GOKUL GLOBAL UNIVERSITY

Approved By Govt. of Gujarat
(Recognized by UGC under Section 22 & 2(f) of 1956)
(Gujarat Private State University Act 4 of 2018)

COURSE STRUCTURE

Master of Engineering

(Structural)

Civil Engineering

Under

Choice Based Credit System (CBCS)

Faculty of Engineeering
Hansaba College of Engineering & Technology
University Campus, State Highway-41, Siddhpur - 384151, Dist. Patan, Gujarat, INDIA
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(PSO) & Course Outcomes (CO)

PROGRAM OUTCOMES (PO)

PO1: Scholarship of Knowledge: To understand the advanced concepts of analysis and design of structures.

PO2: Critical Thinking: To formulate and postulate mathematical models for different structural systems.

PO3: Problem Solving: To propose optimum solutions for designing a wide range of structures.

PO4: Research Skill: To apply research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Usage of Modern Tools: To enhance the skills in the usage of modern structural analysis and design tools.

PO6: Collaborative and Multidisciplinary work: To involve effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary research.

PO7: Communication: To communicate effectively with the research community and industry by acquiring the skills to write scientific communications, prepare technical reports, deliver presentations and convey instructions for execution.

PO8: Life-long Learning: To possess the zeal and capacity for continuously updating the technical skills in accordance with the ever evolving industrial and research developments.

PO9: Ethical Practices and Social Responsibility: To cultivate and apply ethical principles in professional practices and to follow the norms and guidelines laid by the organisation.

PO10: Independent and reflective learning: To examine critically the scientific and technical reports with capability of taking corrective measures independently.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO_01: To implement structural engineering projects as an individual or as a member in design and execution team.
PSO_02: To carry out impactful research in structural and multidisciplinary domains.
PSO_03: To effectively examine materials and technical reports and ensure sustainable construction practices.

SEMESTER -I

SR.NO	SEMESTER	SUBJECT CODE	SUBJECT NAME	CREDIT	CATEGORY
1	I	FEM110001	Research skill and Methodology	2(1+0+2)	MLC
2	I	FEM110002	Disaster Management	0(2+0+0)	Audit 1
3	I	FEM115201	Advanced Concrete Design	4(3+0+2)	Core 1
4	I	FEM115202	Advanced Structural Analysis	4(3+0+2)	Core 2
5	I	FEM115203 FEM115204	1. Analytical and Numerical methods for Structural Engg. 2. Theory of Structural Stability	4(3+0+2)	Program Elective I
6	I	FEM115205 FEM115206	1. Structural Health Monitoring And Retrofitting Of Structures 2. Structural Optimization	4(3+0+2)	Program Elective II
TOTAL				18	

SEMESTER -II

SR	SEMESTER	SUBJECT CODE	SUBJECT NAME	CREDIT	CATEGORY
1	II	FEM120001	Research Paper Writing	0(2+0+0)	Audit 2
2	II	FEM125201	Advanced Steel Design	4(3+0+2)	Core III
3	II	FEM125202	Structural Dynamics	4(3+0+2)	Core IV
4	II	FEM125203 FEM125204	1. Design of High rise structures 2. Design Of Masonary Structure	4(3+0+2)	Program Elective III
5	II	FEM125205 FEM125206	1. Design of Bridge Structures 2. Soil structure interaction	4(3+0+2)	Program Elective IV
6	II	FEM125207	Mini Project With Seminar	2(0+0+4)	Core
TOTAL				18	

SEMESTER -III

SR	SEMESTER	SUBJECT CODE	SUBJECT NAME	CREDIT	CATEGORY
1	III	FEM135201	Internal Review 1	2 (0+0+4)	Internal Review 1
2	III	FEM135202	Dissertation Phase I	8 (0+0+16)	Dissertation
3	III	FEM135203 FEM135204	1.Industrial Safety 2.Operation Research	3 (3+0+0)	Open Elective
4	III	FEM135205 FEM135206	1.Design of Prestressed Concrete structures 2.Earthquake Resistant Design of structures	3(3+0+0)	Program Elective V
TOTAL				16	

SEMESTER -IV

SR	SEMESTER	SUBJECT CODE	SUBJECT NAME	CREDIT	CATEGORY
1	IV	FEM145201	Internal Review - 2	2 (0+0+4)	Dissertation
2	IV	FEM145202	Dissertation Phase II	14 (0+0+28)	Dissertation
TOTAL				16	

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF SCIENCE AND HUMANITIES
SUBJECT NAME: RESEARCH SKILL & METHODOLOGY
SUBJECT CODE:FEM110001
SEMESTER-I

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		ESE (E)	PA (M)	Viva (V)	PA (I)	
1	0	2	3	2	00	00	50	50	100

Th:-Theory, Tu: - Tutorial, Pr:- Practical,

Course Objective:

- To understand the fundamental of research and its types
- To impart the knowledge of various techniques of research
- To impart the knowledge for writing various statements and research paper
- To understand how to conduct literature review and organize references
- To impart the knowledge about copyright, IPR patent and plagiarism

COURSE OUTCOMES

After completion of the course, the students will be able to:

CO-1: Conduct a quality literature review and find the research gap.

CO-2: Identify an original and relevant problem and identify methods to find its solution.

CO-3: Validate the model

CO-4: Present and defend the solution obtained in an effective manner in written or spoken form

CO-5 : take up and implement a research project/ study.

Content:

Unit No	Subject Content	Teaching Hours	(%) Weightage
1	**Introduction to Research:** Nature and Scopeof Research, Information Based Decision Making and Source of Knowledge. The ResearchProcess, Basic approaches and Terminologies used inResearch, Defining Research Problem and FramingHypothesis, Preparing a Research Plan **Defining the Research Problem and Research Design** What is a Research Problem?, Selecting the Problem, Necessity of Defining the Problem, Meaning of Research Design, Need for Research Design, Future of a Good Design, Important Concepts Relating to Research Design, Different Research Design, Basic Principals of Experimental Designs	**13**	**31**
2	**Sampling Design** Census and sample survey, Implications of a Sample Design,Steps in sampling Design, Criteria of Selecting a SamplingProcedure, Characteristics of a Good Sample Design, DifferentTypes of sample Designs, How to Select a Random Sample?,Random Sample from an Infinite Universe, Complex RandomSampling Designs **Methods of Data Collection** Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection	**14**	**34**
3	**Data Analysis** Data Analysis and Presentation Editing and coding of data, tabulation, graphic presentation of data, cross tabulation, Testing of hypotheses; Parametric and nonparametric tests for Univariate and Bivariate data. Tests of association; simple linear regression and other non-parametric tests, Sampling techniques, Probability, Probability Distributions, Hypothesis Testing, Level ofSignificance and Confidence Interval, t-test, ANOVA, Correlation, Regression Analysis	**7**	**12**
4	**Interpretation of Data and Paper Writing** Layout of a Research Paper, Journals in ComputerScience, Impact factor of Journals, When and where to publish? Ethical issues related to publishing,Plagiarism and Self-Plagiarism, Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer ScienceDiscipline.	**4**	**10**

5	**Report Writing** Significance of Report Writing, Deferent Steps in Writing Report. Layout of the Research Report, Types of Report, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing a Research Report **Patent Rights** Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications	**4**	**13**

- **Reference Books:**
  1. Research Methodology Methods and Techniques by C. R. Kothari, New Age International Publishers.
  2. Research Methodology by D. K. Bhattacharyya, Excel Books Publications.
  3. Research Methodology: A Guide for Researchers in Management and Social Sciences by Taylor, Sinha & Ghoshal, PHI Publications

- **List of Tutorials:**
  1. Difference between an experiment and survey.
  2. Problems faced by researchers.
  3. A research scholar has to work as a judge and derive the truth and not as a pleader who is only eager to prove his case in favour of his plaintiff. Justify the statement.
  4. Examine the significance of research.
  5. Research is much concerned with proper fact finding, analysis and evaluation. Do you agree? Support your answer.
  6. Issues to be attended by researchers in formulating research problem.
  7. Develop a research plan.
  8. Different ways of sampling.
  9. Merits and demerits of different data collection methods.
  10. Interpretation is a fundamental component of research process. Justify the statement.
  11. Layout of research report.

- **List of Open Source Software/learning website:**

  Students can refer to video lectures available on the websites including NPTEL. Students can refer tothe CDs which are available with some reference books.

