Concrete Technology", Pearson Education India.

R5.Relevant IS Codes.

R6. ACI: Code for Mix Design"

R7.IS:10262-2004

Online Resources:

W1. https://onlinecourses.nptel.ac.in/noc18_ce21/preview W2. https://nptel.ac.in/courses/105104030/

Course Name: Research Methodology and IPR					
Course Code: MLC136					
	L	**T**	**P**	**Category**	MLC
Contact Hrs./Week	2	0	0	**CIA Marks**	50
Contact Hrs./Sem.	30	0	0	**ESE Marks**	50
Credits.	2	0	0	**Exam Hours**	2
Course objectives: To understand the scope and importance of research methods, problem statement formulation in order to get equipped for research proposal writing and to have an overview of intellectual property rights and their academic importance					
Prerequisites: NIL					

Units	**Teaching Hours**
Unit-1 Introduction to Research	
Meaning and concept of research, Components and types of Research, Variables, Formulation of research problem, Hypothesis and research questions, Research designs.	6
Unit-2 Review of Literature	
Systematic Approaches, Review methods, Planning and conducting literature review	6
Unit-3 Research Proposals and Technical Writings	
Need of research proposal writing, Statement of problems, Effective technical writing, Ethics in Research	6
Unit-4 Intellectual Property Rights	
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	6
Unit-5 Patenting and Transfer of Technology	
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Universities and Patents. New Developments in IPR: Administration of Patent System.	6

Course outcomes:

CO1- Explain research methodology and research problems (L2)
CO2- Explain the functions of the literature review and plan literature reviews. (L2, L3))
CO3- Explain the art of writing research proposals and develop proposals (L2, L3)
CO4- Explain Intellectual Property Rights (L2)
CO5- Compare various forms of the intellectual properties and explain patenting processes (L3, L5)

Reference Books

Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'", Kenwyn, South Africa : Juta & Co. Ltd., 1996.

Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" Juta Academic, 2004

Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners", 2nd Edition, Sage Publication, 2014

Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
Reference Books:

Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.

T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Online Resources:
W1. www.nptel.ac.in
W2. www.coursera.org
W3. www.ocw.mit.edu
W4. www.online.stanford.edu

Course Name: Finite Element Method in Structural Engineering					
Course Code: MTCE231					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam Hours**	**3**
Course objectives: The objective of this course is to familiarize students to study the finite element method and to know the importance in analysis of structures.					
Prerequisites: Mathematics, Solid Mechanics					
Units					**Teaching Hours**
Unit-1 Introduction					
History and Applications. Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress.					9
Unit-2 Method of Weighted Residuals					
Galerkin Finite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications.					9
Unit-3 Analysis of FEM Elements					
Finite elements used for one, two- & three-dimensional problems					9
Unit-4 Application to Solid Mechanics:					
Plane Stress, CST Element, Plane Strain Rectangular Element, Isoparametric Formulation of the Plane Quadrilateral Element, Axi-Symmetric Stress Analysis, Strain and Stress Computations					9
Unit-5 Computer Implementation					
Computer Implementation of FEM procedure, Pre- Processing, Solution, Post-Processing, Use of Commercial FEA Software.					9
Self-study: Triangular Elements, Rectangular Elements, Axi-Symmetric Elements, Numerical Integration, Gaussian Quadrature					
Site/Industrial Visits: Nil					

Course outcomes:

CO1: Identify the various basic theory behind the Finite element analysis.(L2)
CO2: Apply weighted residual method of shape functions to analyze truss and beam elements.(L3)
CO3: Formulate force-displacements relations for 1-D, 2-D and 3-D elements(L5)
CO4: Analyze the continuum problems using finite element analysis.(L4)
CO5: Analyze and interpret solutions of engineering problems with different loading and boundary conditions using FE Software's. (L5)

CO1: Solve structural analysis problems using Finite Element Method L1}{PO1}{PSO3}
CO2: Execute the Finite Element Program/ Software.{L2}{PO1}{PSO4}
CO3: Solve continuum problems using finite element analysis.{L3}{PO1}{PSO3}
Change CO

Reference Books:

R1. Seshu P., "Finite Element Analysis", Prentice-Hall of India,2005
R2. Cook R. D., "Concepts and Applications of Finite Element Analysis", Wiley J., New York, 1995.
R3. Hutton David, "Fundamentals of Finite Element Analysis", Mc-Graw Hill, 2004.
R4. Buchanan G.R., "Finite Element Analysis", McGraw Hill Publications, New York, 1995. R5. Zienkiewicz O.C. & Taylor R.L. "Finite Element Method, Vol. I, II & III", Elsevier, 2000. R6. Belegundu A.D., Chandrupatla, T.R., "Finite Element Methods in Engineering", Prentice Hall India, 1991.

