RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M S Ramaiah University of Applied Sciences

Program Structure and Course Details

of

M Tech (Structural Engineering) Degree Programme

Programme Code: 114

Batch 2022-24

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

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

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

Faculty	Engineering and Technology
Department	Civil Engineering
Name of the Programme	M Tech in Structural Engineering
Programme Code	114
Mode of Study	Full Time
Date of Commencement of the Programme	August 2022
Date of Programme Approval by the Academic Council of MSRUAS	20th November 2018

1. Programme Objective

The aim of the programme is to produce postgraduates with advanced knowledge and understanding of civil structural design; higher order critical, analytical, problem solving and transferable skills; ability to think rigorously and independently to meet higher level expectations of civil construction industry, academics, research or take up entrepreneurial route.

2. Programme Outcomes (POs) / Graduate Attributes

PO 1. Modelling, simulation, analyses, design and validation of structural components/systems

PO 2. Modern construction technologies and materials Selection of materials, manufacturing processes and development of structural components and systems

PO 3. Experiments on structural components/systems and evaluate their performance

PO 4. Use of commercially available software for analysis and design

PO 5. General perspective and opportunities for a career in structural engineering design and analysis in industry, the public sector and non-governmental organisations

PO 6. Teamwork, lifelong learning and continuous improvement

3. Programme Specific Outcomes (PSOs)

The programme specific outcomes are listed under four headings:

1. Knowledge and Understanding
2. Cognitive skills
3. Practical skills and
4. Capability/Transferable skills

Knowledge and Understanding: After undergoing this programme, a student will be able to:

PSO1: Recognize and understand the major features of structural engineering with the perspective of structures' safety and sustainability; explain working, theoretical principles and design of various structural systems

PSO2: Describe the factors critical in designing structures for their structural, handling and safety requirements and approach for design to meet the requirements of national and other codes

PSO3: Explain the design requirements for structural stability, serviceability and durability and disaster prevention in civil structural system; explain the design requirements for structures to withstand forces due to temperature, creep, cracking and imposed loads

PSO4: Understand research techniques including information retrieval, experimental design, theoretical derivation, and/or modelling, discuss various structural materials and systems

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

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

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

Cognitive Skills: After undergoing this programme, a student will be able to:

PSO5: Identify, design and analyse structural engineering problems and solve using a multidisciplinary approach

PSO6: Analyse and propose design changes essential to balance costs, buildability, safety and environmental impact and sustainability

PSO7: Integrate and apply professional judgements to critically evaluate different design options relevant to limitations of local, national and international standards, codes of practice and building regulations

PSO8: Acquire and implement broad research and analytical skills related to structural engineering and arrive at innovative structural design

Practical Skills: After undergoing this programme, a student will be able to:

PSO9: Create structural drawings, working drawings, 3D geometric models of different Stages of construction as per national and international standards, codes of practice

PSO10: Create Finite Element, CFD and static and dynamic analyses models using CAE Tools

PSO11: Conduct physical tests on structural materials and structural components

PSO12: Obtain design information relevant to the site, including carrying out of site investigation, field tests and laboratory tests for soil, wind, earthquake and/or other environmental parameters

Capability Skills / Transferrable Skills: After undergoing the programme, a student will be able to:

PSO13: Manage information, develop technical reports and make presentations

PSO14: Build, Manage and Lead a team to successfully complete a project and communicate across teams and organizations to achieve professional objectives

PSO15: Work under various constraints to meet project targets

PSO16: Adopt to the chosen profession by continuously upgrading his/her knowledge and understanding through Life-long Learning philosophy

4. Eligibility for Admission:

4.1. Eligibility for students seeking admission under Government of Karnataka quota (for 40% seats):

i. A candidate seeking admission to postgraduate programme must have passed graduate level in Engineering and Technology in a related discipline with at least 50% marks in aggregate or equivalent CGPA.

ii. A candidate belonging to SC/ST category will be entitled to a relaxation in the qualifying marks in accordance with the related government notification in this regard.

4.2. Eligibility for Indian students seeking admission under the university quota:

Students seeking admission under University quota must have passed graduate level degree in Engineering in a related discipline with at least 50% marks in aggregate or equivalent CGPA.

4.3. Eligibility for foreign students seeking admission under University quota:

i.Foreign students should have Association of Indian Universities recognized first degree qualification in the Engineering related discipline of equivalent

ii. Should have proof of proficiency in English.

4.4: Selection of Students

Selection of students for admission under Government of Karnataka will be based on Karnataka

Government notified admission tests.

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

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

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

Selection of students for admission to University quota of seats is based on admission policy of the University notified from time to time.

Selection of foreign students for admission to University quota of seats is based on the admission policy of the University notified from time to time.

4.4.1: Admission to Programme

Selected candidates shall complete the admission procedure within the prescribed date by paying the prescribed fees and completing all other admission formalities notified by the University. Failure to do so may lead to cancellation of the selection.

4.4.2: Annual Programme Fee

Details of the fees payable for each Programme will be notified well in advance to the commencement of the programme.

The fees, once paid, will not be refunded under any circumstances.
The continuation of a student's registration in subsequent academic years is subject to payment of the prescribed programme and registration fees for each of those years.

4.4.3: Free-ship and scholarships

The Board of Management, in consultation with the Board of Governors, may consider offering free ships / scholarships to deserving students who maintain a minimum level of academic performance on a yearly basis.

5. Programme Duration

5.1. Normal Duration: The normal duration of the M.Tech. postgraduate programme is:

a. Two years in the Full-Time Route
b. Three years in the Part-Time Route

5.2. Maximum Duration: The maximum period a student is allowed to complete the M.Tech Programme shall be double the normal duration of the programme, i.e., Four Years for Full-Time students and Six years for Part-Time students.

5.3. Duration for Lateral Entry Scheme: N/A

6. Medium of Instruction

English is the medium of instruction for the programme.

7. Programme Structure

The programme structure is presented in **Appendix A**.

8. Programme Curriculum

The programme curriculum is presented in **Appendix B**.

9. Attendance Requirement

A student is required to have a minimum attendance of 80% to be eligible to appear for the examination and for assignment submission. Students who fail to achieve the minimum attendance will be declared as "FAIL". A failed student is required to re-register, attend the course and take up all the components of assessment at the next offering.

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

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

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

10. Assessment

10.1. Achievement Testing: During each semester, students' performance is assessed through two components, Continuous Evaluation (CE) and a Semester-End Examination (SEE). Both CE and SEE carry equal weight.

10.1.1. Continuous Evaluation (CE): This includes term tests, assignments, viva-voce, quiz, seminars, mini projects and other such evaluation methods designed for specific courses and conducted as per the norms of the University for Assessment.

10.1.2. Semester End Examination (SEE): This includes a written/laboratory examination conducted as per the norms of the University for Assessment.

The attainment of student in all COs are evaluated. A typical evaluation template in a theory course is presented in Table 1. A student is required to score a minimum of 40% marks in each course, scoring a minimum of 40% in each of CE and SEE.

Table 1: Typical evaluation template for a theory course

Course Outcome	CE (Weightage: 50 %)				SEE (Weightage: 50 %) Semester End Exam
	Component	Component	Component	Component	
	XX Marks	XX Marks	XX Marks	XX Marks	50 Marks
CO-1					
CO-2					
CO-3					
CO-4					
CO-5					
CO-6					

In the case of a laboratory course, there are two components: Component-1 and Component-2. Component-1 (CE) carries a weight of 50% and Component -2 (SEE) carries a weight of 50%.

The template for weightage of CE and SEE in percentages for each course is indicated in Table 2.

Table 2: Typical evaluation template for a laboratory course

Course Outcome		CE (Weightage: 50 %) 25 Marks				SEE (Weightage: 50 %): 25 Marks
	Assessment Type	Conduction of Lab Exercises	Viva-Voce	Lab Record Submission	Lab Test	SEE
	Component Weightage	10 Marks	05 Marks	05 Marks	05 Marks	25 Marks
CO-1						
CO-2						
CO-3						

CO-4						
CO-5						
CO-6						

10.1.2: Second Assessment and External Review

Each student's work is first assessed by the Course teaching team. All the answer scripts of a given course are to be assessed by a second examiner. 10% of the evaluated scripts will be further reviewed by an examiner who is external to the University. An External examiner will have tenure of 2 years which can be renewed for a further period of 2 years. The first assessor or assessing team is required to fill in the evaluation data and write the Post Module Assessment Report (PMAR).

10.1.2.2: Feedback on Assessed work

The awarded marks and distribution pattern will be reviewed by the Dean of the Faculty before scheduling a face-to-face feedback session with the student. After completing assessment of the course, the course teaching team along with the concerned Head of the Department should provide face-to-face feedback to the student regarding his/her performance after handing over the assessed documents on a prescheduled day. After the feedback, the assessed documents are collected and deposited with the Examination and Assessment Unit of the Faculty.

10.3. Credits not earned in a Course and Opportunities for Make-up:

A minimum of 40 % marks in the assignment and a minimum of 40% marks in the written examination are required for successful completion of a course. A student failing in any one of the components will be declared 'FAILED' in the course. A failed student who has fulfilled the attendance criterion is eligible to re-sit under the fast track scheme.

There is no provision for a re-examination or re-submission of any of the assessment components for a failed course.

A maximum of 3 attempts, including the first attempt, are permitted for successful completion of a course.

11. Academic Awards

Award of Grades: Students will be awarded grades based on the marks scored. The basis for awarding grades is shown in Table 3.

Table 3: Grade Definition and Grade Points

Sl. No.	Marks Scored	Grading	GPA Grade Points
1.	91-100	O (Outstanding)	10
2.	75-90	A+ (Excellent)	9
3.	61-74	A (Very Good)	8
4.	55-60	B+ (Good)	7
5.	50-54	B (Above Average)	6
6.	45-49	C (Average)	5
7.	40-44	P (Pass)	4
8.	Below 40	F (Fail/Absent) RS – Re-sit RR – Re-registration	0
'RS' and 'RR' to be considered as 'F' for SGPA and CGPA calculations.			

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

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

Table 4: SGPA and CGPA calculations for two semesters					
SGPA and CGPA: Sem-1 (All courses excluding 'Consideration Courses')					
Course	**Grade**	**Grade Point (GP)**	**Credit**	**GP * Credit**	
C1	A	8	4	32	**SGPA** = 129/18 = 7.166 = 7.17
C2	B+	7	4	28	
C3	C	5	3	15	
C4	B	6	4	24	
C5	O	10	3	30	
		Total	**18**	**129**	
Cumulative Credits and Grade Point * Credits			**18**	**129**	**CGPA** = 129/18 = 7.17
SGPA and CGPA: Sem-2 (All courses excluding 'Consideration Courses')					
Course	**Grade**	**Grade Point (GP)**	**Credit**	**GP * Credit**	
C10	O	10	3	30	**SGPA = 97/14 = 6.93**
C11	A+	9	3	27	
C12	C	5	4	20	
C13	C	5	4	20	
		Total	**14**	**97**	
Cumulative Credits and Grade Point * Credits			**18 + 14 = 32**	**129 + 97 = 226**	**CGPA** = 226/32 = 7.0625 = 7.10

The SGPA is indicated in the transcript only if all credits prescribed for the semester are earned by the student.

Computation of CGPA:

$$\text{CGPA} = \frac{\sum_1^N \text{Grade points scored in a given course} \times \text{Number of credits for that course}}{\text{Total number of registered credits}}$$

Here, N is the total number of courses registered for in a semester.

Example: Typical SGPA and CGPA calculations for two semesters are shown in Table 4.

Dean
Faculty of Engineering and Technology
M.S. Ramaiah University of Applied Sciences
Bangalore-560054

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

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

Appendix A

Programme Structure

The Programme consists of four semesters as shown below. A student is required to successfully complete the following courses and earn credits for the award of the degree.

Complete details of each of the courses such as ILO's, content, resources, teaching-learning processes and other related information are outlined in Course Specification of the respective programme.