- **ACTIVE LEARNING ASSIGNMENTS:**

  Preparation of power-point slides, which include videos,animations, pictures, graphics for better understanding theory and practical work – The faculty willallocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of

the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to University

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	2	3	3	2	3	3	1	2	3	3	-	2	-
CO-2	2	3	3	2	3	3	1	2	3	3	1	1	-
CO-3	2	3	3	2	3	3	1	2	3	3	-	1	-
CO-4	2	3	3	2	3	3	1	2	3	3	1	1	-
CO-5	2	3	3	2	3	3	1	2	3	3	1	1	1

COURSE: M.E (STRUCTURAL)
SUBJECT NAME: DISASTER MANAGEMENT
SUBJECT CODE: FEM110002
SEMESTER :I

Types of course: Audit Course
Prerequisite: Nil
Rationale: Nil
Teaching & Evaluation Scheme: Nil

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
2	0	0	2	0	70	30	00	00	100

Th:-Theory, Tu: - Tutorial, P:- Practical, SEE:- Semester End Examinations, PA :- Progressive Assessment

Course Objective:

- Identifying the hazard and its cause.
- Reducing vulnerability and potential losses of hazard
- Assessing, reviewing and controlling the risk
- Applying efficient, effective, sustainable relief (food, shelter and money), medical and other facilities in disaster affected people thus they can survive.

COURSE OUTCOMES :

CO-1: learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response
CO-2: Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO-3: develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations
CO-4: Study and assess vulnerability of a geographical area.
CO5: Students will be equipped with various methods of risk reduction measures and risk

mitigation.

CO6: Understand the role of Information Technology in Disaster Management

CO7: Understand Geographical Information System applications in Disaster Management

Content:

Sr No.	Subject Content	Teaching Hours	(%) Weightage
1.	**Introduction:** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	**4**	**17**
2.	**Repercussions Of Disasters And Hazards**: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts	**4**	**17**
3.	**Disaster Prone Areas In India:** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	**4**	**17**
4.	**Disaster Preparedness And Management:** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness	**4**	**17**
5.	**Risk Assessment:** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.	**4**	**16**
6.	**Disaster Mitigation:** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	**4**	**16**

References Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company

2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	-	-	-	-	3	3	3	-	3	-	-	3	1
CO-2	-	-	-	-	3	3	3	-	3	-	-	3	-
CO-3	-	-	-	-	3	3	3	-	3	-	-	3	1
CO-4	-	-	-	-	3	3	3	-	3	-	-	3	--
CO-5	-	-	-	-	3	3	3	-	3	-	-	3	-
CO-6	-	-	-	-	3	3	3	-	3	-	-	3	-
CO-7	-	-	-	-	3	3	3	-	3	-	-	3	1

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M.E (STRUCTURAL)
SUBJECT NAME:ADVANCED CONCRETE DESIGN
SUBJECT CODE:FEM115201
SEMESTER: I

Types of course: - Professional Core Course
Prerequisite: - Elementary design of concrete structures and Concrete Technology
Rationale: Reinforced cement concrete is one of the widely used construction material. With rapid development of infrastructure facilities, large number of special structures like bunker and silos, flat slabs, grid floors, shear walls, corbels, deep beams, water retaining structures etc. are being designed and constructed across the globe. The course on Advanced Concrete Design acquaints the structural engineering students to analyze and design such special structures as per Indian Standard code of practice.
Teaching & Evaluation Scheme:-

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	Pr	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Th:-Theory, Tu: - Tutorial, Pr: - Practical, SEE:- Semester End Examinations, PA :- Progressive Assessment

Course Objective:

- Impart the fundamental knowledge and skill pertaining to designing the Reinforced concrete special structures such as silos, flat slabs, grid floors, deep beams, liquid retaining and storage structures.
- Imbibe the design steps according to relevant Indian standard code of practice for design of the various structures

Course Outcome:

CO-1: Carry out load calculation, analysis, design and detailing of Slender Column, Corbel, Deep beams, flat slabs, water tanks, bunker and silos, Shear Walls as per relevant IS code of practice.,

CO-2: Analysis and design of raft foundation, strip footing and pile caps, Ensure serviceability criteria for reinforced concrete structural elements.

CO-3: Analyse and design a flat slab system.

CO-4: Discuss fire and seismic resistance of concrete structures.

CO-5: Analyse and design bunkers, silos and chimneys.

Content:

Sr No.	Subject Content	Teaching Hours	(%) Weightage
1.	Design philosophy, Loads and load combinations, Material Characteristics ,Serviceability criteria: Deflection and crack width	05	15
2.	Design of slender columns ,Strut-and- Tie Method, Design of Deep Beam and Corbel	06	15
3.	Proportioning, analysis and design of flat slab by direct design method and detailing , Analysis and design of Grid floors by Rankine Grashoff Method, classical equivalent plate theory and IS:456 method.	09	20
4.	Design of rafts, Strip footing and pile cap. Design of Intz type shaft supported water tank	14	30
5	Design of Bunker and Silos, Design of Shear Walls, Compression Field Theory for Shear Design, Design against Torsion	12	20

References Books:

1. Advanced Design of Concrete Structures – Krishana Raju N., Tata Mc-Graw Hill, Delhi.
2. Reinforced Concrete Design – Sinha S. N., Tata Mc-Graw Hill, Delhi.
3. Limit State Design of Reinforced Concrete – Jain A. K., Nemchand& Bros., Roorkee.
4. Advanced Reinforced Concrete, Varghese A. V., Prentice Hall of India.
5. Reinforced concrete, Vol - I and II – Shah H. J., Charotar Pub., Anand.
6. Design of Multi-storied Building (G+3) - Shah and Karve, Structure Pub., Pune.
7. Reinforced Concrete Design, Pillai S. U. and MenonD., Tata McGraw-Hill, 3rd Ed, 1999.
8. Reinforced Concrete Structures, Park R.andPaulayT. , John Wiley & Sons, 1995.
9. Advanced Reinforced Concrete Design, Varghese P. C., Prentice Hall of India, New Delhi

10. Unified Theory of Concrete Structures, Hsu T. T. C. and Mo Y. L., John Wiley & Sons, 2010.
11. IS Codes : IS:456, IS:875, IS:1893, IS:4326, IS:13920, IS: 3370, IS: 4995 (I & II), SP:16, SP:34.

List of Suggested Experiments/Tutorials:):

At least two design suitably selected from topics of the course. The report shall consist of full analytical treatment, design procedure, references and all necessary drawings in the form of neat dimensioned sketches.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	3	3	-	3	1	-	-	-	-	-	-	-	-
CO-2	3	3	-	3	2	-	-	-	-	--	-	-	-
CO-3	3	3	3	3	2	-	-	-	--	-	-	-	-
CO-4	2	2	-	2	2	-	-	-	-	-	-	-	-
CO-5	3	3	3	3	1	-	-	-	-	-	-	-	-

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M.E (STRUCTURAL)
SUBJECT NAME: ADVANCED STRUCTURAL ANALYSIS
SUBJECT CODE: FEM115202
SEMESTER- I

Types of course: - Civil Engineering Core Subject
Prerequisite: -Mechanics of Solids, Structural Analysis and Matrix
Rational: -In the present era of computerization, it has become necessary to recognize the theory of structures into a more systemic form that is valid for all types of structures and can be more easily programmed for a digital computer. Matrix method provides a comprehensive approach to the analysis of different structural systems and therefore offers a major advantage over many traditional methods. It is also suitable for digital computer. There are many structural problems involving complicated geometries, loadings and material properties for which mathematical solution involves ordinary or partial differential equations. Hence numerical methods such as the finite element method, finite difference method, boundary element method etc. may be used. Finite element method is sucha versatile numericalmethod that can be used to solve any complex problem of structural mechanics. In light of above, the course on Advanced Structural Analysis provides the students a clear understanding of determining structuralresponse of skeletal & continuum structure using matrix method and computer software.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	Pr	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Th: -Theory, Tu: - Tutorial, Pr: - Practical, SEE: - Semester End Examinations, PA: - Progressive Assessment

Course Objective:

- To understand the different techniques for analysis of structures
- Determine internal member forces and resulting stress distributions.
- Use and/or develop structural analysis software to analyze complicated structural systems.
- Interpret the output from computer-based analyses for the purpose of structural design.

COURSE OUTCOMES :

After completion of the course, the students will be able to:

CO-1: Analyze skeleton structures using stiffness method

CO-2: Analyze skeleton structures having secondary effects using stiffness method.

CO-3: Derive element properties and analyze structure using finite element method

CO-4: Solve realistic engineering problems through computational simulations using finite element Code.

CO-5: Apply energy principles for the analysis of determinate/indeterminate structures.