Online Resources:

W1. https://nptel.ac.in/courses/112104116/ W2. https://nptel.ac.in/courses/105105041/

Course Name: Structural Dynamics					
Course Code: MTCE 232					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam**	3

Course objectives:

- To understand the basic terminologies of dynamics like simple harmonic motion, natural frequency, time period, degrees of freedom, damping and the difference between statics and dynamics.
- To derive the equation of motion and understand the behaviour of SDOF & MDOF systems subjected to free vibration and forced vibration.
- To understand the behaviour of structures when subjected to dynamic forces like earthquake and wind.

Prerequisites: Engineering Mechanics, Engineering Mathematics

Units	**Teaching**
Unit-1 Introduction to structural dynamics:	
Difference between statics and dynamics, basic terminologies, degrees of freedom, mathematical model, simple harmonic motion, equation of motion of SDOF system subjected to free vibration.	9
Unit-2 Single degree of freedom system	
free vibration: Solution for equation of motion of SDOF system subjected to free vibration, un-damped and damped systems, logarithmic decrement and numerical problems.	9
Unit-3 Single degree of freedom system – forced vibration	
Equation of motion and solution to SDOF system subjected to forced vibration, resonance, dynamic load factor, half power band width, transmissibility ratio, response to impulsive loading, Duhamel's Integral.	9
Unit-4 Multi degree of freedom system	
Shear building model, equation of motion and solution to MDOF system subjected to free vibration, Eigen value and Eigen vectors, Mode shapes, Normalization of modes, response of MDOF systems subjected to forced vibration, approximate methods of analysis and response of continuous systems.	9
Unit-5 Dynamic problems in civil engineering:	
Effect of seismic loading, effects of wind loading, moving loads and vibration caused by traffic, blast loads, foundations for industrial machinery and Base isolation techniques.	9

Self-study: Applications and dynamic problems in civil engineering.

Site/Industrial Visits : Nil

Course outcomes: Upon completion of this course the student will be able to:

CO1: Understand basics of structural dynamics (L2)

CO2: Compute the natural frequency and other dynamic parameters of SDOF system (L2, L3)

CO3: Analyse single degree of system subjected to forced vibration (L4)

CO4: Compute the natural frequency and other dynamic parameters of MDOF system-L2 & L3

CO5: Interpret the behavior of structures subjected to dynamic loading - L4

Reference Books:

1. Chopra A.K "Dynamics of Structures Theory and Applications to Earthquake Engineering", 5th Edition, Pearson, 2017.
2. Paz Mario "Structural Dynamics Theory & Computation ", Springer, 5th Edition, 2006
3. Clough R. W. and Penzien J "Dynamics of Structures", McGraw Hill Education, 3rd
4. Edition, 2003.
5. Damodarasamy. S.R and Kavitha. S, "Basics of Structural Dynamics and Aseismic Design" PHI Learning private limited, 2012.

Online Resources:

W1. Structural Dynamics http://nptel.ac.in/courses/105101006/

Course Name: Advanced Steel Design					
Course Code: MTCE233A					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam**	**3**

Course objectives: At the end of the semester, the student shall understand the need and mode of advanced design of steel structural systems. Finally, the student shall be able to conceive and plan any type of steel structural systems

Prerequisites: Mathematics, Design of Steel Structures, Strength of Materials

Units	**Teaching**
Unit-1 Introduction	
Basic principles of design, stress strain relationship for mild steel, evaluation of full plastic moment for mild steel beams, plastic hinges, shapes factors and plastic moment.	9
Unit- 2 Connections	
Welded, Bolted, Location Beam Column, Column Foundation, Splices.	9
Unit-3 Method of Designs	
Allowable Stress Design, Plastic Design, Load and Resistance Factor Design	9
Unit-4 Strength Criteria	
Strength Criteria: Beams - Flexure, Shear, Torsion, Columns - Moment Magnification Factor, Effective Length, Biaxial Bending, Joint Panel Zones	9
Unit-5 Tubular Structures	
Tubular structures **–** Introduction, permissible stresses, tube columns and compression members, tube tension members. Design of members of tubular roof truss for given member forces and their combination joints in tubular trusses, design of tubular beams and purlins.	9

Self-study: In elastic Bending Curvature, Plastic Moments, Design Criteria Stability, Strength, Drift.