SEMESTER 1

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	19STC501A	Advanced Concrete Technology and Modern Construction Techniques	3	--	2	4	100
2	19STC502A	Direct Stiffness Method and Finite Element Analysis	3	1	2	5	100
3	19STC503A	Structural Dynamics and Earthquake Resistant Design	3	1	2	5	100
4	19STE51XA	*Refer elective course table*	4	--	--	4	100
5	19STE52XA	*Refer elective course table*	4	--	--	4	100
6	19FET508	Research Methodology & IPR	2	--	--	2	50
7	19FET509	Professional Communication	1	--	--	--	--
		Total	**20**	**2**	**6**	**24**	**550**
	Total number of contact hours per week		**28** hours				
	Number of credits can be registered		Minimum	**19**		Maximum	**24**

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

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

SEMESTER 2

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	19STC511A	Advanced Design of RCC Structures	3	1	--	4	100
2	19STC512A	Theory of Elasticity and Plasticity	3	1	--	4	100
3	19STC513A	Advanced Design of Steel Structures	3	1	--	4	100
4	19STE53XA	*Refer elective course table / Online courses/ MOOC*	4	--	--	4	100
5	19STE54XA	*Refer elective course table / Online courses/ MOOC*	4	--	--	4	100
6	19FET510A	Value Education	1	--	--	--	--
		Total	**18**	**3**	**0**	**20**	**500**
	Total number of contact hours per week		**21** hours				
	Number of credits can be registered		Minimum	**16**		Maximum	**20**

SEMESTER 3

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	19STP521A	*Internship / Other activities as specified*	--	--	10	4	100
2	19STP522A	Group Project	--	--	12	8	200
		Total	**0**	**0**	**22**	**12**	300
	Total number of contact hours per week		**22** hours				
	Number of credits can be registered		Minimum	**12**		Maximum	**12**

SEMESTER 4

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	19STP523A	Dissertation and Publication	--	--	24	24	400
		Total	**0**	**0**	**24**	**24**	**400**
	Total number of contact hours per week		**24** hours				
	Number of credits can be registered		Minimum	**24**		Maximum	**24**

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

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

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

Elective Courses List			
Stream / Specialization	**S. No.**	**Course Code**	**Course Title**
Group-1	E11	19STE511A	Advanced Structural Mechanics
	E12	19STE512A	Geotechnical Earthquake Engineering
	E13	19STE513A	Design of Masonry, Timber Structures and Form Work
	E14	19STE514A	Probability and Statistics for Civil Engineers
Group-2	E21	19STE521A	Design of Building and Allied Services
	E22	19STE522A	Green Construction and Alternative Building Materials
	E23	19STE523A	Advanced Foundation Design and Machine Foundation
	E24	19STE524A	Advanced Structural Materials
	E25	19STE525A	Design of Tall Structures
	E26	19STE526A	Design of Formwork and Precast Structures
Group-3	E31	19STE531A	Design of RCC, PSC and Steel Bridges
	E32	19STE532A	Reinforced Soils
	E33	19STE533A	Fracture Mechanics
	E34	19STE534A	Fire and Safety Engineering Design
Group-4	E41	19STE541A	Condition Assessment, Repair, Rehabilitation and AI
	E42	19STE542A	Theory of Plates, Shells and Composites
	E43	11119STE543A	Design of Offshore Structures
	E44	19STE544A	Design of Membrane Structures

Note:
The Vacations and other activities shall be as per the Timetable for the corresponding batch.

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

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

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

Appendix B

Course Title	Advanced Concrete Technology and Modern Construction Techniques
Course Code	19STC501A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course deals with concrete, its components, properties and applications. Students will be taught concepts and procedures of concrete mix design. Concreting technologies, special concretes and their applications. Students will be trained to conduct tests on fresh and hardened concrete and evaluate their properties.

This course deals with various construction equipment and technologies adopted in the construction of different components of Civil Engineering structures. Identification, selection, planning and application of construction equipment and scaffolding technology will be discussed. The various techniques and technologies and their applications in the construction of substructures, superstructures and special structures as well as in the rehabilitation, strengthening, demolition and dismantling of Civil Engineering structures will be discussed

Course Outcomes

After undergoing this module students will be able to:

- **CO 1.** Discuss the properties of fresh and hardened concrete along with the relevant test details
- **CO 2.** Compare and contrast the different technologies involved in manufacture, mix design and placement
- **CO 3.** Apply different codal provisions and prepare mix design of concrete and recommend suitable type of concrete for a given set of conditions
- **CO 4.** Discuss and compare different equipment and construction techniques adopted in the construction of substructures, superstructures and special structures
- **CO 5.** Discuss the retrofitting, dismantling and demolition procedures adopted for existing structures

Course Contents

Unit 1 Mix Proportioning of Concrete:

Principles and methods. Mix Design: Principles of concrete mix design, factors affecting mix design; Methods of concrete mix design- IS method, ACI method, DOE method, Statistical quality control, sampling and acceptance criteria.

Concreting Methods:

Process of manufacturing of concrete, methods of transportation, placing, curing; Extreme weather concreting; Special concreting methods; Vacuum dewatering; Underwater concreting.

Unit 2 Properties of Concrete:

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 requirement of durability; Elastic properties.

Creep and shrinkage; Tests on fresh concrete; 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 water, cement ratio, NDT tests concepts, rebound hammer and pulse velocity methods.

Unit 3 Special Concretes:
Light weight concrete- Introduction, classification, properties, strength and durability, mix proportioning and problems;
High density concrete- radiation shielding ability of concrete materials for high density concrete, mix proportioning, properties in fresh and hardened state, placement methods.
Ferro cement- Ferro cement materials, mechanical properties, cracking of Ferro cement, strength and behavior in tension, compression and flexure, design of Ferro cement in tension, Ferro cement constructions, durability and applications;
Fiber reinforced concrete- fiber materials, mix proportioning, distribution and orientation, interfacial bond, properties in fresh state, strength and behavior in compression and tension including pre-cracking and post cracking stages, behavior in flexure and shear; Fiber reinforced concrete- mechanical properties, crack arrest and toughening mechanism, applications; High performance concrete- constituents, mix proportioning, properties in fresh and hardened states, applications and limitations; RMC concrete- manufacture, transporting, placing, precautions; Methods of concreting pumping, underwater concrete, shotcrete; High volume fly ash concrete- concept, properties, typical mix;
Self compacting concrete- concept, materials, tests, properties, applications and typical mix; Reactive powder concrete; Bacterial concrete; Fly ash concrete; Sulphur impregnated concrete; Polymer concrete; Geopolymer concrete; Waste material based concrete.

Unit 4 Construction Equipment and Management:
Identification, selection and planning of equipment, equipment management and maintenance, equipment operating cost and cost control of equipment.
Materials handling equipment-forklifts and related equipment, portable material bins, material handling conveyors, material handling cranes, industrial trucks; Concrete plants- aggregate production, different crushers, feeders, screening equipment, handling equipment, batching and mixing equipment, pumping equipment, ready-mix concrete equipment- concrete pouring equipment; Asphalt plant, asphalt pavers, asphalt compacting equipment; Precast flat panel system, 3D volumetric construction; precast foundations; fabrication of pre-cast and prestressed components; reinforcing steel- bending, placing, splicing and spacing, tendons.

Unit 5 Substructure Construction:
Box jacking, pipe jacking; Under water construction of basement; Tunneling techniques; piling techniques; Driving well and caisson; Sinking cofferdam; Cable anchoring and grouting; Driving diaphragm walls, sheet piles; Laying operations for built-up offshore system, shoring for deep cutting; Large reservoir construction with membranes and earth system, well points; Dewatering and stand by plant equipment for underground open excavation

Unit 6 Construction of Special Structures:
Erection of lattice towers and rigging of transmission line structures; Construction sequence in cooling towers, silos, chimney, sky scrapers; Construction of bow string bridges, cable stayed bridges; Launching and pushing of box decks; Construction of jetties and breakwater structures; Construction sequence and methods in domes; Support structures for heavy equipment and machinery in heavy industries; Erection of articulated structures and space decks.

Unit 7 Rehabilitation and Strengthening Techniques:
Seismic retrofitting; Strengthening of columns, strengthening of slab, strengthening of masonry wall; Protection methods of structures; Mud jacking and grouting for foundation, micro piling and underpinning for strengthening floor and shallow profile; Sub grade waterproofing; Soil stabilization techniques.

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

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

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

Unit 8 Demolition and Dismantling:

Demolition techniques- demolition by machines, demolition by explosives, advanced techniques using robotic machines, demolition sequence; Dismantling techniques; Safety precautions in demolition and dismantling.

Course Resources

a. Essential Reading

1. Class Notes
2. Shetty M. S.,(2009) Concrete Technology, S. Chand and Co. Ltd.
3. Mehta P. K. And Paulo J. M. Moteiro,(2005) Concrete - Micro Structure, Properties and Materials. Indian Concrete Institute, Chennai and Prentice Hall & Mc Graw-Hill in USA.
4. Neville A. M. And Brooks J. J.,(2000) Concrete Technology, Addison Wesley Longman Ltd. Tina Skinner,(2013), Retaining walls: a building guide and design gallery, National Concrete Masonry Association, Schiffer Pub
5. Peurifoy R.L., Ledbetter W.B. and Schexnayder C.,(2006) Construction Planning, Equipment and Methods, McGraw Hill, Singapore
6. Petros P. Xanthakos. (1991), Ground Anchors and Anchored Structures, A Wiley-Interscience Publication, New York

b. Recommended Reading

1. Gambhir M.L.,(2008) Concrete Technology, McGraw Hill Education.
2. Santhakumar A.R.,(2007) Concrete Technology, Oxford University Press.
3. Gupta B.L. and Gupta A.,(2010) Concrete Technology, Jain Book Agency.
4. Mindaas and Young(1998) Concrete, Prentice Hall.
5. Peter H.E.,(2008) Concrete repair and maintenance illustrated, Galgotia Publications Pvt. Ltd
6. Allen R. T. and Edwards S. C.,(1993) Repair of Concrete Structures, Blakie and Sons, UK

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/

Dean
Faculty of Engineering and Technology
M.S. Ramaiah University of Applied Sciences
Bangalore-560054

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

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

Course Title	Direct Stiffness Method and Finite Element Analysis
Course Code	19STC502A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This module is intended to prepare students to solve structural problems using finite element methods. Basic procedure, meshing, Interpolation models, shape function and theory of isoparametric elements will be discussed. Application and formulation of finite element methodology to solve one dimensional, two dimensional, three dimensional elements and Jacobian matrix will be taught. Students will be trained to use FEM packages to solve complex problems and to develop computer algorithms, flow charts, simple computer program for the analysis of 2D structures. This module also deals with the finite element formulation of axisymmetric element and its applications.

Course Outcomes

After undergoing this module students will be able to:

- **CO 1.** Describe basic concepts, background review, theory of elasticity, energy concepts, equilibrium, energy methods for analyzing structures concepts of discretization and element formulation for finite element analysis
- **CO 2.** Recognize the scope for finite element analysis in civil structural design
- **CO 3.** Develop Interpolation models and shape functions in generalized and natural coordinates for 1D, 2D, 3D elements and axisymmetric elements
- **CO 4.** Model and analyse manually 1D and 2D structures
- **CO 5.** Compare and contrast analyses structures by using different elements

Course Contents

Unit 1 Introduction FEA:
Basic concepts, background review, theory of elasticity, energy concepts, equilibrium and energy methods for analyzing structures.
Matrix displacement formulation, 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 method.

Unit 2 Approximate method of structural analysis, Raleigh - Ritz Method, Galerkin's method application in structural analysis, finite difference method and finite element method. Principles of finite element method, finite element procedure, engineering applications of finite element method, advantages and disadvantages.
Euler's Lagrange's equations of bar, beams, principal of a minimum potential energy, principle of virtual work, principle of Varian's, variation method and minimization of energy approach of element formulation.

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

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

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

Unit 3 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.
Meshing:
Higher order elements, p and h methods of mesh refinement, ill conditioned elements, discretization errors, auto and adaptive mesh generation techniques, error evaluation.
Interpolation models:
Selection of the order of the interpolation polynomial, convergence requirements, 2d Pascal triangle, nodal displacement parameters, convergence criterion, compatibility requirements, geometric invariance.

Unit 4 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 5 Theory of isoparametric elements:
Isoparametric, sub-parametric and super- parametric elements, characteristics of isoparametric elements, validity of isoparametric elements, numerical integration, Jacobian transformation matrix
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 6 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 quadratic elements, rectangular elements and higher order elements, isoparametric formulation, stiffness matrices quadrilateral elements.
Computation of Jacobian matrix, consistent load vector, stresses and strains for 2D elements. Need for mesh quality checks and their effect on analysis, computer algorithms, flow charts, simple computer program for the analysis of 2D structures.

Unit 7 3-D element formulation and applications:
Finite element formulation, hexahedral elements and higher order elements, element stiffness, force terms, stress calculations, problems on modeling.
Axisymmetric cases:

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

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

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

Finite element formulation of axisymmetric element, derivation of the stiffness matrix, stress calculations, finite element formulation for 3 dimensional elements, applications of axisymmetric elements.

Course Resources

a. Essential Reading

1. Class Notes
2. C.S. Krishnamoorthy,(2011) Finite Element Analysis, Tata McGraw-Hill
3. David V. Hutton,(2003) Fundamentals of Finite Element Analysis, McGraw-Hill
4. Daryl L. Logan,(2014) A First Programme In the Finite Element Method, University of Wisconsin–Platteville
5. S S Bhavikatti,(2010) Finite Element Analysis, New age international Pvt. Ltd.

b. Recommended Reading

1. D. Maity,(2007) Computer Analysis of Framed Structures, I. K. International Pvt. Ltd. New Delhi
2. Erik G. TDhompson, (2004) Introduction to the Finite Element Method: Theory, Programming and Applications, John Wiley
3. H. C. Martin and G. F. Carey,(1979) Introduction to Finite Element Analysis - Theory and Application, NewYork, McGraw-Hill
4. Irving H. Shames, Clive L. Dym,(1995) Energy and Finite Element Methods in Structural Mechanics; New Age International

c. Magazines and Journals

1. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campus, Chennai
2. ACI Structural Journal, ACI Structural Journal American Concrete Institute, 38800 Country Club Dr. Farmington Hills, MI48331-34349 USA

d. Other Electronic Resources

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

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

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

Course Title	Structural Dynamics and Earthquake Resistant Design
Course Code	19STC503A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This module deals with the fundamentals of structural dynamics and earthquake analysis of the structures. Students will be taught Single Degree of Freedom (SDoF) System, Multi Degree of Freedom (MDoF) System and continuous system subjected to dynamic loads. Students will be trained to identify, formulate and solve free and forced vibration of structural systems. Students also understand basics of earthquakes and its effects on structures. Base isolation system is designed for the earthquake loads to minimize the structural damage.