Content

Sr No.	Subject Content	Teaching Hours	Weightage (%)
	Module – I: Stiffness Member Approach:		
1.	Principles of Virtual work, Basic concepts of flexibility and stiffness.	**01**	**35**
2.	Analysis of Continuous beam, Plane Truss, Plane Frame, Plane Gridincluding secondary effects such as Temperature changes, Prestrains and End-displacements.	**14**	
3.	Introduction to Non-linearity in structure and non-linear analysis.	**02**	**05**
	Module – II: Finite Element Method		

4.	Principles of discretization, Element stiffness mass formulation based on direct, variational and weighted residual techniques.	**03**	**09**
5.	Computations of element properties for bar elements, beam elements,truss elements, constant strain triangle and quadrilateral elements using generalized coordinates.	**09**	**22**
6.	Computations of element properties for bar elements, beam elements,truss elements, constant strain triangle and quadrilateral elements using natural coordinates; Iso-parametric formulation.	**10**	**22**
7.	Axisymmetric solids	**03**	**07**

References Books: -

1. Matrix Analysis of Framed Structure - Weaver W. and Gere J. M., CBS Publishers,Delhi.
2. Structural Analysis - Ghali&Nevelle, Spon Press, London.
3. Matrix Analysis of Structures - Aslam Kassimali, Cengage Learning, USA.
4. Elementary Matrix Analysis of Structures - H. Kardestuncer, Mc-Graw Hill, USA.
5. Matrix Analysis of Structures - Meghre& Deshmukh, Charotar Publication, Anand.
6. Computer Methods of Structural Analysis - Beaufait, Rowan, Hadley and Heckett
7. Linear Analysis of Frame works - Graves Smith
8. Computer Analysis of Structural Systems - Fleming J.F
9. A First Course in the Finite Element Method - D. L. Logan
10. Introduction to Finite Elements in Engineering - Chandrupatla, R.T. &Belegundu, A.D
11. Finite Element Analysis - S. S. Bhavikatti
12. Finite Element Method in Engineering - S.S.Rao
13. Finite Elements Methods - C.S.Krishnamurthy

List of Suggested Experiments/Tutorials:):

- Tutorial work shall consist of solution of at least five problems from each topic out of which at least half of problems shall be checked by use of standard software.

List ofSoftware: -

STAAD-Pro, SAP2000, ETABS, ABACUS, ANSYS

List of Open Source Software/learning website:

1. https://ndl.iitkgp.ac.in/
2. http://nptel.ac.in/
3. www.mastan2.com/
4. www.scilab.org/
5. http://www.code-aster.org/forum2/ (For open source FEA program Code_Aster)
6. http://www.calculix.de

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	2	1	-	-	-	--	-	1	2	1
CO-2	3	2	3	1	1	-	-	-	-	-	2	2	1
CO-3	3	2	1	1	-	-	-	-	-	-	1	2	1
CO-4	3	3	3	1	2	-	-	-	-	-	1	1	-
CO-5	3	3	2	2	1	-	-	-	-	-	-	1	-

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M.E (STRUCTURAL)
SUBJECT NAME : ANALYTICAL AND NUMERICAL METHODS FOR STRUCTURAL ENGINEERING
SUBJECT CODE: FEM115203
SEMESTER-I

Types of course: - Program Elective
Prerequisite: -
Rational:- To find solution of structural engineering problems, a mathematical model of the problem is formed and then its closed form or numerical solution is obtained using mathematics. Thus, the knowledge of application of various mathematical tools is essential for the solution of structural problems. The course on Analytical and Numerical Methods for Structural Engineering equips the students with the applications of numerical and statistical methods to solve problems related to structural engineering.
Teaching & Evaluation Scheme:-

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		ESE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Th:-Theory, Tu: - Tutorial, P:- Practical, ESE:- End Semester Examinations, PA :- Progressive Assessment

Course objective:

- Provide the students with sufficient exposure to advanced mathematical methods and tools that are relevant to engineering research
- Improving the computational skills of students by giving sufficient knowledge of analytical and numerical techniques useful for solving problems arising in Mechanical Engineering.
- Imparting the knowledge of real time applications of Autonomous systems, Nonlinear systems of ordinary differential equations and partial differential equations.

Course Outcome:
After learning the course the students should be able to:
1. Solve algebraic equations,
2. Obtain numerical solution of ordinary and partial differential equations,
3. Apply integration method/s for structural analysis,
4. Carry out interpolations and curve fitting,
5. Obtain solution of eigen value problems and fourier series for structural analysis,
6. Apply iterative and transformation methods in structural engineering

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1	Errors: Error analysis, types of errors, accuracy & precision, stability in numerical analysis	**02**	**5**
2	Interpolation and Curve Fitting: Empirical laws for curve fitting, general interpolation formulae. Homogeneous Linear ODEs with Constant Coefficients (Euler's formula and review of the circular	**6**	**10**
3	Solution of Non-linear Algebraic and Transcendental Equations: Solution by graphical method, bisection method, Newton Raphson iterative method, Regula-Falsi method.	**06**	**15**
4	Elements of Matrix Algebra: Solution of systems of linear equations, Eigen value problems. Applications to Structural Dynamic problems, stress problems, buckling of columns	**08**	**20**
5	Numerical Differentiation & Integration: Solution of Ordinary and Partial Differential Equations, Euler's equation and other methods. Laplace equation - Properties of harmonic functions - Fourier transform methods for Laplace equation. Numerical Integration.	**10**	**20**
6	Finite difference method: Finite difference technique, its applications to structural engineering problems.	**06**	**20**
7	Computer Algorithms: Numerical solutions for different structural problems.	**04**	**10**

Reference book:

1. Numerical methods in Engineering - Salvadori & Baron

2. Numerical methods – B S Grewal

3. Numerical Methods in Finite Element Analysis - Bathe & Wilson

4. Numerical methods for scientific and engineering computations – S R K Iyengar, R K Jain and Mahinder

List of Suggested Experiments/Tutorials:

Minimum 20 problems from above topics out of which half of the problems shall be also solved using self developed computer programs in any language. Major Equipment: -

List of Open Source Software/learning website:

www.scilab.org/ http://nptel.ac.in/ http://ocw.mit.edu/

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	2	2	-	-	-	-	1	2	-	1	-	-	1
CO-2	1	3	-	1	-	2	-	1	1	-	-	1	-
CO-3	3	3	1	-	1	-	-	-	-	-	1	-	1
CO-4	2	1	-	1	-	-	1	-	-	-	-	1	-
CO-5	1	3	1	-	-	-	-	2	-	-	1	-	-
CO-6	-	3	1	2	-	-	-	1	-	-	1	-	1

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE : M.E (STRUCTURAL)
SUBJECT NAME: THEORY OF STRUCTURAL STABILITY
SUBJECT CODE: FEM115204
SEMESTER - I

Type of Course: Program Elective

Prerequisite: Theory of Structures & Structural Analysis

Rationale: Various loads are acting on structures. Behavior of structure under these loads is very important to understand. Stability is the prime importance for any structures. Therefore various design criteria for the design of structures need to be studied. Instability in any of the structural member leads to failure of the structures. Therefore instability in the individual members is required to be studied due to various structural actions. Instability of the frames to be studied as a whole at the end.

Teaching and Examination Scheme:

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		ESE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Th:-Theory,Tu: - Tutorial, P:- Practical, SEE:- SemesterEnd Examinations, PA :- Progressive Assessment..

Course Objective:

- Developing capacity for analytical and critical thinking and for creative problem

solving

- Developing ability to engage independent and reflective learning
- An in-depth engagement with the disciplinary knowledge in its inter-disciplinary context

Course Objective:

After learning the course the students should be able to:

1. Determine stability of columns and frames
2. Determine stability of beams and plates
3. Use stability criteria and concepts for analyzing discrete and continuous systems
4. Understand the concept of structural stability and the approach for design for stability
5. Apply advanced numerical techniques to bucking analysis of structures

Content:

Sr.	Content	Total Hrs	% Weightage
1.	**Unit I: Fundamental Concepts & Criteria for Design of Structures:** Concept of stability - Stability, Strength, and Stiffness, Classical Concept of Stability of Discreteand Continuous Systems,instabilityand bifurcation, different forms of structural instability, approaches ofstability analysis, Linear and nonlinear behavior	06	15
2.	**Unit II: – Stability of Columns:** Governing differential equation- Euler formulas for column – Eigenvalue problem; buckling modes and critical load; elastically restrainedcolumn, column with geometric imperfections, eccentrically loaded column, and large deflection analysis. Axial and Flexural Buckling, Lateral Bracing of Columns, Combined Axial, Flexural and Torsion Buckling.	08	20
3.	**Unit III: Stability of Beams:** Introductionlateralbuckling of beams in purebending;torsionalbuckling; combined flexural-torsional buckling.	06	15

4.	**Unit IV: Stability of Frames:** **Beam columns:** Standard cases of beam columns, beam-columns with elastic restraints; effect of initial curvature Member Buckling versus Global Buckling, Slenderness Ratio of Frame Members, Buckling analysis ofsingle-storey frameswith sway andno-sway condition using stiffness method	**10**	**20**
5.	**Unit V:Stability of Plates**: Differential equation of plate buckling and boundary conditions,rectangular plates under uniaxial and biaxial compression; axial-flexuralbuckling; shear-flexural buckling, application of energy methods for calculation of buckling loads andmodes.	**08**	**20**
6.	**Introduction to Inelastic Buckling and Dynamic Stability.**	**04**	**10**