Site/Industrial Visits: Nil

Course outcomes: At the end of the course, students will be able to
CO1: Understand basic principles of Limit State method of design (L2)
CO2: Design welded and bolted connections. {L4}
CO3: Design steel structures/ components by different design processes.{L4}
CO4: Analyze and design beams and columns for stability and strength, and drift.{L3}
CO5: Design Tubular members subjected to Compression and tension (L6)

Reference Books:

Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi.
Design of Steel Structures - Arya A. S., Ajmani J. L., Nemchand and Bros., Roorkee.
The Steel Skeleton- Vol. II, Plastic Behaviour and Design - Baker J. F., Horne M. R., Heyman J., ELBS.
Plastic Methods of Structural Analysis, Neal B. G., Chapman and Hall London.
IS 800: 2007 – General Construction in Steel - Code of Practice, BIS, 2007.
SP – 6 - Handbook of Structural Steel Detailing, BIS,1987

Online Resources:

W1. https://nptel.ac.in/courses/105106113/18/ W2. https://nptel.ac.in/

Course Name: Design of Formwork					
Course Code: MTCE233B					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam**	**3**

Course objectives: The objective of this course to understand the formwork, materials of formwork, design and formwork failures.

Prerequisites: Structural Engineering

Units	**Teaching**
Unit-1 Introduction	
Requirements and Selection of Formwork *Formwork Materials*- Timber, Plywood, Steel, Aluminum, Plastic, and Accessories. Horizontal and Vertical Formwork Supports	9
Unit-2 Formwork Design	
Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams.	9
Unit-3 Formwork Design for Special Structures	
Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.	9
Unit-4 Flying Formwork	
: Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork Management Issues –Pre- and Post-Award.	9
Unit-5 Formwork Failures	
Causes and Case studies in Formwork Failure, Formwork Issues in Multi-Story Building Construction.	9

Self-study: Case Studies in formwork failure.

Site/Industrial Visits : Nil

Course outcomes: At the end of the course, students will be able to

CO1. Select proper formwork, accessories and material.(L1) (PO1,PO2)

CO2. Design the form work for Beams, Slabs, columns, Walls and Foundations. (L3) .(PO2,PO3)

CO3. Design the form work for Special Structures. (L3) .(PO2,PO3)

CO4. Understand the working of flying formwork. (L1) (PO1,PO2)

CO5. Judge the formwork failures through case studies (L1) (PO1,PO2)

Reference Books:

1. Formwork for Concrete Structures, Kumar Neeraj Jha, Tata McGraw Hill Education, 2012.
2. Formwork for Concrete Structures, Peurify, Mc Graw Hill India, 2015.

Online Resources: W1.www.egyankosh.ac.in/bitstream/123456789/28755/1 W2. https://nptel.ac.in/courses/105104030/31

Course Name: Design of High-Rise Structures					
Course Code: MTCE233C					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam**	3

Course objectives: At the end of this course the student shall be able to know usefulness of optimization techniques and its applications in analysis and design of complicated civil engineering structures.

Prerequisites: Structural Mechanics, Structural Engineering

Units	**Teaching**
Unit-1 Design Criteria	
Design philosophy, loading, sequential loading, Gravity loading: Dead and live load, methods of live load reduction, Impact, Gravity loading, Construction loads, ***Wind loading:*** static and dynamic approach, ***Earthquake loading:*** Equivalent lateral force, modal analysis, combinations of loading, ***Design Methodology:*** working stress design, Limit state design, Plastic design	9
Unit-2 Design of transmission/ TV tower, Mast and trestles	
Configuration, bracing system, analysis and design for vertical transverse and longitudinal loads.	9
Unit-3 Analysis and Design of RC and Steel Chimney	
Foundation design for varied soil strata	9
Unit-4 Tall Buildings	
Structural Concept, Configurations, various systems, Wind and Seismic loads, Dynamic approach, structural design considerations and IS code provisions. Firefighting design	9
Unit-5 Application	
Application of software in analysis and design	9

Course outcomes: Students will be able to

CO1: Understand the design philosophy and design methodology (L2)

CO2: Analyse, design and detail Transmission/ TV tower, Mast and Trestles with different loading conditions. (L3)

CO3: Analyse, design and detail the RC and Steel Chimney as per IS Codes. (L3)

CO4: Analyse. design and detail the tall buildings subjected to different loading conditions using relevant codes. (L2)

CO5: Model and analyse Transmission Line TV Tower and Tall Buildings using Commercial Software. (L3)

Reference Books:

1.Varyani U. H., "Structural Design of Multi-storeyed Buildings", 2nd Ed., South Asian Publishers, New Delhi, 2002.

2.Taranath B. S., "Structural Analysis and Design of Tall Buildings", Mc Graw Hill, 1988.

3.Shah V. L. & Karve S. R., "Illustrated Design of Reinforced Concrete Buildings (GF+3storeyed)", Structures Publications, Pune, 2013.

4.Design of Multi Storeyed Buildings, Vol. 1 & 2, CPWD Publications, 1976.