Course Outcomes

After undergoing this module students will be able to:

CO 1. Describe SDoF and MDoF system.
CO 2. Discuss the concepts of seismology.
CO 3. Derive equation of motion for free vibration, forced vibration for both damped and undamped cases for SDoF and MDoF systems.
CO 4. Formulate equation of motion for free vibration, forced vibration and flexural vibration of continuous systems.
CO 5. Analyze Multi-storeyed buildings for earthquake loads and design base isolation systems.
CO 6. Model and obtain performance of the SDoF and MDoF system under dynamic loads using MATLAB and FEA packages.

Course Contents

Unit 1 Introduction: Degrees of freedom, springs in parallel and in series. Newton's laws of motion, free body diagrams. D-Alembert's principle, principle of virtual displacement and energy principles, variational approach, solution of the differential equation of motion, frequency and period, amplitude of motion, types of damping.

Unit 2 Generalized Single Degree of Freedom Systems: Basic concepts, mass-spring system, lumped mass systems, systems with distributed mass and elasticity, Rayleigh's method, shape function selection.
Introduction to Dynamics of Continuous Systems: Equations of motions for axial vibration of a beam, equations of motion for flexural vibration of a beam, free vibration analysis, Introduction to forced vibration analysis using modal superposition method.

Unit 3 Dynamics of Single Degree of Freedom Structures: Free vibration analysis of undamped single degree of freedom system, free vibration analysis of damped single degree of freedom system, critically damped system, overdamped system, underdamped system, logarithmic decrement.
Forced vibration: Harmonic and periodic loadings, dynamic response functions, force transmission and vibration isolation, SDOF response to arbitrary functions. Response of SDOF system to harmonic loading, undamped & damped harmonic excitation, evaluation of damping at resonance, bandwidth method (Half power) to evaluate damping, response to support motion, force transmitted to the

foundation, seismic instruments. Response to General Dynamic Loading, Impulsive loading and Duhamel's integral, numerical evaluation of Duhamel's integral.

Unit 4 Free Vibration Response of MDOF Systems: Undamped systems, natural modes and their properties, numerical solution for the eigenvalue problem, solution of free vibration response for undamped systems, free vibration analysis of systems with damping.

Unit 5 Seismology: Earth's Interior and Plate Tectonics, Causes of Earthquakes and Seismic Waves, Measurement of Earthquakes and Measurement parameters, Modification of Earthquake due to the Nature of Soil, Seismic Hazard Analysis

Earthquake Inputs: Time History Records and Frequency Contents of Ground Motion, Power Spectral Density Function of Ground Motion, Concept of Response Spectrums of Earthquake, Combined D-V-A Spectrum and Construction of Design Spectrum, Site Specific, Probabilistic and Uniform Hazard Spectrums Predictive Relationships for earthquake parameters

Unit 6 Earthquake Response of SDOF Systems: Earthquake excitation, response history and construction of response spectra, response spectrum characteristics, tripartite plot, and design spectrum.

Numerical Evaluation of Dynamic Response of SDOF Systems: Time domain analysis-finite difference methods, frequency domain analysis-basic methodology.

Unit 7 Dynamic Analysis of Linear MDOF Systems: Introduction, modal analysis, response-history for earthquake excitations using modal analysis, response spectrum analysis for peak responses, concept of Caughey damping as a general type of proportional damping.

Base isolation for earthquake resistant design of structures: Base isolation concept, isolation systems and their modelling, linear theory of base isolation, stability of elastomeric bearings, codal provisions for seismic isolation, practical applications.

Course Resources

a. Essential Reading

1. Pankaj Agarwal and Manish Shrikhande(2008), Earthquake Resistant Design of Structures, prentice hall of India private limited.
2. Anil K Chopra Dynamic of structures: Theory and Applications to Earthquake Engineering, 5th Edition, prentice hall of India private limited.
3. I.S. 1893 (2007) Criteria for earthquake resistant design of structures
4. I.S. 4326 (2008) Earthquake Resistant Design and Construction of Buildings--Code of Practice
5. I.S. 13920 (2003) Ductile detailing of reinforced concrete structures subjected to seismic forces - Code of practice.

b. Recommended Reading

1. Clough R.W. and Penzien J. (1992) Dynamics of Structures,2nd edition, McGraw-Hill
2. Leonard Mirovitch (2012), Fundamentals of Vibrations, McGraw-Hill Companies
3. Leonard Mirovitch (1985) Introduction to Dynamics and Control, 1st edition, John Wiley & Sons

Russell C. Hibbeler, Engineering Mechanics: Statics & Dynamics 14th Edition

c. Magazines and Journals

1. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campus, Chennai

2. ACI Structural Journal, ACI Structural Journal American Concrete Institute, 38800 Country Club Dr. Farmington Hills, MI48331-34349 USA

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

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

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

d. Other Electronic Resources

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

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

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

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

Course Title	Advanced Structural Mechanics
Course Code	19STE511A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This module deals with the flexibility method, stiffness method, curved beams, shear centre and non-symmetrical bending of straight beams. Beams on elastic foundation, structures subjected to out of plane loading, method of tension co-efficient, stress concentrations and energy methods will be discussed. Students are taught the principles of mechanics of materials applicable for designing structural components relation, bending and vibration of laminated plates. FEM applications to plates and shells are taught in class and as well as in laboratory.

Course Outcomes

After undergoing this module students will be able to:

CO 1. Describe the concept of stiffness and flexibility method, shear centre, unsymmetrical bending and beams on elastic foundation
CO 2. Discuss circumferential stresses and radial stresses in curved beams
CO 3. Locate the shear centre for singly symmetrical and unsymmetrical sections
CO 4. Analyse curved beams, beam subjected to out of plane loading, unsymmetrical bending, and beams on elastic foundation
CO 5. Evaluate stress analysis at various cross section in curved beams
CO 6. Validate FEA tools for analysis of structures

Course Contents

Unit 1 Matrix Methods of Analysis: Static and kinematic indeterminacy, concepts of stiffness and flexibility. Introduction to flexibility and stiffness methods, development of element flexibility and element stiffness matrices for truss, beam and grid elements.
Force-transformation matrix, development of global flexibility matrix for continuous beams, plane trusses and rigid plane frames

Unit 2 Displacement-transformation matrix, development of global stiffness matrix for continuous beams, plane trusses and rigid plane frames
Analysis of continuous beams, plane trusses and rigid plane frames by flexibility method and stiffness method (number of unknowns should not be more than three).

Unit 3 Curved Beams: Introduction, circumferential stress in a curved beam, radial stresses in curved beams, correction for circumferential stresses in curved beams having I, T, or similar cross sections, deflections of curved beams, statically indeterminate curved beams, closed ring subjected to a concentrated load

Unit 4 Non-symmetrical Bending of Straight Beams: Symmetrical and non-symmetrical bending, bending stresses in beams subjected to non-symmetrical bending, deflections of straight beams subjected to non-symmetrical bending.

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

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

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

Unit 5 Beams on Elastic Foundations: General theory, Infinite beam subjected to concentrated load, boundary conditions, Infinite beam subjected to a distributed load segment, semi-infinite beam with different end conditions subjected to concentrated load and moment at its end - short beams

Unit 6 Design of light gauge (Cold formed) steel structures: Shear Center for Thin-Wall Beam Cross Sections: Definition of shear center in bending, approximations employed for shear in thin-wall beam cross sections, shear flow in thin-walled beam cross sections, shear center for singly symmetric and unsymmetrical sections.

Unit 7 Method of Tension Co-efficient: General principles, analysis of three-dimensional trusses and frames

Unit 8

Stability Analysis of Structures:

Introduction, buckling of columns, concepts of stability, methods of neutral equilibrium, Euler column, Eigen value problem, axially loaded column, eccentrically loaded column. Energy principle, Raleigh Ritz method, Galerkin method, numerical methods.

Buckling of Columns: Stability criteria by different approaches, governing differential equation, analysis for various boundary conditions, inelastic buckling of columns.

Course Resources

a. Essential Reading

1. Class Notes
2. S.Rajasekaran, (2001) Computational Structural Mechanics, PHI, New Delhi
3. C.S. Reddy, (2001) Basic Structural Analysis, TMH, New Delhi
   James M. Gere, S.P. Thimoshenko, (2000) Advanced Mechanics of Materials, Second edition, CBS Publiations, New Delhi

b. Recommended Reading

1. F.W.Beaufait et al., (1970) Computer methods of Structural Analysis, Prentice Hall
2. W.Weaver and J.H.Gere, (1980) Matrix Analysis of Framed Structures, Van Nastran
3. H.Karde Stuncer, (1974) Elementary Matrix Analysis of Structures, McGraw Hill

c. Magazines and Journals

1. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campus, Chennai

2. ACI Structural Journal, ACI Structural Journal American Concrete Institute, 38800 Country Club Dr. Farmington Hills, MI48331-34349 USA

d. Other Electronic Resources

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

Dean
Faculty of Engineering and Technology
M.S. Ramaiah University of Applied Sciences
Bangalore-560054

Registrar
M.S. Ramaiah University of Applied Sciences
Bangalore-560054

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

Course Title	Geotechnical earthquake Engineering
Course Code	19STE512A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course deals with the concepts of geotechnical issues related to earthquake engineering. A brief background of seismology and earthquakes, magnitudes, significance of different waves and wave propagation is discussed. The course also focusses on Seismic Hazard Analysis (PSHA), Deterministic Seismic Hazard Analysis (DSHA), site response analysis, dynamic soil properties, liquefaction and seismic design of various geotechnical structures like retaining structures, ground anchors, landfills and slopes

Course Outcomes

After undergoing this module students will be able to:

CO 1. Discuss the fundamental principles of seismology and wave propagation
CO 2. Discuss the role of soil deposits in modifying the ground motion parameters
CO 3. Calculate the various ground motion parameters
CO 4. Perform site response analysis
CO 5. Estimate the liquefaction potential of deposits by different methods
CO 6. Perform seismic design of selected geotechnical structures

Course Contents

Unit 1 Introduction: Seismic Hazards - Mitigation of Seismic Hazards - Significant Historical Earthquakes - Earthquake Records in India, Internal Structure of the Earth: Uncertainty, Hazard, Risk, Reliability and Probability of Earthquakes-Continental Drift and Plate Tectonics-Faults-Elastic Rebound Theory - Location of Earthquakes- Size of Earthquakes-Seismographs

Unit 2 Strong-Motion Measurement: Characteristics of Strong Ground Motion -Ground Motion Parameters-Estimation of Ground Motion Parameters-Spatial Variability of Ground Motions-Methods for Simulating Strong Ground Motion, Parameters for Seismic Hazard Assessment-Identification and Evaluation of Earthquake Sources- Risk Index and Evaluation of Earthquake Motion-Frequency of Earthquake-Earthquake Prediction-Earthquake Hazard Zonation, Risk Evaluation And Mitigation-Deterministic and Probabilistic Seismic Hazard Analysis

Unit 3 One Dimensional Wave Motion-Waves in Unbounded Media-Waves in Semi-Infinite Body-Waves in Layered Body-Attenuation of Stress Waves-Lamb Theory For Wave Propagation- Concepts Of Phase Velocity And Group Velocity,

Unit 4 Soil Properties For Dynamic Loading- Laboratory And Field Techniques-Representation Of Stress Conditions by The Mohr Circle-Dynamic Stress-Strain Relationship-Measurement Of Dynamic Soil Properties-Stress-Strain Behavior Of Cyclically Loaded Soils-Strength Of Cyclically Loaded Soils-Damping Ratio.

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

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

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

Unit 5 Classical Theory for Static Earth Pressure- Dynamic Earth Pressure Theory-Mononobe-Okabe Theory for Dynamic Earth Pressure-Displacement Analysis-Dynamic Stability Analysis.

Unit 6 Site Seismicity-One-Dimensional Ground Response Analysis-Two Dimensional Ground Response Analysis- Three Dimensional Ground Response Analysis-Soil-Structure Interaction, Effects of Local Site Conditions on Ground Motion-Design Parameters-Development of Design Parameters-Development of Ground Motion Time Histories-Design Earthquake.

Unit 7 Liquefaction-Related Phenomena-Mechanism Of Liquefaction-Evaluation Of Liquefaction Hazards-Liquefaction Susceptibility-Initiation Of Liquefaction- Factors Affecting Liquefaction-Laboratory Studies-Dynamic Triaxial Test-Field Studies- Evaluation Of Liquefaction Potential Using SPT –Anti Liquefaction Measures

Unit 8

Types of Earthquake induced Landslides-Earthquake Induce Landslide Activity-Evaluation of Slope Stability-Static Slope Stability Analysis-Seismic Slope Stability Analysis-Inertia Slope Stability-Pseudostatic Method & Network Method-Weakening Slope Stability-Flow Slides.
Seismic design of retaining structures by pseudo-static method, ground anchors, combined pile-raft foundations, soil slopes and landfills, Case studies.

Course Resources

a. Essential Reading

1. Class Notes
2. Steven L.Kramer (2016) Geotechnical Earthquake Engineering, Prentice Hall
3. J.Chakrabarty (2014) Theory of Plasticity, Elsevier Publisher

b. Recommended Reading

1. Robert W. Day, (2001) Geotechnical Earthquake Engineering Handbook, McGraw Hill
2. Ikuo Towhata, (2008)Geotechnical Earthquake Engineering, Springer
3. Shamsher Prakash, (1981) Soil Dynamics, McGraw-Hill Book Company
4. IS 1893, Indian Standard Criteria for earthquake resistant Design of Structures

c. Magazines and Journals

1. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campus, Chennai
2. ACI Structural Journal, ACI Structural Journal American Concrete Institute, 38800 Country Club Dr. Farmington Hills, MI48331-34349 USA

d. Other Electronic Resources

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

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

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

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

Course Title	Design of Masonry, Timber Structures and Form Work
Course Code	19STE513A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course provides students with a basic knowledge of structural analysis and design for Masonry, Timber structures. Students will be able to understand the different types and properties of timber and do the design of timber structural elements using limit states design principles. This course also provides knowledge on common form work and special form works, and design of form work with different materials for various structural elements.