Reference Books:

1. Theory of elastic stability, Timoshenko and Gere, Tata Mc Graw Hill,1981
2. Principles of Structural Stability Theory, Alexander Chajes, Prentice Hall, New Jersey.
3. Structural Stability of columns and plates, Iyengar, N. G. R., Eastern west press Pvt. Ltd.
4. Chen, W.F. &Lui, E.M.: Structural Stability, Elsevier (1987).
5. Gambhir, M.L.: Stability Analysis and Design of Structures, Springer - Verlag (2004).
6. Strength of Metal Structures, Bleich F. Bucking, Tata McGraw Hill, New York

List of Suggested Practical:

1. Write an 8085 assembly language program for exchanging two 8-bit numbers stored in memory locations 2050h and 2051h.
2. Write an 8085 assembly language program to add two 8-bit numbers stored in memory locations 2050h and 2051h. Store result in location 2052h.
3. Write an 8085 assembly language program to add two 16-bit numbers stored in memory.
4. Write an 8085 assembly language program to add two decimal numbers using DAA instruction.
5. Write an 8085 assembly language program to find the minimum from two 8-bit numbers.
6. Write an 8085 assembly language program to get the minimum from block of N 8-bit numbers.
7. Write an 8085 assembly language program to add block of 8-bit numbers.
8. Write an 8085 assembly language program to find the number of 1's binary representation of given 8-bit number.

9. Write an 8085 assembly language program to count the length of string ended with 0dh starting from location 2050h.
10. Write an 8085 assembly language program to covert given hex digit to its equivalent ASCII number.
11. Write an 8085 assembly language program to compute even parity and insert it as MSB in 8-bit number.
12. Write a subroutine to exchange two 8-bit numbers. Use it to reverse an array of 8-bit numbers.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	1	-	-	-	-	-	-	2	3	1
CO-2	-	-	-	-	2	3	3	3	3	3	3	3	-
CO-3	-	-	-	-	2	3	3	3	3	3	3	3	-
CO-4	3	-	-	-	-	-	-	2	1	1	3	3	-
CO-5	3	-	-	-	-	3	3	-	-	-	3	3	-

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: B.E
SUBJECT NAME: STRUCTURAL HEALTH MONITORING AND RETROFITTING OF STRUCTURES
SUBJECT CODE: FEM115205
SEMESTER-I

Types of course: - Program Elective – IV

Prerequisite: - Concrete technology, Analysis & Design of reinforced concrete structures, Repairs & rehabilitation of structures

Rational:-. Recent structural failures and the increased deterioration of the civil infrastructure, calls for the technology that can help to preserve structural integrity thereby assuring the public safety. Structural Health Monitoring (SHM) is one such technology that helps to assess the in-service performance of the structures located in earthquake zones or remote areas, using a variety of measurement techniques. SHM plays a predominant role in catering to the need of monitoring of innovative designs and materials & better management of existing structures. The proper diagnosis through SHM helps to suggest the most appropriate retrofitting techniques to localize damages at their first occurrence.

Teaching & Evaluation Scheme:-

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	Pr	Total		ESE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Th:-Theory, Tu: - Tutorial, Pr: - Practical, ESE:- End Semester Examinations, PA :- Progressive Assessment

Course objective:

- To understand the structural health monitoring for structures.

- To understand the conditional assessment & techniques for strengthening and retrofitting of structures.

COURSE OUTCOMES

After completion of the course, the students will be able to:

CO-1: Diagnose the distress and the cause of distress in the structure.

CO-2: Detect the changes in the characteristics of the structure.

CO-3: Assess the remaining performance capacity.

CO-4: Choose & apply the appropriate repair and retrofitting techniques for damaged structures.

CO-5: Identify suitable Sensors & Instruments required in SHM for in-service performance of structures.

Content

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1.	**Structural Assessment& Need for retrofitting:** Introduction to health assessment of structures, structural damages & failures, Principles of structural assessment, Classification &levels of assessment, Current scenario of infrastructure through case studies	08	20
2.	**Introduction to SHM:** Introduction to global infrastructure crisis, Definition & Motivation for SHM, SHM versus Non-destructive evaluation, Concept of smart materials & smart structures with SHM,SHM& biomimetics, System components & categories of SHM, Classification of SHM systems, Methodologies and monitoring principles, Local & global Techniques for SHM, Advantages of SHM	12	30
3.	**Monitoring techniques of SHM:** A) Static field testing: Behavior tests, Diagnostic tests, Proof tests, Sensors & sensing technology for Structural monitoring, Structural responses B) Dynamic Field Testing: Stress history tests, Ambient vibration tests, Dynamic Load Allowance tests, Pull back (anchored cable tests) C) Periodic Monitoring: Field testing, tests to determine changes in structure Continuous monitoring: Active & Passive Monitoring	12	30

4.	**Concept of repair & retrofitting of structures:** Case studies of structural & foundation failure, performance problems, responsibility & accountability, causes of distress in structural members, design and material deficiencies, factors causing extensive deterioration. Retrofitting of structures: Fundamental of retrofitting, Flow of retrofitting process, Methods of retrofitting, Materials for retrofitting(conventional and smart materials), selection of retrofitting methods	**10**	**20**

References Books:-

1. Structural Health Monitoring, Daniel Balageas, Peter Fritzen, Alfredo Guemes, John Wiley & Sons, 2006.
2. Health Monitoring of Structural Materials and Components_Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.
3. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006
4. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2007.

List of Experiments (Practical's):

1. To determine change in dynamic response of material due to damage : Steel
2. To determine change in dynamic response of material due to damage : Concrete
3. Damage detection using Acoustics/Ultrasonic wave propagation
4. Mapping of reinforcement details of given reinforced concrete element
5. Comparison of core test with destructive testing
6. Testing of rehabilitated beam – Flexure
7. Testing of rehabilitated beam – Shear
8. Testing of rehabilitated column

Major Equipments :

1. Vibration analyzer with sensors
2. Concrete Core cutter
3. Cover meter and rebar locator
4. USPV tester
5. Acoustic tester

6. Reinforced member casting facility
7. Load frame for testing elements

List of Open Source Software/learning website:

- https://research.csiro.au/data61/structural-health-monitoring
- https://beanair.com/conditioning-monitoring-system.html
- https://www.hindawi.com/journals/ace/2010/724962/
- https://www.ndt.net/events/NDTCanada2014/app/content/Slides/40_Tamutus.pdf
- https://cpwd.gov.in/Units/FinalDraftHandbook_Apr2007.pdf

Expected Mapping with Programme Outcomes													
Course Outcomes	*(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	3	-	-	-	-	3	3	3	3	3	3	3	
CO-2	3	-	-	-	-	3	3	3	3	3	3	3	
CO-3	3	-	-	-	-	3	3	3	3	3	3	3	
CO-4	3	-	-	-	-	3	3	3	3	3	3	3	
CO-5	3	-	-	-	-	3	3	3	3	3	3	3	

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M.E (STRUCTURAL)
SUBJECT NAME:STRUCTURAL OPTIMIZATION
SUBJECT CODE:FEM115206
SEMESTER:I

Types of course: Program Elective
Prerequisite:Nil
Rationale: The basic requirement of an efficient structural design is that the response of the structure should be acceptable as per various specifications, i.e., it should at least be a feasible design. There can be large number of feasible designs, but it is desirable to choose the best from these several designs. The best design, optimal design, could be in terms of minimum cost, minimum weight or maximum performance or a combination of these. Thus, optimization techniques play an important role in structural design. The purpose of optimization is to find the best solutions from which a designer can derive a maximum benefit from the available resources.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Th: -Theory, Tu: - Tutorial, P: - Practical, SEE: - Semester End Examinations, PA: - Progressive Assessment

Course Objective:

- Formulate structural optimization problems in the framework of calculus of variations as well as finite-variable optimization.
- Become familiar with principles of structural optimization and be able to solve them analytically when it is possible and computationally in most cases.

Course Outcome:

After studying this subject student will be able to:

1. understand optimization techniques,
2. classify the optimization problems,
3. derive response quantities corresponding to design variable,
4. apply optimization techniques to trusses, beams and frames.