5.Smith Byran S. and Coull Alex, "Tall Building Structures", Wiley India. 1991.
Wolfgang Schueller, "High Rise Building Structures", Wiley, 1971.

6.Manohar S. N., "Tall Chimneys", Tata Mc Graw Hill Publishing Company, New Delhi, 1985

7.Lynn S. Beedle, "Advances in Tall Buildings", CBS Publishers and Distributors, Delhi, 1996.

Online Resources:

W1. https://www.youtube.com/watch?v=XCun_ewg-I8
W2. https://www.youtube.com/watch?v=TuK672TtW0U

Course Name: Design of Masonry Structures					
Course Code: MTCE233D					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam**	3

Course objectives: The primary objective of this course is to familiarize the student with the complete design of a masonry structure and their physical properties, construction related aspects. This includes not only the study of masonry as a building material but the design of an actual structure for all code prescribed loads including

Prerequisites: Building materials, Concrete Technology

Units	**Teaching**
Unit-1 Introduction	
Introduction: Historical Perspective, Masonry Materials, Masonry Design Approaches, Overview of Load Conditions, Compression Behaviour of Masonry, Masonry Wall Configurations, Distribution of Lateral Forces.	9
Unit-Flexural Strength & Interaction	
Flexural Strength of Reinforced Masonry Members: In plane and Out-of-plane Loading. Interactions: Structural Wall, Columns and Pilasters, Retaining Wall, Pier and Foundation	9
Unit-3 Shear Strength	
Shear Strength and Ductility of Reinforced Masonry Members.	9
Unit-4 Prestressed Masonry	
Prestressed Masonry - Stability of Walls, Coupling of Masonry Walls, Openings, Columns, Beams.	9
Unit-5 Inelastic Analysis & Modelling Techniques	
Elastic and Inelastic Analysis, Modelling Techniques, Static Push Over Analysis and use of Capacity Design Spectra.	9

Self-study: Strength properties of masonry, Modelling Techniques

Site/Industrial Visits:

Course outcomes: At the end of the course, students will be able CO1: Understand the masonry design approaches. {L1}
CO2: Analyse Reinforced Masonry Members {L4}
CO3: Determine interactions between members & Asses the stability of walls {L5}
CO4: Determine shear strength and ductility of Reinforced Masonry members{L5} CO5: CO6: Determine elastic and Inelastic analysis of masonry

Reference Books:

1.Design of Masonry Structures, A.W. Hendry, B.P. Sinha and S.R. Davies, E&FN Spon an imprint of Chapman & Hall, UK
2.Concrete Masonry, John Roberts, Alan Tovey, Anton Fried, Taylor &Francis 2001
3.Design of Reinforced Masonry Structures, Narendra Taly, McGraw Hill Professional, 05-Jun-2010
4.Structural Masonry, A rnold W Hendry, MacMillan Press Ltd
5.Seismic Design of Reinforced Concrete and Masonry Buildings, Thomas Paulay, M. J.
6.N. Priestley, Wiley, 1992
7.Design of Reinforced Masonry Structures, Narendra Taly, ICC, 2nd Edn,
8.Masonry Structures: Behavior and Design, Hamid Ahmad A. and Drysdale Robert G., 1994
9.Mechanics of Masonry Structures, Editor: Maurizio Angelillo, 2014.
10.Earthquake-resistant Design of Masonry Buildings, Tomaevi Miha, Imperial College Press, 1999

Online Resources:

W1. https://sws.cept.ac.in/
W2. https://study.com/brick_masonry_course.html

Course Name: Design of Advanced Concrete Structures					
Course Code: MTCE234A					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam**	3

Course objectives: This course aims at providing students with a solid background on principles of structural engineering design.

- Students will be exposed to the theories and concepts of both concrete and steel design and analysis both at the element and system levels
- To reinforce the philosophy of design and link design and analysis relevant to various codes
- An understanding of real-world open-ended design issues

Prerequisites:
Engineering Mechanics, Design of RRC & Steel structures

Units	**Teaching**
Unit-1 Design Philosophy	
Design philosophy, Modelling of Loads, Material Characteristics	9
Unit-2 Reinforced Concrete P-M, M-phi Relationships	
Reinforced Concrete - P-M, M-phi Relationships, Strut-and- Tie Method, Design of Deep Beam and Corbel	9
Unit-3 Shear	
Reinforced Concrete Design of Shear Walls, Compression Field Theory for Shear Design, and Design against Torsion; IS code, ACI and Euro code.	9
Unit-4 Shear and Torsion	
Compression Field Theory for Shear Design, and Design against Torsion; IS code, ACI and Euro code	9
Unit-5 Steel Structures	
Steel Structures -- Stability Design, Torsional Buckling - Pure, Flexural and Lateral, Design of Beam-Columns, Fatigue Resistant Design, IS code, AISC Standards and Euro code.	9