Course Outcomes

After undergoing this module students will be able to:

- **CO 1.** Understand and describe the important structural characteristics of masonry and Timber structures
- **CO 2.** Analyze and design unreinforced masonry structures using engineering methods
- **CO 3.** Understand the behavior of reinforced masonry structures, and be able to design for flexure, shear, axial forces, combined flexure and axial forces, and in-plane shear forces
- **CO 4.** Design of Tension (Beams) and Compression (Column) timber member in a structure
- **CO 5.** Design the form work for Beams, Slabs, columns, Walls and Foundations

Course Contents

Unit 1 Materials, Strength and Stability of Masonry Structures

Masonry Units, Materials, types and masonry construction: Bricks, Stone and Block masonry units-strength, modulus of elasticity and water absorption of masonry materials – classification and properties of mortars. Defects and Errors in masonry construction – cracks in masonry, types, reason for cracking, methods of avoiding cracks.

Strength and Stability: Strength and stability of axially loaded masonry walls, effect of unit strength, mortar strength, joint thickness, rate of absorption, effect of curing, effect of ageing, workmanship. Compressive strength formulae based on elastic theory and empirical formulae.

Unit 2 Permissible stresses and Design Considerations of Masonry Structures

Permissible stresses: Types of walls, permissible compressive stress, stress reduction and shape modification factors, increase in permissible stresses for eccentric vertical and lateral load, permissible tensile stress and shear stresses.

Design Considerations: Effective height of walls and columns, openings in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action in lintels. Problems on design considerations for solid walls, cavity walls, wall with pillars.

Load considerations and design of Masonry subjected to axial loads: Design criteria, design examples of walls under UDL, solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers.

Unit 3 Design of Masonry Walls

Design of walls subjected to concentrated axial loads: Solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers, design of wall with openings.

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

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

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

Design of walls subjected to eccentric loads: Design criteria – stress distribution under eccentric loads – problems on eccentrically loaded solid walls, cavity walls, walls with piers.
Design of Laterally and transversely loaded walls: Design criteria, design of solid wall under wind loading, design of shear wall – design of compound walls.
Introduction to reinforced brick masonry, lintels and slabs.
In-filled frames: Types – modes of failures – design criteria of masonry retaining walls.

Unit 4 Design of Timber Structures :
Types and properties of timber, Allowable stresses in timber, Use of Timber in construction, Codes of practice for the design of timber structures, Design of compression members, Design of beams, Types of joints and their connections.

Unit 5 Formwork:
Introduction, Requirements of good formwork, Materials for forms, choice of formwork, Loads on formwork, Permissible stresses for timber, Design of formwork, Shuttering for columns, Shuttering for slabs and beams, Erection of Formwork, Action prior to and during concreting, Striking of forms. Recent developments in form work.

Course Resources

a. Essential Reading

1. Class Notes
2. Design of Wood Structures-ASD/LRFD, 7th Edition, by Donald Breyer (Author), Kelly Cobeen (Author), Kenneth Fridley (Author), David Pollock Jr. (Author), 2014, McGraw-Hill Education, ISBN: 978-0-07-174560-4, MHID: 0071745602
3. Kumar Neeraj Jha, Formwork for Concrete Structures, Tata McGraw Hill Education
4. Hendry, A.W (2017), Design of Masonry Structures,CRC Press

b. Recommended Reading

1. Peurify, Formwork for Concrete Structures, McGraw Hill Publication India
2. Sinha, B.P and Davies, S.R (1997), "Design of Masonry Structures", E & FN spon.
3. IS 1905-1987 (3rd revision), "Code of practice for structural use of unreinforced masonry", BIS, New Delhi.

c. Magazines and Journals

1. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campus, Chennai
2. ACI Structural Journal, ACI Structural Journal American Concrete Institute, 38800 Country Club Dr. Farmington Hills, MI48331-34349 USA

d. Other Electronic Resources

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

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

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

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

Course Title	Probability and Statistics for Civil Engineers
Course Code	19STE514A
Programme	M.Tech in Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course deals with Understand the use of statistical tools to express the traffic data for better interpretation. Apply probability concept to understand the vehicular flow behavior helping the planners to predicttraffic flow. Use appropriate statistical testing tools to check the degree of accuracy in the traffic data analysis.Test the hypothesis and assess the error involved in the data analysis.Use software tools like MATLAB, MINITAB etc., for analysis of traffic data and also use curve fitting techniques for predicting the performance trends.

Course Outcomes

After undergoing this course students will be able to:

CO 1. Use statistical tools to express the traffic data for better interpretation.
CO 2. Apply probability concept to understand the vehicular flow behavior helping the planners to predict traffic flow.
CO 3. Use appropriate statistical testing tools to check the degree of accuracy in the traffic data analysis.
CO 4. Test the hypothesis and assess the error involved in the data analysis.
CO 5. Use software tools like MATLAB, MINITAB etc., for analysis of traffic data and also use curve fitting techniques for predicting the performance trends.

Course Contents

Unit 1

Introduction to statistical methods, scope aim and limitations, sample, attribute and types of data, sources and collection of data. Accuracy of data. Representation and summarizing data. Frequency distribution, histogram and frequency curves. Ogive curve, Measure of central tendency – arithmetic mean,median and mode dispersion- range, standard deviation, variance and co-efficient of variation, skewness and kurtosis.

Unit 2

Introduction to probability & statistics for Traffic Engineering Design –Introduction, Random variables and statistical measures: arithmetic mean, measures of dispersion, basic laws of probability, probability laws for discrete random variables: binomial and Poisson distribution, probability laws for continuous random variables: normal distribution, Poisson distribution.

Unit 3

Sampling Techniques – objective, basics of sampling, advantages of sampling, sampling techniques, sampling distributions – sampling distribution of the sample mean, central limit theorem, chi square, t and F – distributions. Sampling error, sample size and design.

Unit 4

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

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

Statistical decisions – point estimation, properties of parameters, Testing of Hypothesis – Type I and II errors. Tests of significance – tests for mean and variance. Tests for proportions.

Unit 5

Chi-square test of goodness of fit, student's t test, Confidence interval. Curve fitting by the method of least squares, Linear correlation & regression, multiple linear regression. Analysis of variance Use of soft-wares in statistical analysis – MATLAB, MINITAB

Course Resources

a. Essential Reading

1. Martin Wohl, Brian V Martin, "Traffic System Analysis"- Mc Graw Hill Series
2. Johnson R and G Bhattacharya, "Statistics – Principles and methods"- John Wiley & sons, New york, 1985
3. Medhi, "Introduction to statistics"- New Age Pub, New Delhi
4. Benjamin Jack R and Cornell C Allin, "Probability Statistics & Decisions for Civil Engineers"- McGraw Hill Co.

b. Recommended Reading

1. Agarwal, B.L, "Basic Statistics"- 3rd edition, New Age Pub. New Delhi.
2. L.R Kadiyali, "Traffic Engineering"- Khanna Publishers New Delhi

c. Magazines and Journals

1. International Journal of Traffic Engineering

d. Other Electronic Resources

1. http://onlinepubs.trb.org/onlinepubs/archive/mepdg/home.htm

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

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

Course Title	Design of Building and Allied Services
Course Code	19STE521A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course aims to give an overview of the various building services and the architectural requirements for their accommodation in buildings. The students will be introduced to basic calculations for sizing the systems' components for incorporation in building design, standards and codes relating thereto. Students will be familiarized with sustainable principles of building services with a focus on efficiency of design, installation and operation. The course culminates in a module wherein Integrated Building Management, operation of service systems and building performance modelling through Intelligent Systems shall be the focus.

Course Outcomes

After undergoing this module students will be able to:

- **CO 1.** Explain the concepts of Planning, analysis and design of buildings
- **CO 2.** Discuss the sewage, storm water drainage and wastewater treatment systems
- **CO 3.** Discuss Electrification, Lighting & Acoustics for buildings
- **CO 4.** Design mobility, air-conditioning and sewerage systems for buildings
- **CO 5.** Analyse and Design all the structural components of building

Course Contents

Unit 1 Structures: Design of a building involving a high level of services and advanced structural systems e.g. A hospital, hotel, housing, sports facilities, long span structure etc. Besides Architectural Design, the choice may be Interior Design, etc. Planning, analysis and design of different structures. Load calculations, wind analysis, seismic analysis.

Unit 2 Water Supply: Introduction to water resources; collection, processing, distribution and storage of water; calculation of water demand and consumption; sizing of storage tanks and water quality standards for code compliance, importance of water conservation
Water Distribution: Service connections and systems of hot and cold water supply; plumbing networks; sanitary fixtures, fittings, valves and pipes, dual-plumbing systems.

Unit 3 Wastewater systems: Systems and components for sewage and storm water drainage; wastewater treatment systems and septic tanks; building and site planning for water drainage and sewage disposal; water harvesting and water recycling; solid waste collection, segregation and disposal.

Unit 4 Electrification, Lighting & Acoustics
Electricity: Electrical distribution and safety systems in buildings; fixtures, equipment, and appliances; electrical circuitry and internal wiring; electrical loads, peak demand, operational costs;
Communication: Intercoms, Wi-Fi, broadband data cabling, and CCTV systems

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

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

Unit 5 Lighting: Lighting principles, luminance and glare; lighting systems and types of luminaires; lighting design and layouts; architectural lighting and special effects; integration with day-lighting and energy conserving strategies

Acoustics: Basic concepts of sound and acoustics; sound insulation and transmission; absorption, reverberation, noise control and attenuation; acoustical requirements for different space types and design planning; site planning for noise control

Unit 6 Air-conditioning: Principles and components of mechanical ventilation and air-conditioning systems; calculation based on design conditions and system sizing, design considerations for chiller rooms, cooling plants, AHUs; integration with natural ventilation, and other energy conserving technologies.

Unit 7 Fire Safety: Fire sources, spreading, and growth decay curve; material fire response and fire retardant materials; fire hydrants, fire escapes, refuge areas, fire tender access; smoke detector, alarm, and sprinkler systems; representation of fire considerations in drawings

Unit 8

Mobility Systems: Lifts, escalators, conveyors, and travolators; sizing of space for lifts and other mobility systems; construction and installation; design and operation of automated parking systems

Course Resources

a. Essential Reading

1. Class Notes
2. G.M.Fair & J. C. Geyer, Water Supply and Waste disposal, John Wiley and sons, New York.
3. E.B Phelps &C.J. Velj, Public Health engineering, John Wiley and sons, New York.
4. F.C.Mcquiston, J.DParker and Jeffrey.D.Spitler,(2001) Heating, ventilating and air conditioning- Analysis and design-John Wiley and sons

   R.W.Hines and D.C.Hittle, (2006) Control system for heating, ventilating and air conditioning- (6th Edition)springer

b. Recommended Reading

1. Air-conditioning Principles and systems, PHI Learning Private Limited
2. Carrier Hand Book Trane manual on design HVAC systems ASHRAE standards

c. Magazines and Journals

1. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campus, Chennai
2. ACI Structural Journal, ACI Structural Journal American Concrete Institute, 38800 Country Club Dr. Farmington Hills, MI48331-34349 USA

d. Other Electronic Resources

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

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

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

Course Title	Green Construction and Alternative Building Materials
Course Code	19STE522A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This module 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.

Course Outcomes

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 choose different alternate building materials and technologies suitable for a particular construction project
CO 5. Recommend technologies and equipment for production of alternate building materials for green construction
CO 6. Design green building and construction process xplain the concepts of Planning, analysis and design of buildings

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, Environmental 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 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

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

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

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

Unit 6 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 7 Equipment for Production of Alternative Materials:
Equipment for production of stabilized blocks, Moulds required, and methods of production of precast elements.

Unit 8
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.
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.

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

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. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campus, Chennai
2. ACI Structural Journal, ACI Structural Journal American Concrete Institute, 38800 Country Club Dr. Farmington Hills, MI48331-34349 USA

d. Other Electronic Resources

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

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

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

Course Title	Advanced Foundation Engineering and Machine Foundations
Course Code	19STE523A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course deals with the concepts of site exploration and the types of foundations subjected to various types of loading. They will be able to apply the principles of soil mechanics and analytical techniques to different foundation designs. The course also deals with the analysis and design of machine foundations.