Content:

Sr No.	Subject Content	Teaching Hours	(%) Weightage
1.	Introduction to optimization, optimization techniques for unconstrained and constrained optimization problems.	**08**	**20**
2.	Classical Optimization, Lagrange Multiplier technique and Kuhn – Tucker conditions	**08**	**20**
3.	Solution of NLP by direct methods and by series of unconstrained optimization problems, formulation of different types of structural optimization problems.	**08**	**20**
4.	Computation of derivatives of response quantities with respect to design variables.	**08**	**15**
5.	Minimum weight design of trusses, frame, etc.	**08**	**20**
6.	Introduction Genetic Algorithm.	**05**	**5**

Reference Book:

1. Optimization theory & application S. S. Rao
2. Structural optimization Majid
3. Advanced mathematics Kresysig
4. Numerical analysis Scarborough
5. Foundation of structural optimization Marris
6. Optimum Structural Design Spunt
7. Optimum Structural Design Uri Krisch

List of Tutorials/Assignments:

Tutorial work shall consist of presentations / problems / preparation of learning material based on above topics. Apart from above assignments a group of students has to undertake one open ended design problem based on engineering application.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	1	2	3	2	1	2	3	1	-	-
CO-2	3	3	2	1	1	3	2	2	1	3	1	-	1
CO-3	3	3	2	-	1	3	-	2	1	3	2	-	2
CO-4	3	2	1	1	1	3	2	3	2	3	1	1	1

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M.E (STRUCTURAL)
SUBJECT NAME: RESEARCH PAPER WRITTING
SUBJECT CODE: FEM120001
SEMESTER : II

Types of course: Audit Course
Prerequisite:Nil
Rationale: Nil
Teaching & Evaluation Scheme:

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
2	0	0	2	0	70	30	0	0	100

Th:-Theory, Tu: - Tutorial, P:- Practical, SEE:- Semester End Examinations, PA :- Progressive Assessment

Course Outcome:

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

1. Understand that how to improve your writing skills and level of readability.
2. Learn about what to write in each section.
3. Understand the skills needed when writing a Title.
4. Ensure the good quality of paper at very first-time submission.

Content:

Sr No	Subject Content	Teaching Hours	(%) Weightage
1.	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4	17

2.	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	**4**	**17**
3.	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check	**4**	**17**
4.	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature	**4**	**17**
5.	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions , useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	**08**	**32**

Reference Books:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Course Outcomes	**Expected Mapping with Programme Outcomes** *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PSO-1**	**PSO-2**	**PSO-3**
CO-1	1	3	2	2	3	3	1	2	3	-	-	-	2
CO-2	1	3	2	2	3	3	1	2	3	-	-	-	2
CO-3	1	3	2	2	3	3	1	2	3	-	-	-	1
CO-4	1	3	2	2	3	3	1	2	3	-	-	-	-
CO-5	1	3	2	2	3	3	1	2	3	-	-	-	-

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M.E(STRUCTURAL)
SUBJECT NAME: ADVANCED STEEL DESIGN
SUBJECT CODE: FEM125201
SEMESTER: II

Types of course: Core
Prerequisite: It is assumed that all students have a working familiarity with the elementary design of steel structural members.
Rationale: This course examines advanced design concepts for structural steel applicable to various types of steel structures; the primary code source applies to building design, which is supplemented by a strong theoretical background in steel behavior applicable to non-typical structures.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Th: -Theory, Tu: - Tutorial, P: - Practical, SEE: - Semester End Examinations, PA: - Progressive Assessment

Course objectives:

- Understand the material characteristics of steel and how material characteristics affect the performance of steel structures under extreme loading
- Analyze and design gravity force-resisting systems in steel buildings
- Analyze and design lateral force-resisting systems in steel buildings and evaluate options available in each lateral force-resisting system
- Analyze and design connections in steel buildings

COURSE OUTCOMES

After completion of the course, the students will be able to:

CO-1: Apply unified code philosophy to steel building design

CO-2: Apply plastic method for design of beams and frames.

CO-3: Design & detail Industrial building, steel stacks & composite structures as per the IS code.

CO-4: Use of cold form sections in the steel structure including pre-engineered building.

CO-5: Develop design basis report.

Content:

Sr No.	Subject Content	Teaching Hours	(%) Weightage
1.	**Properties of Steel:** Mechanical Properties, Hysteresis, Ductility. Compactness and non-compactness, slenderness, residual stresses.	05	05%
2.	**Plastic Behaviour of Structural Steel :** Introduction, Plastic theory, Plastic hinge concept, Plastic collapse load, conditions of plastic analysis, Theorem of Plastic collapse, Methods of Plastic analysis.	08	15%
3.	**Design of Industrial Buildings:** Introduction, selection of bay width, structural framing, purlins, girts and eave strut, plane trusses, Design of Gantry girders.	10	20%
4.	**Design of cold formed sections:** Advantages, stiffened and un stiffened elements, local buckling and post buckling strength, shear lag and flange curling, unusually wide flange section, short span sections, members subjected to axial tension, compression and bending. Design of beams and columns, Introduction to pre-engineered buildings using cold formed sections.	12	25%
5.	**Design of Steel Stacks:** Introduction, Proportioning of stack, Codal provisions, Loads on Stacks, Load combinations, Stresses in Self-supporting stacks, Design procedure for self-supporting stacks, Guyed steel stacks **Design of composite structures:** Composite Floor and Roof System Design, Composite beam, Open web steel joist / joist girder, Serviceability requirements	12	35%

Reference Book:

1. N. Subramanian Design of Steel Structures: Theory and Practice, Oxford University.
2. V. L. Shah and Veena Gore, Limit State Design of Steel Structures IS : 800-2007, Structures.
3. S. S. Bhavikatti, Design of Steel Structures by Limit State Methods as Per IS 800-2007, I & K. International.
4. M. R. Shiyekar, Limit State Design in Structural Steel, PHI Learning.
5. S. K. Duggal, Limit State Design of Steel Structures, Tata McGraw Hill.
6. M. L. Gambhir, Fundamentals of Structural Steel Design, McGraw Hill Education.
7. IS Codes: IS: 800, IS: 875, SP: 6 and Steel Table.
8. Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi.
9. Design of Steel Structures - Arya A. S., Ajmani J. L., Nemchand and Bros., Roorkee.

List of Tutorials/Assignments:

Tutorial work shall consist of presentations / problems / preparation of learning material based on above topics. Apart from above assignments a group of students has to undertake one open ended design problem based on engineering application.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	1	2	-	-	-	-	-	-	3	2
CO-2	3	3	3	1	2	-	-	-	-	-	-	3	-
CO-3	3	3	3	1	2	-	-	-	-	-	-	3	-
CO-4	3	3	3	1	2	-	-	-	-	-	-	3	2
CO-5	3	3	3	1	2	-	-	-	-	-	-	3	-

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M.E(STRUCTURAL)
SUBJECT NAME: STRUCTURAL DYNAMICS
SUBJECT CODE: FEM125202
SEMESTER - II

Type of course: Core

Prerequisite: Engineering Mechanics, Structural Analysis and Engineering Mathematics

Rationale: Earthquake, wind, moving loads, traffic, blasting etc. impose time-dependent forces on the structure and thereby induces vibration in the structures. The analysis of structure under such time- dependent forces is carried using theory of structural dynamics. Therefore, understanding of structural dynamics is essential for safe design of Civil Engineering Structures.

Teaching and Examination Scheme:

Teaching Scheme					Examination Marks				
					Theory		Practical		
Th	Tu	P	Total	Credits	SEE (E)	PA (M)	Viva (V)	PA (I)	Total Marks
3	0	2	5	4	70	30	30	20	150

Th:-Theory, Tu: - Tutorial, P: - Practical, SEE: - Semester End Examinations, PA: - Progressive Assessment.

Course Objectives:

- To understand the basics of structural dynamics for seismic analysis of structures
- To understand the behavior of the structure subjected to earthquake forces.

COURSE OUTCOMES

After completion of the course, the students will be able to:

CO-1: Analyze and Interpret dynamics response of single degree freedom system using

CO-2: fundamental theory and experiments

CO-3: Analyze and Interpret dynamics response of Multi degree freedom system using

CO-4: fundamental theory and experiments

CO-5: Differentiate the effects of various types of dynamic loads Use structural engineering software for dynamic analysis

CO-6: Perform & interpret the results of various experiments on models to understand structural behavior of symmetrical & un-symmetrical structures

Content:

Sr.	Content	Total Hrs	% Weightage
1	**Introduction:** Objectives, Importance of vibration analysis, Nature of exciting forces, Basic terminology related to vibration – natural frequency, natural period, resonance etc, Dynamic degree of freedom, Assumption to reduce dynamic DoF, Mathematical modeling of dynamic systems.	03	10
2	**Single Degree of Freedom System:** Free and forced vibration with and without damping, Response to Harmonic Loading, Response to general dynamic loading using Duhamel's integral, Numerical solution of response using Newmark's method & Direct Integration, Concept of response spectrum.	13	30