Self-study: Visual approach of structural design, Qualitative visual thinking and analysis

Site/Industrial Visits: Nil

Course outcomes: The students will be able to

CO1: Understand basic philosophy of Limit State method of design {L2}

CO2: Analyze and design simple connections of reinforced concrete members {L4}

CO3: Understand behaviour of RC structure under shear and Torsion {L2}

CO4: Carry out load calculation, and design of shear walls as per relevant IS code, ACI and Euro code of practice {L3}

CO5: Design of steel structures walls as per relevant IS code, ACI and Euro code of practice. {L4}

Reference Books:

Reinforced Concrete Design, Pillai S. U. and Menon D., Tata McGraw-Hill, 3rd Ed, 1999

Design of Steel Structures, Subramaniam N., Oxford University Press, 2008.

Reinforced Concrete Structures, Park R. and Paulay T. , John Wiley & Sons, 1995

Advanced Reinforced Concrete Design, Varghese P. C., Prentice Hall of India, New Delhi.

BIS, ACI code, Euro code (2017)

Steel Structures Design and Behavior Emphasizing Load and Resistance Factor Design, Salmon C. G., Johnson J. E. and Malhas F. A., Pearson Education, 5th Ed, 2009.

Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi. Plastic Methods of Structural Analysis, Neal B.G., Chapman and Hall London.

Online Resources:

W1. http://www.thestructuralengineer.info/online-library W2. http://www.ucl.ac.uk

W3. https://unl.libguides.com/

Course Name: Advanced Design of Foundations

Course Code: MTCE234B

	L	T	P	Category	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam**	**3**

Course objectives: In this course, the students will learn the Geotechnical investigation program, Methods for determining bearing capacity of soil, selection and design of a suitable shallow foundation based on bearing capacity of soil, Deep foundation like Pile foundation and Caisson and its design.

Prerequisites: Geotechnical Engineering and Foundation Engineering.

Units	**Teaching**
Unit-1 Soil Investigation	
Soil Investigation: Introduction, Site investigation, In-situ testing of soils, Subsoil exploration, Classification of foundations systems. General requirement of foundations, Selection of foundations.	9
Unit-2 Bearing Capacity of Shallow Foundations	
Methods of Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations.	9
Unit-3 Design of Shallow Foundations	
Design of individual footings, strip footing, combined footing, Concepts in design of rigid and flexible raft/mat foundations, soil-structure interaction.	9
Unit-4 Pile Foundations	
Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behaviour of Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of	9
Unit-5 Well Foundations	
- Types, components, construction methods, design methods (Terzaghi, I.S and I.R.C approaches), Tunnels and Arching in Soils. Open Cuts, Sheeting and Bracing Systems in Shallow and Deep Open Cuts in Different Soil Types.	9
List of Experiments (If any): Nil	

Self-study: Nil.

Site/Industrial Visits: Nil

Course outcomes:
CO1: Understand basics of soil investigation {L2}
CO2: Decide the suitability of soil strata for different projects. {L3}
CO3: Design shallow foundations deciding the bearing capacity of soil. {L3}

CO4: Understand analysis methods for well foundation. {L3} CO5: Design Pile Foundation {L5}
Reference Books: R1. Design of foundation system, 3/E, N.P. Kurian, Narosa Publishing House, 2006. R2. Foundation Analysis and Design, 5/E, J. E. Bowles, Tata McGraw Hill New York, 2001. R3. Analysis and Design of Substructures, 2/E, Sawmi Saran, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi, 2006.
Online Resources: W1. https://nptel.ac.in/courses/105108069/ W2. https://nptel.ac.in/

Course Name: Soil Structure Interaction					
Course Code: MTCE234C					
	L	**T**	**P**	**Category**	PEC
Contact Hrs./Week	3	0	0	**CIA Marks**	50
Contact Hrs./Sem.	45	0	0	**ESE Marks**	50
Credits.	3	0	0	**Exam**	**3**

Course objectives:
To introduce the concepts and terminology of soil structure interaction.
To analyse different type of framed structures resting on natural deposits. To develop a knowledge on behaviour of piles and pile groups on soils.

Prerequisites: Geotechnical Engineering and Foundation Engineering.