Course Outcomes

After undergoing this module students will be able to:

- **CO 1.** Discuss and interpret the soil behaviour relevant to foundation systems from site exploration
- **CO 2.** Calculate the bearing capacity of footings in layered soils and slopes
- **CO 3.** Discuss contact pressure and theory of subgrade reaction
- **CO 4.** Analyze pile foundations and retaining structures
- **CO 5.** Discuss the elements of vibration theory and dynamic response of foundation

Course Contents

Unit 1 Site Exploration, Boring and Sampling of soils, Standard Penetration Test, Cone Penetration Test, Correlation between SPT and CPT, Geophysical Explorations, Rock Sampling, Core Recovery, Rock Quality Designation (RQD), Borelogs, Soil report

Unit 2 Foundations, components, geotechnical and structural design, foundation design, classification of foundation, loads for geotechnical design, Bearing capacity and settlement, bearing capacity of footings in layered soils, bearing capacity of footings on slopes, bearing capacity from SPT and CPT, bearing capacity of rock, Foundation settlements

Unit 3 Soil pressure for structural design, influence of water table, backfilled footings and rafts, compensated raft, spring bed analogy for soils, Soil-structure interaction, contact pressure by theory of subgrade reaction, Analysis of foundations of finite rigidity by the theory of subgrade reaction

Unit 4 Deep foundations: types and technologies, load transfer mechanism, Single piles subjected to vertical and lateral loads in cohesive and cohesionless soils, Vertically and laterally loaded pile groups, Efficiency of pile groups, settlement of pile groups, Batter piles, Negative skin friction

Unit 5 Geotechnical analysis of retaining structures: Purpose, types of retaining structures, drainage of retaining walls, backfill material, stability analysis, earth pressure, proportioning of retaining wall, reduction of the system of forces, aspects of stability, Stability analysis of cantilever sheet pile walls, anchored bulkheads, equivalent beam method, Braced cuts, deep cuts in sand, cuts in saturated clay, cuts in stratified soils, stability of braced cuts, design of struts

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

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

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

Unit 6 Design of Foundations for Vibration Controls, introduction, elements of vibration theory, general case of vibrating base, soil springs and damping constants, soil properties for dynamic base design, unbalanced machine forces, coupled vibrations, embedment effects on dynamic response, pile supported dynamic foundations

Unit 7

Application of FE software for the bearing capacity failure of foundation

Course Resources

a. Essential Reading

1. Class Notes
2. Joseph M Bowles (1997) Foundation analysis and Design, 5th edition, McGraw-Hill Publishers

b. Recommended Reading

1. V N S Murthy (2017) Advanced Foundation Engineering, CBS Publishers
2. Braja M Das (2017) Principles of Foundation Engineering, 8th ed, Cengage India Ltd.
3. Shamsher Prakash, (1981) Soil Dynamics, McGraw-Hill Book Company
4. Braja M Das and G V Ramana (2010) Principles of Soil Dynamics, Nelson Engineering, International Student edition
5. IS 1893, Indian Standard Criteria for earthquake resistant Design of Structures
6. Kurian N P (2010) Design of Foundation Systems: Principles and Practices, Alpha Science International, 3rd edition

c. Magazines and Journals

1. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campus, Chennai
2. ACI Structural Journal, ACI Structural Journal American Concrete Institute, 38800 Country Club Dr. Farmington Hills, MI48331-34349 USA

d. Other Electronic Resources

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

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-560 054

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

Course Title	Advanced Structural Materials
Course Code	19STE524A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course explores the materials science of structural materials, and attempts to bring about the understanding of material behaviour from a fundamental perspective. The behaviour of various types of advanced materials used in the construction engineering is discussed. The course also focusses on fibre reinforced plastics, smart materials and durability and deterioration of concrete structures.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Discuss the different types of advanced structural materials used in building construction
- **CO 2.** Discuss the application of fibre reinforced plastics and smart materials in engineering structures
- **CO 3.** Develop and design high strength, high density and high performance concrete mix
- **CO 4.** Discuss the microstructure of cementatious materials and durability and deterioration of concrete structures
- **CO 5.** Compare and choose different structural materials and technologies suitable for a particular construction project
- **CO 6.** Recommend technologies for production of advanced structural materials for engineering construction

Course Contents

Unit 1:
Introduction: types of concrete and cementatious materials, Types of steel and their properties, advantages of new alloy steels, Types of plastics, non-weathering materials

Unit 2 :
Special Concretes: Definition & Introduction, General properties, Advantages, Disadvantages, Applications, High density concrete, Shrinkage compensating concrete, Mass concrete, Roller compacted concrete. Light weight concrete, High strength concrete, Ultra-high strength concrete (reactive powder concrete). High performance concrete.

Unit 3:
Fibre Reinforced Plastics in construction (FRP): Introduction, types, uses, properties, manufacturing, advantages and disadvantages. Types of fibres and components of composite materials

Unit 4 :
Smart Construction Materials: Introduction, types of smart materials- shape memory alloys, magnetostrictive materials, piezoelectric materials, electrorheological fluids, Electrochromic materials, smart concrete and application of smart materials

Unit 5:
Microstructure of cement based materials – Identification and detection of hydrated compounds using specialized techniques including FTIR, TGA, XRD, XRF, NMR, SEM, Optical microscopy, Calorimetry and several others. Relationship between microstructural parameters such as porosity, permeability, pore structure of concrete with associated properties

Unit 6 :

Durability and deterioration of concrete structures: Definitions, Deterioration processes – Physical, Chemical, Environmental & Biological; Measures for ensuring durability, Corrosion of reinforcing steel, protective measures.

Course Resources

a. Essential Reading

1. Class Notes
2. Sabnis S.P. Arora & S.P. Bindra, A Text Book of Building Construction, Dhanpat Rai & Sons, New Delhi., 2010
3. Sheety, M.S, Concrete Technology, Theory and Practice, S. Chand and Company Ltd, New Delhi, 2008

b. Recommended Reading

1. Gambhir, M.L, Concrete Technology, Tata McGraw – Hill Publishing Company Ltd, New Delhi, 2013
2. Pijush Samui, Dookie Kim, New Materials in Civil Engineering, Butterworth-Heinemann, Elseveir, 2020
3. Lawarence C. Bank,Composite for Construction: Structural Design with FRP Materials, John Wiley & Sons, INC., New Jersey.
4. Concrete: Microstructure, properties and materials, P.K. Mehta and P.J.M. Monteiro, McGraw Hill, 2556.

c. Other Electronic Resources

1. Electronic resources on the module area are available at MSRUAS library

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

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

Course Title	Design of Tall structures
Course Code	19STE525A
Programme	M.Tech in Structural engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

The objective of this course is to make students to learn principles of stability of tall buildings, To design the tall buildings for earthquake and wind resistance. To evaluate the performance of tall structures for strength and stability.

Course Outcomes

After undergoing this course students will be able to:

CO 1. Achieve Knowledge of design and development of problem solving skills.
CO 2. Understand the principles of strength and stability
CO 3. Design and develop analytical skills.
CO 4. Summarize the behavior of various structural systems.
CO 5. Understand the concepts of P-Delta analysis

Course Contents

Unit 1

Introduction: Evolution of tall buildings – Classification of Buildings – Low-rise, medium-rise, highrise – Ordinary framed buildings & Shear-wall buildings –Behaviour of buildings under lateral loads like Wind loads, Earthquake loads & Blast loads – Basic structural & functional design requirements – Strength, Stiffness & Stability

Unit 2

Lateral load resisting elements :Frames, Shear walls & Tubes – Shear, Bending & combine modes of deformation – Structural behavior of Rigid frames – Simplified methods of analysis – Substitute frame method, Portal method, Cantilever method, Equivalent frame method –Structural behaviour of Shear walls – Approaches of analysis – Elastic continuum approach & Discrete approach — Structural behavior of Tubes –Actions.

Unit 3

Choice of System for a Building:Frame building, Shear wall building, Shear walls acting with frames, Single framed tubes – Other structural forms – Staggered Wall-beam system, Tube-in-tub system, Base isolation technique for earthquake resistance. Load distribution in a tall building – Load resisted by different shear walls & frames – Determinate & Indeterminate problems – Equivalent Stiffness method.

Unit 4

Methods of Analysis:Shear walls without Openings – Estimation of Stiffness by simple Cantilever theory & Deep beam theory – Shear walls with Openings – Equivalent frame for large openings – Muto's method for small openings –Elastic Continuum approach – Coull & Chowdhry's method – Design Charts – Limitations of Continuum approach. Shear wall-Frame Interaction: Sharing of loads between wall & frame – Different methods – comparison — Khan & Sbrounis' method – Design charts – Mac Leod's method – Advantages & limitations — Cooperation of Floor slabs – Equivalent width.

Unit 5

Other high-rise building structure: Deep Beam Systems ,High-Rise Suspension Systems Pneumatic High ,Rise Buildings, Space Frame Applied to High , Rise Buildings , Capsule Architecture.

Course Resources

a. Essential Reading

1. Taranath B.S, "Structural Analysis and Design of Tall Buildings"- McGraw Hill
2. Wilf gang Schuller, "High rise building structures"- John Wiley
3. Bryan Stafford Smith & Alexcoull, "Tall building structures Analysis and Design"- John Wiley

b. Recommended Reading

1. Reinforced Concrete Design of Tall Buildings by Bungales. Taranath, CRC Press.
2. Analysis of Shear Walled Buildings by S. M. A. Kazimi& R. Chandra, Tor-steel Research Foundation, Calcutta, India.
3. Analysis of Framed Structures by Gere & Weaver

c. Other Electronic Resources

https://nptel.ac.in/

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

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

Course Title	Design of Formwork and Precast Structures
Course Code	19STE526A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course deals with various construction technologies adopted in the construction of different components of Civil Engineering structures. Identification, selection, planning and application of construction formwork and scaffolding technology will be discussed. The various methods, design techniques involved in formwork structures are discussed. Students will also be taught the concepts, classification, planning and design of precast structures.

Course Outcomes

After undergoing this module students will be able to:

CO 1. D Compute different types of loads acting on formwork and check for their stability
CO 2. Design formworks for various civil engineering structures
CO 3. Propose suitable construction and scaffolding technology for the construction of special structures
CO 4. Suggest a cost effective solution for usage of equipment, formwork and technology
CO 5. Compare and contrast the different technologies involved in manufacture, mix design and placement methods of concrete
CO 6. Classify and design precast elements

Course Contents

Unit 1 Construction Equipment and Management:
Scaffolding:
Planning, Site Equipment for formwork:
General objectives of formwork building, forms for foundations, columns, beams, walls, etc., overall planning, detailed planning, standard units, corner units, pass units; Calculation of labour constants, labour requirements, formwork hours; costing and planning at tender stage, development of a basic system, planning for maximum reuse; planning for safety, transporting plant, formwork beams, scaffold frames, framed panel formwork, wales and ties, vertical transportable frame work, formwork accessories.

Unit 2 Materials, Accessories and Proprietary Products:
Lumber- types, finish, sheathing ratio, working stresses, repetitive member stress, plywood- types and grades, jointing, boarding, textured surfaces and strength, reconstituted wood; Steel- aluminum- form lining materials, hardware and fasteners, nails in plywood.

Unit 3 Design Considerations:
Live loads and wind pressure, concrete pressure on formwork, concrete density, height of discharge, temperature, rate of placing, consistency of concrete, vibration, hydrostatic pressure and pressure distribution, examples; Adjustment for non- standard conditions, basic simplification, beam forms, slab forms, column forms, wall forms, allowable stresses; Check for deflection, bending and lateral stability shear and bearing, examples in each, simple wood stresses, slenderness ratio, allowable load v/s length behavior of wooden shores; Form lining, design tables for wall framework, slab formwork,

column formwork, slab props, stacking towers, free standing and restrained; Rosette shoring, shoring tower, heavy duty propsIssues

Unit 4 Formwork Design:
Shell forms- design considerations, loads, building forms, strength requirements, tunnel forming components, curb and gutter forms, invert forms, arch forms, concrete placement methods; Slip forms- principles, types, advantages, functions of various components, planning, safety in slip forms, special structures built with slip-form technique, codal provisions; Types of scaffolds- putlog and independent scaffold- single pole scaffolds, fixing ties, spacing of ties, bracing, knots safety net, general safety requirements, shuttering for precast members and continuous casting forms

Unit 5 Building and Erecting the Formwork:
Location of job mill, storage, equipment, form for wall footings, column footings, slab on grade and paving work, highway and airport paving, external vibration, prefabricated panel systems, giant forms, curved wall forms, erection practices, column heads, beam or girder forms, suspended forms, concrete joint construction, flying system forms; Causes of failures- case studies, finishes of exposed concrete, design deficiencies, safety factors, stripping sequence, re-shore installation, advantages of re-shoring.

Unit 6 Concept of Precast Construction:
Necessity, advantages, disadvantages, mass produced steel, reinforced concrete and masonry systems, industrial buildings; Concept of modular coordination, basic module, planning and design modules, modular grid systems, National Building Code specifications; Standardization, dimensioning of products, preferred dimensions and sizes, tolerances and deviations, layout and process.

Unit 7 Precast Classification:
Foundations, columns, beams, roof and floor panels, wall panels, clay units, box prefabricates in erection and assembly.
Construction techniques:
Large panel system, tunnel system, skeletal system, lift slab system, box system, Equipment for horizontal and vertical transportation.
Unit 8
Precast materials and manufacturing:
Dry cast concrete, wet cast concrete, self-compacting concrete, sandwich panel construction, precast light concrete, precast ultra concrete, types of surface finishes, supports and fixing.
Design of Precast Elements:
Basic design considerations, general design procedure for architectural precast concrete cladding units.
Joints and connections: Definition, Basic mechanisms, compression joints, shear joints, tension joints, pinned jointed connections, moment resisting connections
Component design: Design of beams, columns, wall panels, slab footings and their lift point systems

Course Resources

a. Essential Reading

1. Class Notes
2. Peurifoy R. L. and Oberlender, G. D. (1996), Formwork For Concrete Structures, McGraw Hill
3. Sheppard D. A. and Phillips W. R., (1989), Plant - Cast Precast and Prestressed Concrete : A Design Guide
4. Bachmann H., Steinle A., (2011), Precast Concrete Structures, Ernst and Sohn

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

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

b. Recommended Reading

1. Elliot S.K., (2002), Precast Concrete Structures, Butterworth Heinemann
2. PCI Design Handbook Precast and Prestressed Concrete, 6th Edition, PCI Industry Handbook Committee

c. Magazines and Journals

1. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campus, Chennai
2. ACI Structural Journal, ACI Structural Journal American Concrete Institute, 38800 Country Club Dr. Farmington Hills, MI48331-34349 USA

d. Other Electronic Resources

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

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

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

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

Course Title	Advanced Design of RCC structures
Course Code	19STC511A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This module deals with the design philosophies and procedures for Reinforced Concrete (RC) structures. Student are exposed to various concepts and practices used in design of flat slabs, design of continuous beams with redistribution of moments chimneys, deep beams, grid floors, bunkers and overhead tanks. Students are taught the seismic design philosophy, codal provisions and their application on different type of structures Students are also taught to analyze and design RCC structures using various software packages.