3	**Multiple Degree of Freedom System:** Equation of motion of symmetrical and un-symmetrical structures in plan, Natural frequencies and mode shapes of vibrating system, Orthogonality of modes, Dynamic response by Modal Superposition Method, Response Spectrum Analysis, Missing mass correction Introduction to multiple degree of freedom system with distributed mass and loading, Generalized Single Degree of Freedom System	**20**	**40**
4	**Special Topics in Structural Dynamics(Concepts only):** Dynamic effects of Wind loading, Moving loads, Vibrations caused by High Speed Traffic, Blasting and Pile driving, Foundations for industrial machinery, Base-isolation.	**06**	**20**

Reference Books:

1. Structural Dynamics and Introduction to Earthquake Engineering, Chopra A.K.
2. Dynamics of Structures, Clough R. W. and Penzien J., Mc GrawHill
3. Dynamics of Structures, Humar J. L., PrenticeHall
4. Structural Dynamics - Theory and Computation, Paz Mario, CBSPublication
5. Dynamics of Structures, Hart andWong
6. Vibration of Structures - Application in Civil Engineering Design, Smith J. W., Chapman andHall

Course Outcomes:

1. Analyze and Interpret dynamics response of single degree freedom system using
2. fundamental theory and experiments
3. Analyze and Interpret dynamics response of Multi degree freedom system using
4. fundamental theory and experiments
5. Differentiate the effects of various types of dynamic loads Use structural engineering software for dynamic analysis

Perform & interpret the results of various experiments on models to understand structural behavior of symmetrical & un-symmetrical structures

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	3	3	1	3	3	3	1	1	-	-	-	2	1
CO-2	3	3	1	3	3	3	1	1	-	-	-	-	1
CO-3	3	3	1	3	3	3	1	1	-	-	-	-	1
CO-4	3	3	1	3	3	3	1	1	-	-	-	2	1
CO-5	3	3	1	3	3	3	1	1	-	-	-	-	1
CO-6	3	3	1	3	3	3	1	1	-	-	-	-	1

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M.E(STRUCTURAL)
SUBJECT NAME: DESIGN OF HIGH RISE STRUCTURES
SUBJECT CODE: FEM125203
SEMESTER: II

Type of course: Program Elective
Prerequisite: Elementary design of steel and concrete structures and Concrete Technology
Rationale: Due to urbanization and lack of land, it has become inevitable to construct high rise structures. This subject will make the students aware about the various structural systems for high rise structures and the suitability of each towards various varying parameters. Advanced method of analysis of such structures and modeling these structures in various softwares with the pros and cons will be dealt in detail.

Teaching and Examination Scheme:

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Th:-Theory, Tu: - Tutorial, P:- Practical, SEE:- Semester End Examinations, PA :- Progressive Assessment.

Course objectives:

- To understand the various structural systems for high rise structures
- To evaluate the behavior of structure under dynamic loading.
- To analyse and design of advanced structures.
- To apply the advanced method of analysis of such structures and modelling these structures in various software with pros and cons

COURSE OUTCOMES

After completion of the course, the students will be able to:

CO-1: Analyze, design and detail Tall structures under different loading conditions by static and dynamic method of analysis.

CO-2: Use of computational software for analysis and design of high rise structures.

CO-3: Apply codal provisions for tall structures.

CO-4: Choose & apply appropriate structural systems for different size & height of structure Develop design basis report

CO-5: Describe the design criteria and loading conditions for buildings

Content:

Sr.	Content	Total Hrs	% Weightage
	Design of transmission/ TV tower, Mast and trestles: Configuration, bracing system, analysis and design for vertical transverse and longitudinal loads.	**10**	**18**
2	**Analysis and Design of RC and Steel Chimney**, Foundation design for varied soil strata.	**10**	**18**
3	**Tall Buildings**: **Introduction:** Why Tall Buildings, Factors affecting growth, Height and structural form. Design philosophy **Design Criteria:** Codal provisions for Loading, Sequential loading, Strength and Stability, Stiffness and drift limitations, Human Comfort criteria, Creep, Shrinkage and temperature effects, Fire. Foundation settlement and soil structure interaction. **Loading On Tall Structures :** a. Gravity loading:-Methods of live load reduction, Impact gravity loading, Construction loading.	**10**	**18**

	b. Wind loading:- Static loading, Dynamic loading. c. Earthquake loading:-Equivalent lateral force procedure, Modal analysis procedure. d. Combination of loading:-Working stress design, Limit Sate design; **Structural Form:** Braced frame structures, Rigid Frame structures, In filled-Frame structures, Flat plate- Flat slab structures, Shear wall structures, Wall frame structures, Framed tube structures, Suspended structures		
4	**Application of software in analysis and design** **Approaches to analysis:** Preliminary analyses, Intermediate and final analysis, **Assumptions:** Materials, Participating components, Floor slabs, Negligible stiffness, Negligible deformations, Cracking, High-Rise Behavior, **Modeling for Approximate analyses:** Approximate Representation Bents, Approximate modeling of slabs, Modeling for continuum analyses, **Modeling for Accurate analyses:** Plane frames, Plane shear walls, Three dimensional frame and wall structures, P-Delta effects, The assembled model; **Braced Frames:** Types of bracings, Behavior of bracings, Behavior of bracing bents, **Methods of analysis:** member force analysis, Drift analysis, Worked example for calculating drift by approximate methods, use large scale bracing	**10**	**18**
5	**Dynamic Analysis:** **Dynamic Response to Wind Loading:** Sensivity of structures wind forces, Dynamic structural response due to wind forces, Along wind response, Cross wind response, worked examples**,** **Dynamic response to Earthquake motions:** Response of Tall buildings to ground accelerations, response	**16**	**28**

	spectrum analysis, Empirical relations for fundamental natural frequency, Structural damping ratios **Comfort criteria:** Human perception of building motion, Perception thresholds, Use of comfort criteria in design		

Reference Books:

1. Structural Design of Multi-storeyed Buildings, Varyani U. H., 2nd Ed., SouthAsian Publishers,New Delhi.
2. Structural Analysis and Design of Tall Buildings, Taranath B. S., Mc Graw Hill, 1988
3. Advanced Design of Concrete Structures – Krishana Raju N., Tata Mc-Graw Hill, Delhi
4. Design of Multi Storeyed Buildings, Vol. 1 & 2, CPWD Publications.
5. Tall Building Structures, Smith Byran S. and Coull Alex, Wiley India
6. High Rise Building Structures, Wolfgang Schueller, Wiley
7. Tall Building Structures on Elastic Subgrade and Research of Semi-Analytical method by Gong Yaoqing. Beijing: Tsinghua University
8. Tall Chimneys, Manohar S. N., Tata Mc Graw Hill Publishing Company, New Delhi
9. Advanced Reinforced Concrete, Varghese A. V., Prentice Hall of India.
10. Advanced Reinforced Concrete Design, Varghese P. C., Prentice Hall of India, New Delhi.
11. Unified Theory of Concrete Structures, Hsu T. T. C. and Mo Y. L., John Wiley & Sons, 2010. 12. IS Codes : IS:456, IS:875, IS:1893, IS:4326, IS:13920, IS: 3370, IS: 4995 (I & II), SP:16, SP:34.

List of Suggested Practical:

At least two designs suitably selected from topics of the course. The report shall consist of full analytical treatment, design procedure, references and all necessary drawings in the form of neat dimensioned sketches.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	1	3	-	-	-	-	-	1	2	1
CO-2	3	3	3	1	3	-	-	-	-	-	1	2	1
CO-3	3	3	3	1	3	-	-	-	-	-	1	2	2
CO-4	3	3	3	1	3	-	-	-	-	-	1	2	1
CO-5	3	3	3	1	3	-	-	-	-	-	1	2	1

	GOKUL GLOBAL UNIVERSITY
	DEPARTMENT OF CIVIL ENGINEERING
	COURSE: M.E(STRUCTURAL)
	SUBJECT NAME: DESIGN OF MASONARY STRUCTURE
	SUBJECT CODE: FEM125204
	SEMESTER - II

Type of course: Core

Prerequisite: Engineering Mechanics, Structural Analysis and Engineering Mathematics

Rationale: Earthquake, wind, moving loads, traffic, blasting etc. impose time-dependent forces on the structure and thereby induces vibration in the structures. The analysis of structure under such time- dependent forces is carried using theory of structural dynamics. Therefore, understanding of structural dynamics is essential for safe design of Civil Engineering Structures.

Teaching and Examination Scheme:

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Th:-Theory, Tu: - Tutorial, P: - Practical, SEE: - Semester End Examinations, PA: - Progressive Assessment.

Course Objectives:

- 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

Course Outcomes:

1. Apply knowledge of structural masonry for advanced research and construction procedures
2. Justify the design of masonry buildings for sustainable development.
3. Check the stability of walls.
4. Distinguish from a wide range of materials for their suitability to arrive at feasible and optimal solutions for masonry constructions.