Units	**Teaching**
Unit-1	
Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil Structure Interaction. Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method.	9
Unit-2	
Relaxation and Interaction for the Evaluation of Soil Structure Interaction for Different Types of Structure under various Conditions of Loading and Subsoil Characteristics.	9
Unit-3	
Preparation of Comprehensive Design Oriented Computer Programs for Specific Problems, Interaction Problems based on Theory of Sub Grade Reaction Such as Beams, Footings, Rafts Etc.	9
Unit-4	
Analysis of Different Types of Frame Structures Founded on Stratified Natural Deposits with Linear and Non-Linear Stress-Strain Characteristics.	9
Unit-5	
Determination of Pile Capacities and Negative Skin Friction, Action of Group of Piles Considering Stress-Strain Characteristics of Real Soils, Anchor Piles and Determination of Pull-out Resistance.	9

Self-study: Nil.

Site/Industrial Visits: Nil

Course outcomes:
CO1: Understand soil structure interaction concept and complexities involved. {L2}
CO2: Evaluate soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics. {L3}
CO3: Prepare comprehensive design-oriented computer programs for interaction problems based on theory of sub grade reaction such as beams, footings, rafts etc. {L3}

CO4: Analyze different types of frame structure founded on stratified natural deposits with linear and non-linear stress-strain characteristics. {L3}

CO5: Evaluate action of group of piles considering stress-strain characteristics of real soils. {L3}

Reference Books:

R1. Analytical and Computer Methods in Foundation, Bowels J.E., McGraw Hill Book Co., New York, 1974.

R2. Numerical Methods in Geotechnical Engineering, Desai C.S. and Christian J.T., McGraw Hill Book Co., New York, 1977.

R3. Soil Structure Interaction - The real behaviour of structures, Institution of Structural Engineers, 1989.

R4. Elastic Analysis of Soil-Foundation Interaction, Selvadurai A.P.S., Elsevier Scientific Publishing Company, 1979.

R5. Analysis & Design of substructures, 2/E, Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd, 2006.

R6. Design of Foundation System- Principles & Practices, 3/E, Kurian N. P., Narosa Publishing, 2006.

Online Resources:

W1. https://nptel.ac.in/courses/105101004/6 W2. https://nptel.ac.in/

Course Name: Model Testing Laboratory					
Course Code: MTCE251					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	0	0	2	**CIA Marks**	50
Contact Hrs./Sem.	0	0	30	**ESE Marks**	50
Credits.	0	0	2	**Exam**	3

Course objectives:

- To test structural elements like beam, slab and columns using loading frame.
- To test building models for dynamic loading on electro dynamic shake table.

Prerequisites: Advanced Concrete technology Lab, Structural Dynamics

List of Experiments	**Practical**
1. To test beam element on loading frame	6
2. To test column element on loading frame	6
3. To test Slab element on loading frame	6
4. To calculate the natural frequency of a scaled building model	6
5. Beam vibration and vibration isolation	6

Self-study: Nil

Site/Industrial Visits: Nil

Course outcomes:

CO1: Test structural elements using loading frame

(L2) CO2: Prepare report for experimental testing

(L3)

Course Name: Numerical analysis lab

Course Code: MTCE 252

	L	T	P	Category	PCC
Contact Hrs./Week	0	0	2	**CIA**	50
Contact Hrs./Sem.	0	0	30	**ESE**	50
Credits.	0	0	2	**Exam**	**3**

Course objectives: The aim is to teach the student various topics in Numerical Analysis such as solutions of nonlinear equations in one variable, interpolation and approximation, numerical differentiation and integration, direct methods for solving linear systems, numerical solution of ordinary differential equations.

Prerequisites: Advanced Mathematics, Numerical Methods

List of Experiments	**Practical**
1. Find the Roots of Non-Linear Equation Using Bisection Method.	**4**
2. Find the Roots of Non-Linear Equation Using Newton's Method.	**4**
3. Curve Fitting by Least Square Approximations.	**4**
4. Solve the System of Linear Equations Using Gauss - Elimination Method.	**2**
5. Solve the System of Linear Equations Using Gauss - Seidal	**2**
6. Solve the System of Linear Equations Using Gauss - Jorden Method.	**2**
7. Integrate numerically using Trapezoidal Rule.	**2**
8. Integrate numerically using Simpson's Rules.	**2**
9. Numerical Solution of Ordinary Differential Equations by Euler's	**4**
10. Numerical Solution of Ordinary Differential Equations By Runge- Kutta	**4**

Self-study: Concepts of

Site/Industrial Visits:

Course outcomes:

CO1: Develop a program to find roots of non-linear equations by Bisection method and Newton's method and Do curve fitting by least square approximations (L6)

CO2: Develop a program to Determine solutions for a system of Linear Equations using Gauss - Elimination/ Gauss - Seidal Iteration/Gauss - Jorden Method (L6)

CO3: Develop a program to Integrate Numerically Using Trapezoidal and Simpson's Rules (L6)

CO4: Develop a program to find Numerical Solution of Ordinary Differential Equations by Euler's Method, Runge- KuttaMethod. (L6)

Reference Books:

R1. Sastry S.S, Introductory Methods of Numerical Analysis, 5th Edition

R2. Shanker G. Rao, Numerical Analysis, 5th Edition.