Course Outcomes

After undergoing this module students will be able to:

CO 1. Use the design philosophies and procedures for RC structures
CO 2. Illustrate codal provisions and their application on different types of structures
CO 3. Design RC Structures structures based on codal provisions of different countries and produce working structural working drawings
CO 4. Analyze and design RC structures like flat slab, chimneys, deep beams, grid floors, bunkers, silos and water tanks using suitable software
CO 5. Validate the analysis and design of RC structures using suitable software and compare with semi-empherical method

Course Contents

Unit 1 The nature of concrete, stress-strain relationships of concrete, stress block parameters. Failure criteria for concrete, behavior of concrete flexural members, general equations for calculation of moment capacities at ultimate limit state and at limit state of local damage, flexural rigidity, calculation of deflection, redistribution of moments, design examples.

Unit 2 Design of continuous beams with redistribution of moments

Unit 3 Analysis and design of flat slabs, chimneys, cooling towers, bunkers, silos and overhead water

Unit 4 Design of reinforced concrete deep beams:
Introduction, minimum thickness, steps of designing deep beams, design by IS 456, design according to British practice, ACI procedure for design of deep beams, checking for local failures, detailing of deep beams

Unit 5 Approximate analysis of grid floors:
Introduction, analysis of flat grid floors, analysis of rectangular grid floors by Timoshenko's plate theory, analysis of grid floors by equating joint deflections, comparison of methods of analysis, detailing of steel in flat grids.

Unit 6 Earthquake resistant design:
Seismic design philosophy, Earthquake resistant design of RC and Steel and masonry buildings

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore-560058

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

Course Resources

a. Essential Reading

1. Class Notes
2. Varghese P C,(2008) Advanced Reinforced Concrete Design Practice, Hall of India, Neevpeth
3. Krishna Raju,(2008) Advanced R C Design, CBSRD ,Tata McGraw-Hill Publishing Company Ltd, New Delhi
4. S S Bhavikatti,(2008)Advanced RCC Design, New age international pvt. Ltd

b. Recommended Reading

1. Fintel,(2004) Handbook of Concrete Engineering, Van Nostrand
2. Punmia,(2006) Reinforced concrete structures Vol. 1 and 2, Standard Publications
3. Dr.Punmia.B.C, Ashok Kumar Jain, Arun Kumar Jain,(1998) Comprehensive RCC Design

c. Magazines and Journals

1. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campus, Chennai
2. ACI Structural Journal, ACI Structural Journal American Concrete Institute, 38800 Country Club Dr. Farmington Hills, MI48331-34349 USA

d. Other Electronic Resources

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

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

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

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

Course Title	Theory of Elasticity and Plasticity
Course Code	19STC512A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course deals with analysis of stresses, analysis of strains, stress-strain relations, two dimensional problems in Cartesian coordinate system, two dimensional problems in polar coordinate system and torsion of prismatic bars. Introduction to plasticity, plastic behaviour under plane stress conditions, plastic behaviour of bar structures and theorems of limit analysis, hardening are discussed. Students are taught the concepts of elasticity, plasticity, Airy's stress function and their applications in structural design. Students are also taught to predict material behaviour under various loading conditions using various

Course Outcomes

After undergoing this module students will be able to:

CO 1. Apply the mathematical preliminaries to understand the basics of elasticity
CO 2. Discuss the displacements, strains, state of stress in a body and stress equilibrium
CO 3. Calculate the general state of stress and strain at a point in the body and body forces for equilibrium
CO 4. Discuss the theorems of limit analysis and plastic behaviour
CO 5. Discuss the concepts of yield surfaces, hardening, hardening models and normality rule
CO 6. Apply the concepts to understand constitutive models and predict structural behaviour

Course Contents

Unit 1 Continuum Concept and Continuum Mechanics, Mathematical Preliminaries: Scalars, Vectors, Cartesian Tensors, Indical notation, Kronecker Delta, Alternating symbol, Co-ordinate transformations, Eigen values and eigen vectors of a symmetric tensor, Invariants of a tensor, Vector, Matrix and Tensor Algebra, Calculus of Cartesian Tensors, Curvilinear co-ordinates
Displacements and strains: Deformation, Deformed Configuration, Analysis of deformation, Rigid body motion, Strain-displacement relations, State of Strain, Strain tensor, Strain invariants, Interpretation of strain tensors, Principal strains, Spherical and Deviatoric strains, Mohr's circle of strains, Compatibility conditions, Strains in Polar co-ordinates

Unit 2 Stresses and Equilibrium: Body force, Surface force, Stress vector, Stress tensor, Stress invariants, Principal stresses and principal planes, Shear stresses, Spherical and Deviatoric stresses, Laws of Motion, Equilibrium equations, Stress transformation, Mohr's circles for 2-D and 3-D state of stresses, Equilibrium equations in polar coordinates for two-dimensional state of stresses.
Material Behaviour: Linear Elastic Materials, Generalised Hooke's law, transformation of compatibility conditions from strain components to stress components, Plane stress and plane strain conditions, Airy stress function, Stress function for plane stress and plane strain cases, solution of two-dimensional problems with different loading conditions by the use of polynomials

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

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

Dean
Faculty of Engineering and Technology
M.S. Ramaiah University of Applied Sciences
Bangalore-560054

Unit 3 Two Dimensional Problems in Polar Coordinate System: Strain-displacement relations, compatibility equation, stress- strain relations, stress function and bi-harmonic equation Axisymmetric problems, thick-walled cylinders, rotating disks of uniform thickness, stress concentration, effect of circular holes on stress distribution in plates, General solution of the torsion problem of prismatic bars, stress function, torsion of circular and elliptic cross sections
Application of suitable software for the estimation of stresses and strains

Unit 4 Axisymmetric problems, thick-walled cylinders, rotating disks of uniform thickness, stress concentration, effect of circular holes on stress distribution in plates, General solution of the torsion problem of prismatic bars, stress function, torsion of circular and elliptic cross sections
Application of suitable software for the estimation of stresses and strains

Unit 5 Introduction to Plasticity: Introduction, nonlinear stress-strain behavior, theories of failure, physical assumptions, criterion of yielding, strain-hardening postulates, rule of plastic flow. Plastic stress strain relationship, elastic plastic problems in bending – torsion and thick cylinder.

Unit 6 Framework of Plastic Constitutive Relations: Plastic behaviour in simple tension, generalisation of results in simple tension, yield surfaces, uniqueness and stability postulates, convexity of yield surface and normality rule, limit surfaces.
Initial Yield Surfaces for Metals: Summary of general form of plastic constitutive equations, the Tresca initial yield condition, consequences of isotropy.

Unit 7 Plastic Behaviour under Plane Stress Conditions: Initial and subsequent yield surfaces in tension-torsion, the isotropic hardening model, the kinematic hardening model, yield surfaces made of two or more yield functions, piecewise linear yield surfaces, elastic perfectly plastic material
Plastic Behaviour of Bar Structures: Behaviour of a three bar truss, behaviour of a beam in pure bending, simply supported beam subjected to a central point load, fixed beams of an elastic perfectly plastic material, combined bending and axial force.
The Theorems of Limit Analysis: Introduction, theorems of limit analysis, alternative statement of the limit theorems, the specific dissipation function.

Unit 8
Limit Analysis in Plane Stress and Plane Strain: Discontinuities in stress and velocity fields, the Tresca yield condition in plane stress and plane strain, symmetrical internal and external notches in a rectangular bar, the punch problem in plane strain, remarks on friction.
Stress Concentrations: Basic concepts, nature of stress concentration problems. Stress concentration factors, experimental techniques, stress gradients due to concentrated load, the stationary crack, crack propagation, stress intensity factor, effective stress concentration factors and applications

Course Resources

a. Essential Reading

1. Class Notes
2. Chandramouli (2014) Continuum Mechanics, Yes Dee Publishers
3. J.Chakrabarty (2014) Theory of Plasticity, Elsevier Publisher

Approved by the Academic Council at its 26th meeting held on 14th July 2022

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

b. Recommended Reading

1. Sadhu Singh, (2003) Theory of Elasticity, Khanna Publishers
2. Timoshenko, Goodier, (2010) Theory of Elasticity, McGraw-Hill
3. Srinath L.S., (2010) Advanced Mechanics of Solids, 10th print, Tata McGraw Hill

c. Magazines and Journals

1. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campus, Chennai
2. ACI Structural Journal, ACI Structural Journal American Concrete Institute, 38800 Country Club Dr. Farmington Hills, MI48331-34349 USA

d. Other Electronic Resources

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

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

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

Course Title	Advanced Design of Steel Structures
Course Code	19STC513A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This module deals with the design philosophies and procedures for Steel, Aluminium and cold formed structures. Student are exposed to various concepts and practices used in design of chimneys, silos, bunkers, transmission towers, aluminium and cold formed structures. Students are taught the seismic design philosophy, codal provisions and their application on different type of steel structures. Analysis and design of steel towers, storage structures, tall structures, industrial structures, light gauge steel and alluminum structures are also dealt. Students are also taught to analyze and design steel structures using various software packages.

Course Outcomes

After undergoing this module students will be able to:

CO 1. Use the design philosophies and procedures for Steel structures
CO 2. Illustrate codal provisions and their application on different types of Steel, light gauge and cold formed structures
CO 3. Design Metal structures based on codal provisions of different countries and produce working structural drawings
CO 4. Analyze and design steel structures like tubular connections, transmission tower, light gauge steel structure, industrial building , aluminum structure using suitable software
CO 5. Validate the analysis and design of metal structures using suitable software and compare with semi- empherical method pply the mathematical preliminaries to understand the basics of elasticity

Course Contents

Unit 1 Metal Structures: Introduction, plastic methods of analysis and design, plastic behaviour under static and cyclic loading, static, kinematic and uniqueness theorems, shape factors, moment redistribution, analysis of single and two bay portal frames, plastic design with LRFD concepts, LRFD with elastic analysis, current and future design philosophies.
Unit 2 Design of connections: Bolted connections, failure modes of a joint, high strength bolts, HSFG bolts, seat angle and web angle connections, moment resistant connections, semi rigid connections, design of framed beam connection, continuous beam to beam connection. Welded connections, stiffened beam seat connection, moment resistant joint
Unit 3 Design of storage structures and tall structures: Design of liquid retaining structures, silos, bunkers, chimneys and transmission towers.
Unit 4 Design of industrial buildings: Design of members subjected to lateral loads and axial loads, sway and non-sway frames, bracings and bents, rigid frame joints, knees for rectangular frames and pitched roofs, knees with curved flanges, valley joints, rigid joints in multi-storey buildings, vierendeel girders.
Unit 5 Design principles of structures with round tubular sections: Introduction, round tubular section, permissible stresses, compression members, tension members, beams and roof trusses

Unit 6 Design of light gauge (Cold formed) steel structures: Introduction, types of cross sections, materials, local and post buckling of thin elements, stiffened and multiple stiffened compression elements, tension members, beams and deflection of beams, combined stresses and connections.

Unit 7 Design of aluminium structures: Introduction, stress-strain relationship, permissible stresses, tension members, compression members, laced and battened columns, and beams, local buckling of elements of compression, riveted and bolted connections.

Unit 8

Multi Storey Building: Introduction to multi storey buildings, Loading, Analysis for gravity and lateral loads, Advanced structural forms

Course Resources

a. Essential Reading

1. Class Notes
2. S K Duggal, Design of Steel Structures , 3rd Edittion, McGraw-Hill Education
3. Rama Chandra, Design of Steel Structures, Volume 2, Standard Book House
4. IS: 800 (2007), Code of Practice for General Construction in Steel, BIS
5. IS : 801 (1975), Code of Practice for use of Cold-Formed light gauge steel structural, BIS
6. IS:875 (Part I to Part V), Code of Practice for Design Loads (Other than Earth quake load)
7. SP 6(1) (1964), Hand Book for Structural Engineers
8. AISI:D110(2016), cold formed steel framing design guide
9. IS: 8147 (1976), Code of practice for use of Aluminium alloys

b. Recommended Reading

1. Gaylord,(2010) Design of Steel Structures, McGraw Hill, New York
2. Dayarathnam, (1999) Design of Steel Structures, Wheeler Pub
3. N. Subramanian, (2010), Steel Structures: Design and Practice, Oxford publications

c. Magazines and Journals

1. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campus, Chennai

2. ACI Structural Journal, ACI Structural Journal American Concrete Institute, 38800 Country Club Dr. Farmington Hills, MI48331-34349 USA

d. Other Electronic Resources

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

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

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

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

Course Title	Design of RCC, PSC and Steel Bridges
Course Code	19STE531A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This module deals with design of various types of bridges and studies essential for a bridge project. Students will be taught design of all the components of RCC, PSC and Steel bridges. Various types of bearings and expansion joints are explained. Different types of surveys which has to conduct to get the details of bridge site are also discussed.