Content:

Sr.	Content	Total Hrs	% Weightage
1	**Introduction**: Historical Perspective, Masonry Materials, Masonry Design Approaches, Overview of Load Conditions, Compression Behavior of Masonry, Masonry Wall Configurations, Distribution of Lateral Forces.	06	10
2	**Characteristics of masonry constituents**: Types of masonry units such as stone, bricks, concrete blocks, clay blocks and stabilized mud blocks. Properties of masonry units like strength, modulus of elasticity and water absorption. Masonry mortars – Classification and properties of mortars, selection of mortars.	08	20
3	**Strength of Masonry in Compression**: Behavior of Masonry under compression, strength and elastic properties, factors influencing the compressive strength masonry, Effects of slenderness and eccentricity, water absorption, curing, ageing and workmanship on compressive strength. Prediction of strength of masonry in Indian context	08	20
4	**Shear and Flexure Behavior of Masonry** : Bond between masonry unit and mortar, test methods for determining flexural and shear bond strengths, test procedures for evaluating flexural and shear strength, factors affecting bond strength, effect of bond strength on compressive strength, flexure and shear strength of	10	25

	masonry. Flexural strength of reinforced masonry members: In plane and Out-of-plane loading. Concept of Earthquake resistant masonry buildings.		
	Design of load bearing masonry buildings: concept of basic compressive stress, Permissible compressive stress, reduction factors. Increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses, Effective height of walls and columns, opening in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action, lintels; Wall carrying axial load, eccentric load with different eccentricity ratios, wall with openings, freestanding wall; Design of load bearing masonry for buildings up to 3 storeys using BIS codal provisions	**10**	**25**

Reference Books:

1. Structural Masonry Designers' Manual" by W G Curtin and Gerry Shaw
2. "Masonry Structural Design, by Jennifer Eisenhauer Tanner and Richard E Klingner

List of Suggested Experiments: ---

Designed & detailed atleast one full load bearing masonry building. The report shall consist of full analytical treatment, design procedure, references and all necessary drawings in the form of neat dimensioned sketches

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	1	3	-	-	1	-	-	1	2	1
CO-2	3	3	3	1	3	-	-	-	-	-	1	2	2
CO-3	3	3	3	1	3	-	-	1	-	-	1	2	2
CO-4	3	3	3	1	3	-	-	1	-	-	1	2	1

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M.E(STRUCTURAL)
SUBJECT NAME: DESIGN OF BRIDGE STRUCTURE
SUBJECT CODE: FEM125205
SEMESTER: II

Type of Course: Program Elective

Prerequisite: Design of Structures

Rationale: Bridge is an important infrastructure facility required for the passage of railways, road ways and footpaths and even for carriage of fluids. Further, the constant increase in traffic loads associated with the economic growth in modern societies imparts large demands to build such structures. Therefore, the study of analysis and design of bridges is essential for the structural engineering students.

Teaching and Examination Scheme:

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Th:-Theory, Tu: - Tutorial, P:- Practical, SEE:- Semester End Examinations, PA :- Progressive Assessment.

Course Objectives:

- To understand the various types of bridges
- To understand the codal provisions for loading and design standards of bridges

- To design the superstructure of bridge using different methods and loading conditions
- To understand the design of bearings

COURSE OUTCOMES

After completion of the course, the students will be able to:

CO-1: Analyze and design small to medium span of reinforced concrete slab culverts, T beam bridges as per IRC specifications

CO-2: Apply design principles of pre-stressed concrete T beam bridges, box girder bridges and balanced cantilever bridges.

CO-3: Use of computational software for analysis & design of bridges

CO-4: Choose & apply appropriate structural form for different span of bridges Develop design basis report

CO-5: To familiarize with the usage of codal provisions in the design of bridges

Content:

Sr.	Content	Total Hrs	(%) Weightage
1	Components of bridges and Classification of Bridges, Investigations and planning, Choice of type of bridges	2	5
2	I.R.C. and other international specifications on live loads for road bridges, Various forces acting on bridges, Load distribution theories: Courbon's Method, Hendry Jaeger Method, Grillage analogy, Pigeaud's curves	7	15
3	Superstructure: General design considerations, Analysis and design of reinforced concrete slab culverts, Tee beam and slab bridges, Design of prestressed concrete T beam bridges, Box girder bridges, Balanced cantilever bridges	15	35
4	Substructure : Various parts of substructures, Various types of substructures, Loads acting on substructures, Design of pier	15	35

	and pier cap, Design of different types of foundation – Open, pile & well foundation,		
5	New era methodology/technology for design and construction of bridges, Seismic resistant design provisions, load test on bridges	**3**	**10**

Reference Books:

1. Krishnaraju, N., "Design of Bridges" Oxford and IBH Publishing Co., Bombay, Calcutta, New Delhi, 1988
2. Ponnuswamy, S., "Bridge Engineering", Tata McGraw Hill, 1989
3. Taylor, F.W., Thomson, S.E., and Smulski E., "Reinforced Concrete Bridges", John Wiley and Sons, New York
4. Raina V.K. "Concrete Bridge Practice", Tata McGraw Hill Publishing Company, New Delhi, 1991.
5. M.J. Ryall, G.A.R Parke, J.E. Harding, "The Manual of Bridge Engineering", Thomas Telford Publishers.
6. R. Rajagopalan, "Bridge Superstructure", Tata McGraw- Hills Publishing Company Limited
7. Chen Wai-Fah, Duan Lian, Bridge Engineering Handbook - Fundamentals, CRC Press.
8. Chen Wai-Fah, Duan Lian, Bridge Engineering Handbook - Superstructure Design,CRC Press.
9. Chen Wai-Fah, Duan Lian, Bridge Engineering Handbook - Construction & Maintenance, CRC Press.
10. Chen Wai-Fah, Duan Lian, Bridge Engineering Handbook - Seismic Design, CRC Press. 11. Chung C. Fu, Wang Shuqing, Computational Analysis & Design of Bridge Structures, CRC Press.
11. IRC: 5, 6, 78, 112-2011

List of Suggested Experiments:

Analysis and design of at least one full design of RC bridge and one superstructure of PSC bridge with computation analysis & design, references and all necessary drawings in the form of neat dimensioned sketches.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	3	-	-	-	-	-	2	2	2
CO-2	3	3	3	3	1	-	-	-	-	-	2	1	1
CO-3	3	3	3	3	3	-	-	-	-	-	-	1	2
CO-4	3	3	3	3	3	-	-	-	-	-	2	-	1
CO-5	3	3	3	3	3	-	-	-	-	-	1	-	1

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M.E (STRUCTURAL)
SUBJECT NAME: SOIL STRUCTURE INTERACTION
SUBJECT CODE: FEM125206
SEMESTER :II

Types of course: Program Elective
Prerequisite: Basic Structural Engineering, Soil Mechanics, Foundation Engineering
Rationale: To retain earth in an engineered way as per requirement and to determine soil response both under static and dynamic loadings is one of the major tasks for structural engineers. As soil is heterogeneous material, it is very difficult to retain it under different situation. Many theories are available to analyze and design such structures. To deal with any type foundation and earth retaining structure, the knowledge of its behavior on field is very important to take proper engineering decisions in practical situations.

Teaching & Evaluation Scheme:

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	Pr	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Th: -Theory, Tu: - Tutorial, Pr: - Practical, SEE: - Semester End Examinations, PA: - Progressive Assessment

Course Objectives:

Exposing participants to the fundamentals of soil structure interaction and reliability-based design
To introduce the challenges in the uncertainty-based analysis and design of various soil-structures interaction problems

Course Outcomes: -

After learning the course, the students should be able to

1. Apply various theories applicable to SSI and will have capacity to idealize soil response in order to analyze and design rigid and flexible foundation elements subjected to different loadings.
2. Calculate Contact pressure and settlement under shallow foundations, mat foundation, pile-raft foundation, settlement computation from constitutive laws.
3. Annalise retaining structures through various analytical and graphical approaches, and design supporting structures for excavations
4. Annalise sub-structural and super-structural element using various SSI tools based on hybrid models, discrete models and FEM approach and elastic theory approach.
5. Annalise vertical piles, laterally loaded piles and pile-raft system and foundations subjected to dynamic forces/seismic forces.