R3. Mahinder Kumar Jain, Numerical Methods: Problems and Solutions

Online Resources:

W1. www.nptel.ac.in

W2.www.coursera.org

W3. www.ocw.mit.edu

Course Name: - Cyber Security					
Course Code: BTCY01					
	L	**T**	**P**	**Category**	PCC
Contact Hrs./Week	2	0	0	**CIA Marks**	50
Contact Hrs./Sem.	30	0	0	**ESE Marks**	50
Credits.	2	0	0	**Exam Hours**	

Course objectives: The objectives of this course is providing knowledge about different Cyber Crimes, Threats and Laws. Creating awareness about risk management and protection from the cyber threats.

Prerequisites: NA

Units	**Teaching Hours**
Unit -1 Security Fundamentals	
Architecture, Authentication, Authorization ,Accountability, Social Media, Social Networking and Cyber Security. Cyber Laws, IT Act 2000-IT Act 2008-Laws for Cyber-Security, Comprehensive National Cyber-Security Initiative CNCI – Legalities.	**6**
Unit -2 Cyber Attack and Cyber Services	
Computer Virus – Computer Worms – Trojan horse. Vulnerabilities - Phishing - Online Attacks – Pharming - Phoarging – Cyber Attacks - Cyber Threats - Zombie- stuxnet - Denial of Service Vulnerabilities - Server Hardening-TCP/IP attack-SYN Flood.	6
Unit-3 Cyber Security Management	
Risk Management and Assessment - Risk Management Process - Threat Determination Process -Risk Assessment - Risk Management Lifecycle. Security Policy Management - Security Policies - Coverage Matrix Business Continuity Planning – Disaster Types - Disaster Recovery Plan - Business Continuity Planning Process	6
Unit-4 Vulnerability and Architectural Integration	
Vulnerability - Assessment and Tools: Vulnerability Testing - Penetration Testing Black box- white box. Architectural Integration: Security Zones – Devices viz. Routers, Firewalls, DMZ. Configuration Management - Certification and Accreditation for Cyber	**6**
Unit-5 Authentication and Cryptography	
Authentication and Cryptography: Authentication - Cryptosystems - Certificate Services Securing Communications: Securing Services - Transport – Wireless - Steganography and NTFS Data Streams. Intrusion Detection and Prevention Systems: Intrusion - Defense in Depth - IDS/IPS -IDS/IPS Weakness and Forensic Analysis. Cyber Evolution: Cyber Organization - Cyber Future.	**6**

Self-study: NIL

Site/Industrial Visits: NIL

Course outcomes: - Upon the completion of this course the student will be able to:

CO1 – Explain the concepts associated to Indian Information Technology Act 2000 and 2008 (L2)

CO2 – Illustrate the need for Security and outline Threats, Attacks, Legal issues. (L2)

CO3 – Experiment with various Risk, Vulnerable and Possible Controls (L3)

CO4 – Understand the Policies, Standards and Practices of Information Security (L2)

CO5 – Examine the IDS, Scanning, Tools and Access Control Devices in connection with authentication and cryptography (L4)

Textbooks:

T1. Jennifer L. Bayuk and Jason Healey and Paul Rohmeyer and Marcus Sachs, Cyber Security Policy Guidebook, Wiley; 1 edition , 2012, ISBN-10: 1118027809

T2. Dan Shoemaker and Wm. Arthur Conklin, Cybersecurity: The Essential Body Of Knowledge, Delmar Cengage Learning; 1 edition (May 17, 2011) ,ISBN-10: 1435481690

T3. Jason Andress, The Basics of Information Security: Understanding the Fundamentals of InfoSec in Theory and Practice, Syngress; 1 edition (June 24, 2011) , ISBN-10: 1597496537

Reference Books:

R1. Matt Bishop, "Computer Security Art and Science", Pearson/PHI, 2009.

R2. Stuart Mc Clure, Joel Scrambray, George Kurtz, "Hacking Exposed", 7th Edition Tata McGraw-Hill, 2012.

R3. Stallings, "Cryptography & Network Security - Principles & Practice", Prentice Hall, 3rd Edition 2002.

R4. Bruce, Schneier, "Applied Cryptography", 2nd Edition, Toha Wiley & Sons, 2007.

R5. Man Young Rhee, "Internet Security", Wiley, 2003.

R6. Pfleeger & Pfleeger, "Security in Computing", Pearson Education, 3rd Edition, 2003.