Course Outcomes

After undergoing this module students will be able to:

CO 1. Discuss the different types of bridges , loads and stresses acting on bridges
CO 2. Discuss various surveys and investigations to be conducted for bridge project
CO 3. Discuss the suitability of RCC, PSC and Steel bridges
CO 4. Design various types of bearings, expansion joints and foundation for a bridge structure
CO 5. Design of all components of RCC, PSC bridges and steel bridges

Course Contents

Unit 1 Types of Bridges: Consideration of loads and stresses in bridges, bridge loading as per IRC and IRS specifications, traffic lanes, footway, kerbs, railing and parapet loading, impact, wind load, longitudinal forces, temp effects, secondary stresses, erection stresses, earth pressure, effect of live load on back fill and on the abutment.

Unit 2 Design of RC Bridges: Slab culvert, box culvert, pipe culvert, T-beam bridge, super structure, design examples, brief introduction to rigid frame, arch and bow string girder bridges.

Unit 3 Design of pre-stressed concrete bridges: pre-tensioned and post tensioned concrete bridges, analysis and design of multi-lane pre-stressed concrete T-beam bridge super structure.

Unit 4 Steel Bridges: Types, economical span, loads, permissible stresses, fluctuation of stresses, secondary stresses, plate girder bridges, general arrangement, bridge floors, plate girder railway bridges, deck type plate girder bridges, design example. Truss bridges, types, wind force on lattice girder bridge, bracings, truss bridge for railway – through type truss bridge.

Unit 5 Substructures: Pier, abutment and wing walls, types of piers, forces on piers, stability, abutments, bridge code provisions for abutments, wing walls and design examples.

Unit 6 Bearings: Functions, bearings for steel and concrete bridges, bearings for continuous span bridges, IRC provisions for bearings, fixed bearings, expansion bearings, materials and specifications, permissible stresses, design considerations for rocker and roller cum rocker bearings, sliding bearings.

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

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

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

Unit 7 Foundations: Types, general design criterion, design of well and pile foundations for piers and abutments.

Course Resources

a. Essential Reading

1. Class Notes
2. Victor D. J., (1980) Essentials of Bridge Engineering, Oxford and IBH.
3. Krishna Raju N., (1988) Design of Bridges, Oxford and IBH.
4. T. R. Jagadeesh and M. A. Jayaram, (2009), Design of Bridge Structures, PHI Learning pvt. Ltd.

b. Recommended Reading

1. Raina V. K., (2002) Concrete Bridge Practice: Analysis, Design and Economics, Tata McGraw Hill.
2. Fryba L., (1996) Dynamics of Railway Bridges, Thomas Telford.
3. IRC 6, (2014), Standard Specifications and Code of Practice for Road Bridges- Section II- Loads and Stresses
4. IRC 21 (2000), Standard Specifications and Code of Practice for Road Bridges- Section III- Cement Concrete (Plain and Reinforced)

c. Magazines and Journals

1. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campus, Chennai
2. ACI Structural Journal, ACI Structural Journal American Concrete Institute, 38800 Country Club Dr. Farmington Hills, MI48331-34349 USA

d. Other Electronic Resources

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

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

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

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

Course Title	Reinforced Soil Structures
Course Code	19STE532A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course deals with fundamentals of reinforced earth construction. Students are introduced with the concepts of Geosynthetics and its functions. Students are taught design of reinforced earth retaining walls with typical design problems. Geosynthetics filter design requirements and Geosynthetics for roads and slopes road are also dealt.

Course Outcomes

After undergoing this module students will be able to:

CO 1. Discuss basics of reinforced earth construction
CO 2. Describe geosynthetics and their functions
CO 3. Explain the concept of soil nailing technique
CO 4. Apply the design philosophies and design reinforced earth retaining walls
CO 5. Apply the design philosophies and design reinforced earth foundations and embankments foundations

Course Contents

Unit 1 Introduction:

Fundamentals of reinforced earth construction-definition, historical background, components, mechanism and concept, advantages and disadvantage of reinforced earth construction
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 man-made, geosynthetics – geotextiles, geogrids, geomembranes, geocomposites, geonets, geofoam, geomats, geomeshes, geowebs etc.

Unit 2 Design of reinforced earth retaining walls -
Cconcept of reinforced earth retaining wall, internal and external stability, selection of materials, typical design problems.

Unit 3 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 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.

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

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

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

Unit 5 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.

Unit 6 Landfills –
Typical design of landfills – landfill liner & cover, epa guidelines, barrier walls for existing landfills and abandoned dumps

Unit 7 Foundations: Geosynthetics for roads and slopes roads -
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.

Course Resources

a. Essential Reading

1. Class Notes
2. Koerner. R.M., (2005), Design with Geosynthetics, Prince Hall Publication
3. 2. 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.(2006), Reinforced Soil and its Engineering Applications, International Pvt. Ltd, New Delhi
6. Venkattappa Rao, G., and Suryanarayana Raju, Engineering with Geosynthetics, Tata Mc 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 Octial, 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, Editor Sarsby R W, Woodhead Publishing Ltd. CRC Press, 2007

c. Magazines and Journals

1. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campus, Chennai

2. ACI Structural Journal, ACI Structural Journal American Concrete Institute, 38800 Country Club Dr. Farmington Hills, MI48331-34349 USA

d. Other Electronic Resources

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

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

Course Title	Fire and Safety Engineering Design
Course Code	19STE534A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Engineering and Technology

Course Summary

The main objective of the course is to expose the students to the concept of fire resistant design of structures, to understand the behavior of structural systems and materials under the fire effects. Further objective is to learn basic fire safety design issues and gain an educational & comprehensive experience on fire resistance design concepts.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Interpret the intentions of code requirements for fire safety
- **CO 2.** Discuss the concepts of fire severity and fire resistance
- **CO 3**. Discuss the various methods of testing structures for fire resistance
- **CO4.** Calculate fire resistance, Depth of temperature reached, temperature in plane and bar type structures and change in strength of structures due to temperature variations
- **CO 5**. Design of concrete and steel structures to resist fire exposure

Course Contents

Unit 1: Classification of Buildings and Types of Production Processes
Types of construction and classification of buildings, Main building elements, Requirements of buildings, Combustibility and fire resistance

UNIT 2: Fire Safety in Buildings
Fire safety objectives, Life safety, Property protection, Environmental protection. Fire resistance, Objectives for fire resistance, Fire design time, trade-offs.

Unit 3: Calculation of Required Fire Resistance Limit of Building Structures
Initial condition for calculating fire resistance of structures, Duration of fire, Temperature of fire, Main points on the method of investigating temperature regimes of fires, Results of experimental investigations on fires, Simulation of temperature regimes of fires, Determination of fire in residential and public buildings, Determination of fire duration of fire in industrial buildings and warehouses

Unit 4: Methods of Testing Structures for Fire Resistance
Problems of testing for fire resistance, Set-up for testing fire resistance, Temperature regime of the tests, Test pieces of structures, Conditions of loading and supporting of structures

Unit 5: Fire Resistance of Reinforced Concreter Structures
Main aspects of the calculations for fire resistance, Thermo technical part of the calculation Boundary conditions, Calculation of temperature in plane structures (one- dimensional temperature field), Calculation of temperature in bar type structures (Two- dimensional temperature field), Calculation of depth at which a given temperature is reached, Effect of moisture in concrete on the heating of structures, Thermo physical properties of concrete at high temperatures ,Statics part of calculations, Change in the strength of reinforcement steel with increase of temperature, Change in the strength of concrete in compression with increase in temperature, Coefficients of thermal expansion of

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

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

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

reinforcement bars and concrete, Axially loaded columns, Statically determinate elements subjected to bending stresses.

Unit 6: Design of Structures Exposed to Fire
Design equation, loads for fire design, Structural analysis for fire design, Computer calculations. Material properties in fire,Testing regimes, Components of strain. Design of individual members exposed to fire, Tension members, Compression members, Beams. Design of structural assemblies exposed to fire, Frames, Redundancy, Disproportionate collapse, Continuity, Plastic design.

Course Resources

a. Essential Reading

1. Class Notes
2. Andrew H. Buchanan, "Structural Design for Fire Safety" John Wiley & Sons. Ltd – 2001.

b. Recommended Reading

1. U.S Bendev Etal, "Fire Resistance of Buildings"- Amerind Publishing Co. Pvt. Ltd
2. IS: Andrew H. Buchman "Structural design for fire safety, comprehensive overview of the fire resistance of building structures"-, John Wiley and sons., 2001.
3. IS John A. Purkiss "Fire Safety Engineering Design of structures"-, Butterworth Heinemann, 2009.

c. Other Electronic Resources

1. Electronic resources on the module area are available at MSRUAS library

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

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

Course Title	Condition assessment, Repair, Rehabilitation and Artificial Intelligence
Course Code	19STE541A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This module introduces the basic concepts and techniques of Artificial Intelligence (AI), structural health monitoring and retrofitting. Topics covered are Expert systems, uncertainty, Neural Network, and fuzzy Logic, and their applications of AI in Construction Management. This module also provides an in depth knowledge about causes of structural failures and structural health monitoring of the structures. Students will be trained to develop Efficient and cost-effective approaches for repair, rehabilitation and retrofitting of structures. Students will be trained in forensic investigations, issue reports and provide expert testimony during depositions and trials.

Course Outcomes

After undergoing this module students will be able to:

CO 1. Explicate characteristics of AI that make it useful to real-world civil engineering problems, different causes of structural failures of buildings, bridges and other constructed facilities, sensors

CO 2. Discuss Artificial Neural Network (ANN), Fuzzy logic (FL) and expert systems (ES), sensors and Data acquisition systems and their applications in specialisations of civil engineering

CO 3. Identify suitable Sensor and SHM technique for a given structure, and AI models for applications Specialisations of civil engineering

CO 4. Design Efficient and cost-effective approaches for repair, rehabilitation and retrofitting of structures Conduct forensic investigations, issue reports and provide expert testimony during depositions and trials

CO 5. Apply concepts of ANN, FL and ES in specializations of Civil Engineering

CO 6. Compare and contrast different failures and recommend code standards and practices to avoid failures in the future

CO 7. mpute different types of loads acting on formwork and check for their stability

Course Contents

Unit 1 Artificial Intelligence:

Introduction to Artificial Intelligence (AI), branches of AI, and applications of AI to civil engineering Expert systems superiority over conventional software, components of an expert system, expert system life cycle, expert system development process, nature of expert knowledge, techniques of soliciting and encoding expert knowledge; Inference- Forward chaining, backward chaining, rule value approach.

Knowledge based approaches in engineering Expert Systems:

Fundamentals of Neural Networks: Research history, model of artificial neurons, neural networks architectures, learning methods in neural networks, single layer neural network system. Applications of Neural Networks in Structural engineering:

Unit 2 Introduction, Fuzzy set - Membership, Operations, Properties, Fuzzy Relations; fuzzy models in Structural Engineering Application of AI in Structural Engineering
Environmental Problems and Natural Hazards: Effect of corrosive, chemical and marine environment, pollution and carbonation problems, durability of RCC structures, damage due to earthquakes and flood, strengthening of buildings, provisions of BIS 1893 and 4326

Unit 3 Structural Health Monitoring:
Review of Structural Modelling and Finite Element Models: Modelling for damage and collapse behaviour of structures, finite element modelling, theoretical prediction of structural failures

Unit 4 Signals, Systems and Data Acquisition Systems: Acoustic emission sensors, ultrasonic sensors, piezoceramic sensors and actuators, fibre optic sensors and laser shearography techniques, imaging techniques. Health Monitoring/Diagnostic Techniques: Vibration signature analysis

Unit 5 Building and Erecting the Formwork:
Location of job mill, storage, equipment, form for wall footings, column footings, slab on grade and paving work, highway and airport paving, external vibration, prefabricated panel systems, giant forms, curved wall forms, erection practices, column heads, beam or girder forms, suspended forms, concrete joint construction, flying system forms; Causes of failures- case studies, finishes of exposed concrete, design deficiencies, safety factors, stripping sequence, re-shore installation, advantages of re-shoring.

Unit 6 Classification of Techniques:
Integrated Health Monitoring Systems: Intelligent Health Monitoring Techniques, neural network classification techniques, extraction of features from measurements, and case studies

Unit 7 Information Technology for SHM:
Information gathering, signal analysis,information storage, archival, retrieval, security; wireless communication, telemetry, real time remote monitoring, network protocols, data analysis and interpretation.

Unit 8
Classification of techniques. Project Based Health Monitoring Techniques: Health monitoring techniques based on case studies, practical aspects of testing large bridges for structural assessment, optimal placement of sensors, structural integrity of aging multistorey buildings, condition monitoring of other types of structures.
Case studies: Buildings- heritage buildings- high rise buildings, water tanks, bridges and other structure

Course Resources

a. Essential Reading

1. Class Notes
2. Krishnamoorthy C.S., Rajeev S., (1996)Artificial Intelligence and Expert Systems for Engineers, CRC Press, CRC Press LLC
3. Rajasekaran S. and VijayalaksmiPai G.A., (2005) Neural Network, Fuzzy Logic, and Genetic Algorithms - Synthesis and Applications, Prentice Hall
4. Adeli H., Karim A., (2001) Construction scheduling , cost optimisation, and management, Spon Press, New York

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

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

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

b. Recommended Reading

1. Winston P.H., (1999) Artificial Intelligence, Pearson Educati
2. Lugur G. F., (2002) Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Addison – Wesley
3. Russel S. and Norvig P., (2002) Artificail Intelligence: A Modern Approach, Prentice Hall

c. Magazines and Journals

1. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campus, Chennai
2. ACI Structural Journal, ACI Structural Journal American Concrete Institute, 38800 Country Club Dr. Farmington Hills, MI48331-34349 USA

d. Other Electronic Resources

http://nptel.ac.in/

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

Registrar
M.S. Ramaiah University of Applied Sciences
Bangalore-560054

Course Title	Theory of plates, shells and composites
Course Code	19STE542A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This module deals with the bending of plates, laterally loaded rectangular plates, classification of shell structures, general theory of cylindrical shells, composites and smart materials. Students are taught the concepts of bending of rectangular plates, bending of circular plates, Navier's solution for SS plate subjected to various loads, general theory of cylindrical shells and macro mechanical failure theories of composites. Analysis and design of spherical domes, water tanks, shell roofs and laminated structural elements will be discussed. Students are also taught to analyse the stress-strain relations, load deformation.

Course Outcomes

After undergoing this module students will be able to:

CO 1. Explain plate, shell and composite structures
CO 2. Discuss the classical theories of plates, shells and composites
CO 3. Solve simply supported plates subjected to various loads and boundary conditions
CO 4. Evaluate different types of folded plates, lamina and laminates.
CO 5. Analyze and design spherical domes, water tanks, barrel vaults, hyperbolic paraboloid
CO 6. roofs and laminated structural elements
CO 7. Analyze and design plates, shells and composite structures by using standard FEA Packages

Course Contents

Unit 1 Plates: Introduction, slope and curvature of slightly bent plates, relations between bending moments and curvature in pure bending of plates, strain energy in pure bending, differential equation for cylindrical bending of plates, differential equation for symmetrical bending of laterally loaded circular plates, uniformly loaded circular plates with and without central cutouts, with two different boundary conditions (simply supported and clamped). Centrally loaded clamped circular plate, circular plate on elastic foundation

Unit 2 Laterally loaded rectangular plates: Differential equation of the deflection surface, boundary conditions, simply supported rectangular plates subjected to harmonic loading. Navier's solution for SS plate subjected to UDL, patch UDL, point load and hydrostatic pressure. Bending of rectangular simply supported plate subjected to a distributed moments at a pair of opposite edges, numerical examples

Unit 3 Bending of rectangular plates subjected to UDL (i) two opposite edges simply supported and the other two edges clamped, (ii) three edges simply supported and one edge built-in and (iii) all edges built-in. Bending of rectangular plates subjected to uniformly varying lateral load (i) all edges built-in and (ii) three edges simply supported and one edge built-in.

Unit 4 Design and detailing of folded plates with numerical examples.

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

Shells: Introduction, Classification of shells- Surfaces of Revolution, Translational Surfaces and Ruled Surfaces

Unit 5 Cylindrical shells: General theory and analysis of cylindrical shells (Membrane Theory, beam theory, arch analysis): Circular cylindrical shell loaded symmetrically with respect to its axis, particular cases of symmetrical deformations of circular cylindrical shells, cylindrical tanks of uniform wall thickness.
Analysis & design of spherical domes with and without lanterns at top, water tanks, barrel vaults and hyperbolic paraboloid roofs. Construction of concrete shell roofs and folded plates.

Unit 6 FEM for plates and shells: Finite element analysis of thin plate, thick plate and skew plate using triangular CST elements, rectangular elements and finite element analysis of shell.

Unit 7 Introduction to fibrous composites:
Introduction, definition, classification and characteristics of composite materials, advantages and limitations. Characteristics and configurations of lamina, laminate, micromechanics and macro mechanics

Macromechanical Analysis of a Lamina:
Introduction, Hooke's law for different types of materials, Hooke's law for a two-dimensional unidirectional lamina, Hooke's law for a two-dimensional angle lamina, Strength failure theories of angle lamina, hygrothermal effects on lamina.

Micromechanical Analysis of a Lamina:
Introduction, volume and mass fractions, density, and void content, evaluation of the four elastic moduli, ultimate strengths of a unidirectional lamina, coefficients of thermal and moisture expansion

Unit 8
Macromechanical Analysis of Laminates:
Introduction, stress–strain relations for a laminate, in-plane and flexural modulus of a laminate, hygrothermal stresses and strains in a laminate, failure analysis of a laminate

Course Resources

a. Essential Reading

1. Class Notes
2. Timoshenko, Krieger, (2001) Theory of Plates and Shells, McGraw Hill, International Book Company
3. S S Bhavikatti,(2012) Theory of plates and shells,New age international Pvt. Ltd.
4. Chandrashekara K,(2000) Theory of Plates,University Press
5. Chatterjee B.K., (1986) Theory and Design of Concrete Shell Roofs, CBS Publications and Distributiors,New Delhi

b. Recommended Reading

1. Ugural A C, (2011) Stressin Plates and shells, McGraw-Hill International Book Company
2. Ramaswamy G.S.,(1986) Design and Constructions of Concrete Shell Roofs, CBS Publishers and Distributors,New Delhi
3. M. Mukhopadhya,(2009) Mechanics of Composite Materials and Structures,Universities Press
4. Robart M.Jones,(1998) Mechanics of Composite Materials, McGraw Hill PublishingCo.
Bhagwan D Agarvalm, Lawrence J Brutman,(2006) Analysis and Performance of Fiber Composites, JohnWilly and Sons

c. Magazines and Journals

Approved by the Academic Council at its 26th meeting held on 14th July 2022

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

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

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

1. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campus, Chennai
2. ACI Structural Journal, ACI Structural Journal American Concrete Institute, 38800 Country Club Dr. Farmington Hills, MI48331-34349 USA

d. Other Electronic Resources

http://nptel.ac.in/

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

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

Course Title	Design of Offshore Structures
Course Code	19STE543A
Programme	Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course deals with the design of components of offshore structures. Types of offshore platforms and the forces it is subjected to be discussed. This course focusses on the design, fabrication, erection and maintenance of offshore structures. Students will be taught design of Bracings, Jacket, Piles and tubular joints of offshore structures

Course Outcomes

After undergoing this module students will be able to:

- **CO 1.** Discuss the types of offshore platforms
- **CO 2.** Calculate the various forces acting on offshore platforms
- **CO 3.** Discuss fabrication, erection and maintenance of offshore structures
- **CO 4.** Discuss failure modes of offshore structural components
- **CO 5.** Design Bracings, Jacket, Piles and tubular joints of offshore structures

Course Contents

Unit 1 Introduction to Offshore Platforms

Types of offshore platforms: Fixed platforms, compliant platforms and Floating platforms.

Unit 2 Forces on Offshore Platforms

Introduction, Gravity forces, Wind force and spectra, Wave forces and spectra, Earthquake Loads, Ice and Snow loads, Current and Buoyancy forces, Morison's Equation - Maximum wave force on offshore structure - Concept of Return waves - Principles of Static and dynamic analyses of fixed platforms - Use of approximate methods - Design of structural elements

Unit 3 Design of Offshore Structure components

Introduction, Preliminary Dimensioning, Bracing and Jacket Design, Cylinder member strength calculation as per ISO 19902, Design of Piles

Unit 4 Tubular Joint Design

Introduction to tubular joints - Possible modes of failure - Eccentric connections and offset connections - Cylindrical and rectangular structural members – In plane and multiplane connections - Parameters of in-plane tubular joints

Unit 5 Kuang's formulae – Elastic stress distribution - Punching shear Stress - Overlapping braces - Stress concentration -Chord collapse and ring stiffener spacing - Stiffened tubes - External hydrostatic pressure- Fatigue of tubular joints - Fatigue behaviour - S-N curves - Palmgren-Miner cumulative damage rule - Design of tubular joints as per API Code.

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

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

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

Unit 6 Fabrication and Maintenance

Introduction, Construction procedure, Fabrication- Joint fabrication, Fabrication based on ISO, Jacket assembly and erection, Transportation, Launch and Lifting procedure.

Unit 7 Corrosion - Corrosion mechanism - Types of corrosion - Offshore structure corrosion zones – Biological corrosion - Preventive measures of Corrosion - Principles of cathode protection systems - Sacrificial anode method and impressed current method – Online corrosion monitoring - Corrosion fatigue.

Course Resources

a. Essential Reading

1. Class Notes
2. Srinivasan Chandrasekaran (2018) Dynamic Analysis and Design of Offshore Structures, 2nd edition, Springer
3. Mohamed A, El Reedy (2012) Offshore Structures Design, Construction and Maintenance, Gulf Professional Publishing

b. Recommended Reading

1. Dawson, T. H. (1983) Offshore Structural Engineering, Prentice Hall
2. API RP 2A. Planning, Designing and Constructing Fixed Offshore Platforms, API.
3. McClelland, B & Reifel, M. D.,(1986) Planning & Design of fixed Offshore Platforms, VanNostrand
4. B.C Gerwick, Jr. Construction of Marine and Offshore Structures, CRC Press, Florida, 2000.

c. Magazines and Journals

1. Journal of Structural Engineering, CSIR-Structural Engineering Research Centre, CSIR Campus, Chennai
2. ACI Structural Journal, ACI Structural Journal American Concrete Institute, 38800 Country Club Dr. Farmington Hills, MI48331-34349 USA

d. Other Electronic Resources

http://nptel.ac.in/

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

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

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

Course Title	Internship
Course Code	19STP521A
Programme	M.Tech in Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

The aim of this course is to make a student experience an industrial or business environment. The student will visit various departments of an industry/business and observe the activities in each department for a certain duration of time and try to relate his/her experience with the theory practiced back at the faculty. The student should develop a report and make a presentation on his/her experience at the industry/business.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Describe the organization structure of the industry/business
- **CO 2.** Identify Business objectives of the organization
- **CO 3.** Describe the various departments of the organization and their activities and responsibilities to meet the business objectives
- **CO 4.** Discuss the limitations and new opportuinites for growth of the organization
- **CO 5.** Express the education and skill requirement of graduates to pursue their career in industry

Course Contents

Industry Internship in the relevant organization

Course Resources

a. Essential Reading

1. Organization website
2. Discussions with Managers/Mentor/Supervisor of different departments of the organization

b. Other Electronic Resources

1. Electronic resources on the subject area are available at MSRUAS library

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

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

Course Title	Group Project
Course Code	19STP522A
Programme	M.Tech in Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course is intended to provide student an opportunity to synergise their learning from the earlier courses through working in a team, sharing responsibilities, to conceiving, designing and fabricating a working prototype of a system related to an automotive application. The students will learn skills related to project identification, planning, management and execution, working in teams and verbal and written communication. During design, analysis and synthesis stage, they will get an opportunity to apply theoretical knowledge to develop real life product and prototyping stage will provide them experience of converting a design into a working system through use of various fabrication techniques available.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** Work in a team and undertake a project in the area of Transportation Engineering
- **CO 2.** Apply Transportation Engineering methodologies and reconfigurable techniques for executing road project
- **CO 3.** Apply appropriate research methodology while formulating a project
- **CO 4.** Define Specifications, Synthesize, Analyse, Develop and Evaluate a project
- **CO 5.** Develop a video which explains the project, exhibit, make a presentation and document the work

Course Contents

Need for undertaking a project, design specifications, design, analysis, design evaluation and presentation.

Project Management Costing, Construction, Procurement, Project Development, Testing, Project Evaluation, Exhibition, Presentation.

Team building, Team work, Leadership skills.

Course Resources

a. Essential Reading

1. Assigned reading relevant to the group project.

b. Other Electronic Resources

1. Electronic resources on the subject area are available at MSRUAS library

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

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

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

Course Title	Dissertation and Publication
Course Code	19STP523A
Programme	M.Tech in Structural Engineering
Department	Civil Engineering
Faculty	Faculty of Engineering and Technology

Course Summary

This course is intended to give an insight to the students on application of principles of research methodology, preparation of research project proposal, research project management, execution of research project and effective technical communication and presentation. It also emphasizes the need and the relevance of a structured approach to identify a research topic and undertake research. This course provides an opportunity for students to apply theories and techniques learnt during programme work. It involves in-depth work in the chosen area of study.

Course Outcomes

After undergoing this course students will be able to:

- **CO 1.** 1.Critically review scholarly literature collected from various sources for the project purpose and formulate a research problem
- **CO 2.** Prepare and present a research proposal
- **CO 3.** Conduct research to achieve research objectives
- **CO 4.** Propose new ideas/methodologies or procedures for further improvement of the research undertaken
- **CO 5.** Create research document and write research papers for publications
- **CO 6.** Defend the research findings in front of scholarly audience

Course Contents

- Research Methodology
- Information search, retrieval and review
- Project definition and project planning
- Use of conceptual models and frameworks
- Problem solving and Evaluation
- Interpretations and drawing conclusions
- Proposing ideas or methods for further work
- Thesis writing
- Oral presentation
- Authoring Research paper

Course Resources

a. Essential Reading

1. Lecture Sessions on Dissertation, Thesis Preparation delivered by the concerned Head of Dept.

b. Other Electronic Resources

1. Electronic resources on the subject area are available at MSRUAS library

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

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

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