Online Resources:

1. W1. https://www.aicte-india.org/downloads/itact2000.pdf
2. Von Solms, Rossouw, and Johan Van Niekerk. "From information security to cyber security." *computers & security*38 (2013): 97-102.
3. Ahmad, Nazilah, et al. "Cyber Security Situational Awareness among Parents." *2018 Cyber Resilience Conference (CRC)*. IEEE, 2018.
4. Bhusan, Mayank, Rajkumar Singh Rathore, and Aatif Jamshed. *Fundamental of Cyber Security*. BPB Publications, 2018.
5. Klingensmith, Kurt, and Azad M. Madni. "Architecting Cyber-Secure, Resilient System-of-Systems." *Disciplinary Convergence in Systems Engineering Research*. Springer, Cham, 2018. 157-174.

Course Name: Disaster management (Audit course-MTech)					
Course Code: AC 131					
	L	**T**	**P**	Category	**CORE**
Contact Hrs./Week	**1**	**1**	**0**	CIA Marks	
Contact Hrs./Sem.	**15**	**15**	**0**	ESE Marks	
Credits.	**2**			Exam Hours	

Course objectives:

- To create awareness and to develop skills in disaster risk reduction measures in order to understand sustainable development in a changing world

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1 INTRODUCTION TO DISTER MANAGEMENT:	
Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Disaster and Hazard characteristics (Physical dimensions)	6 Hrs
Unit-2 Disaster Impacts	
Repercussions of Disasters: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Disaster and Hazard typologies and their applications in Engineering.	6 Hrs
Unit-3 Disaster Prone Areas In India	
Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	6 Hrs
Unit-4 Disaster Preparedness And Management	
Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	6 Hrs
Unit-5 Disaster Risk Reduction	

Concept And Elements, Strategies of Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Linkages of Risk Reduction with Sustainable Development	6 hrs

Self-study: Exploring the data base and spatial techniques (GIS, Virtual globes, EM Dat, ENatech and GDACS)

Site/Industrial Visits: Visit to emergency operation centres and specific sites which are disaster prone

Course outcomes: Upon completion of this course, the students will be able to:
CO1: Explain Hazards and Disasters (L2)
CO2: Apply methods and tools for Disaster Impacts (L3)
CO3: Explain disaster management developments in India (L2)
CO4: Illustrate technology as enablers of Disaster Preparedness (L4)
CO5: Compare disaster risk reduction methods and approaches at global and local level (L4)

Reference Books

Coppola, D, "Introduction to International Disaster Management ". Elsevier, 2015.

Paul, B.K, " Environmental Hazards and Disasters: Contexts, Perspectives and Management", Wiley-Blackwell, 2011

Online Resources:
W1. http://www.training.fema.gov/emiweb/edu/ddemtextbook.asp
W2. https://www.weadapt.org/
W3. https://nagt.org/nagt/search_nagt.html?search_text=hazards&search=Go
W4. https://www.unisdr.org/
W5. https://emdat.be/
W6. http://bhuvan.nrsc.gov.in/bhuvan_links.php
W7. https://www.usgs.gov/

Course Name: Constitution of India (Audit course-MTech)					
Course Code: AC231					
	L	**T**	**P**	Category	**CORE**
Contact Hrs./Week	**1**	**1**	**0**	CIA Marks	
Contact Hrs./Sem.	**15**	**15**	**0**	ESE Marks	
Credits.	**2**			Exam Hours	

Course objectives:

- To understand the Indian Constitution comprehensively and the role of engineers in various components of constitution through the lens of professional ethics

Prerequisites: Nil

Units	**Teaching Hours**
Unit-1 Introduction to Indian Constitution	
History and scope of Indian Constitution. Composition of drafting committee. Philosophy of the Indian Constitution: Preamble Salient Features	6 Hrs
Unit-2 Constitutional Rights & Duties	
Fundamental Rights: Right to Equality, Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.	6 Hrs
Unit-3 Governance in India	
Parliament: Composition, Powers and Functions. President, Governor, Council of Ministers. Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions	6 Hrs
Unit-4 Local Administration	

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO o Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	6 hrs
Unit-5 Professional Ethics	
Scope and Importance. Engineering Professionals and code of conduct. Case studies	6 hrs

Course outcomes: Upon completion of this course, the students will be able to:
CO1: Explain history and philosophy of Indian Constitution (L2)
CO2: Categorize fundamental rights (L3)
CO3: Explain governance in India and challenges (L2)
CO4: Illustrate and examine functioning of local administration in India (L2, L4)
CO5: Discuss engineering professional ethics case studies (L4)

Reference Books

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Online Resources:
W1: https://www.india.gov.in/my-government/constitution-india/constitution-india-full-text
W2: https://www.nspe.org/resources/ethics/code-ethics