Content

Sr No.	Subject Content	Teaching Hours	(%) Weightage
1.	**Introduction to SSI:** Introduction to SSI, Importance of SSI, Applications and Examples of SSI for geotechnical engineer, Effect of structure roughness / smoothness on soil behavior.	03	10
2.	**SSI problems**: General soil-structure interaction problems- Shallow foundation, Sheet piles, Mat/Raft foundation, pile raft foundation,etc. Contact pressure and soil-structure interaction for shallow foundation, Fixed/ Flexible base, Differential foundation settlement for high rise buildings,Pressure settlement prediction from constitutive laws.	11	28
3.	**SSI Models:** Elastic continuum, Winkler's model, Multi parameter models, Hybrid models, Codal provisions, discrete models and finite element models.	07	14
4.	**Seismic Soil-Structure Interaction:** Dynamic response of soil, strain- compatibility, and damping characteristics of soil-structure. Machine foundation - soil interaction, Shake-table tests, SSI in time domain (dynamic stiffness and Green'sfunctions).	08	18
5.	**Soil-Pile Behaviour**: Introduction, axial and laterally loaded piles, load-displacement behaviour, Modified Ramberg Osgood Model, pile group, interaction effect in pile group, soil-pile modelling in FEM, Elastic	08	22

	continuum and elasto-plastic analysis of piles and pile groups. Non-linearload-deflection response, Pile-raft system		
6	**SSI in Retaining Structures:** Curved failure surfaces, their utility and analytical / graphical predictions from Mohr – Coulomb envelope and circle of stress, Earth pressure computations by friction circle method, Earth pressure on wall with limited/restrained deformations, Earth pressure on sheet piles, braced excavations, Design of supporting system for excavations.	**05**	**08**

References Books: -

1. Bowels, J.E., "Analytical and Computer methods in Foundation" McGraw Hill Book Co., NewYork.
2. Desai C.S. and Christian J.T., "Numerical Methods in Geotechnical Engineering" McGraw Hill BookCo. NewYork.
3. Soil Structure Interaction, the real behaviour of structures, Institution of Structural Engineers,1989.
4. Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg.vol-17, Elsevier Scientific PublishingCo.
5. Kameswara Rao, N.S.V., "Dynamics soil tests and applications", Wheeler Publishing, New Delhi,2000
6. Selvadurai, A.P.S., "Elastic Analysis of Soil Foundation Interaction", Elsevier1979
7. Hemsley, J.A, "Elastic Analysis of Raft Foundations", Thomas Telford,1998
8. ACI 336. (1988), Suggested Analysis and Design Procedures for combined footings and Mats,American Concrete Institute,1988.

List of Suggested Experiments/Tutorials:):

- Tutorial work shall consist of presentations / problems / preparation of learning material based on above topics. Apart from above assignments a group of students has to undertake one open ended design problem based on engineering application.

Expected Mapping with Programme Outcomes													
Course Outcomes	*(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PSO-1**	PSO-2	**PSO-3**
CO-1	3	-	-	-	-	3	3	3	3	3	3	3	1
CO-2	3	-	-	-	-	3	3	3	3	3	3	3	1
CO-3	3	-	-	-	-	3	3	3	3	3	3	3	1
CO-4	3	-	-	-	-	3	3	3	3	3	3	3	2
CO-5	3	-	-	-	-	3	3	3	3	3	3	3	2

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M. E (STRUCTURAL)
SUBJECT NAME: MINI PROJECT WITH SEMINAR
SUBJECT CODE: FEM125207
SEMESTER:II

Types of course: Core course

Teaching & Evaluation Scheme:-

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	Pr	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
0	0	4	4	2	0	0	0	100	100

Th:-Theory, Tu: - Tutorial, Pr: - Practical, SEE: - Semester End Examinations, PA: - Progressive Assessment

Course Objectives:

- To plan for various activities of the project and distribute the work amongst team members.
- To develop student‘s abilities to transmit technical information clearly and test the same by delivery of Seminar based on the Mini Project
- To understand the importance of document design by compiling Technical Report on the Mini Project work carried out.

COURSE OUTCOMES

After completion of the course, the students will be able to:

CO-1: Demonstrate a sound technical knowledge of their selected mini project topic.

CO-2: Undertake problem identification, formulation and solution.

CO-3: Design engineering solutions to complex problems utilising a systems approach.

CO-4: Communicate with engineers and the community at large.

CO-5: Demonstrate the knowledge, skills and attitudes of a professional engineer.

Content

Sr No.	Subject Content	Teaching Hours	(%) Weightage
01	A mini project requires comparatively less time than major projects. They are comparatively simpler and have shorter duration. Mini Project helps students to explore and strengthen the understanding of fundamentals through practical application of theoretical concepts. Mini Project can help them to boost their skills and widen their horizon of thinking. It will act like a beginners guide to undertake the major project/dissertation during the final year and will ensure preparedness of students to undertake major projects/dissertation. Students will be required to select the topic relevant to their specialization and that has value addition. Students will get an opportunity to work in actual industrial environment if they opt for internship. Based on the selected topic student will also prepare seminar report based on the literature survey Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available. End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution. Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the departmental committeeconcept to detailed design & drawing) from above topics along with cost estimation.	**56**	**100**

Expected Mapping with Programme Outcomes													
Course Outcomes	*(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PSO-1**	PSO-2	**PSO-3**
CO-1	3	-	-	-	-	3	3	3	3	3	3	3	1
CO-2	3	-	-	-	-	3	3	3	3	3	3	3	-
CO-3	3	-	-	-	-	3	3	3	3	3	3	3	-
CO-4	3	-	-	-	-	3	3	3	3	3	3	3	-
CO-5	3	-	-	-	-	3	3	3	3	3	3	3	1

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M. E (STRUCTURAL)
SUBJECT NAME: INTERNAL REVIEW - 1
SUBJECT CODE: FEM135201
SEMESTER-III

Types of course: - Dissertation

Prerequisite: - NA

Rationale:

Teaching & Evaluation Scheme:

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	Pr	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
0	0	4	4	2	00	00	00	100	100

Th:-Theory, Tu: - Tutorial, Pr: - Practical, SEE: - Semester End Examinations, PA: - Progressive Assessment

Course Objectives:

- To train the students in preparing project reports and to face reviews and viva-voce examinations.
- To develop the methodology to solve the identified problem.

Course Outcomes:-

At the end of the course, students must be in a position to:

1. The student can identify different areas of mid semester Thesis Progress Review.
2. Can find the applications of all the areas in day to day life.

Content

Sr No.	Subject Content
1.	**Course Objective**: To present a problem oriented in depth knowledge of Mid semester Thesis Progress Review. To address the underlying concepts and methods behind Mid semester Thesis Progress Review
2.	**Instructional Method & Pedagogy** At the start of course, the course delivery pattern, prerequisite of the subject will be discussed. Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations. Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation. Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation. Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	2	1	3	3	-	-	-	-	-	--	-	-	2
CO-2	2	1	3	3	-	-	-	-	-	--	-	-	2

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M. E (STRUCTURAL)
SUBJECT NAME: DISSERTATION PHASE I
SUBJECT CODE: FEM135202
SEMESTER-III

Types of course: - Dissertation
Prerequisite: - NA

Rationale:
Teaching & Evaluation Scheme:

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	Pr	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
0	0	16	16	08	00	00	100	00	100

Th:-Theory, Tu: - Tutorial, Pr: - Practical, SEE:- Semester End Examinations, PA :- Progressive Assessment

Course Objectives:

- To identify a specific problem for the current need of the society and collect information
  related to the same through a detailed review of literature.
- To develop the methodology to solve the identified problem

Content

Sr No.	Subject Content
1.	**Course Objective:** To select topic based on structural engineering related requirement as per the current scenario and work accordingly.
2.	**Instructional Method & Pedagogy** At the start of course, the course delivery pattern, prerequisite of the subject will be discussed. Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while

	teaching and conduction of all examinations. Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation. Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation. Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.

Course Outcomes:

- At the end of the course, students will gain an experience in reviewing various research paper, understanding various newer concepts of problem solving and finalizing the topic related to the course for the work

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	1	1	1	3	2	3	3	-	3	-	1	2	2

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M.E (STRUCTURAL)
SUBJECT NAME: INDUSTRIAL SAFETY
SUBJECT CODE: FEM135203
SEMESTER:III

Types of course: Open Elective
Prerequisite:Nil
Rationale: The basic requirement of an efficient structural design is that the response of the structure should be acceptable as per various specifications, i.e., it should at least be a feasible design. There can be large number of feasible designs, but it is desirable to choose the best from these several designs. The best design, optimal design, could be in terms of minimum cost, minimum weight or maximum performance or a combination of these. Thus, optimization techniques play an important role in structural design. The purpose of optimization is to find the best solutions from which a designer can derive a maximum benefit from the available resources.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	0	3	3	70	30	00	00	100

Th: -Theory, Tu: - Tutorial, P: - Practical, SEE: - Semester End Examinations, PA: - Progressive Assessment

Course Objectives:

- To Inculcate the Industrial Safety Environment to the students
- To Explore the Human Capital Management and Hazardous System

Content:

Sr No.	Subject Content	Teaching Hours	(%) Weightage
1.	**Industrial safety**: Accident, causes, types, results and control,		10

	mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.	08	
2.	**Fundamentals of maintenance engineering**: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment	08	**10**
3.	**Wear and Corrosion and their prevention:** Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods	**10**	**30**
4.	Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes	**09**	**20**
5.	Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air	**10**	**30**

	compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance		

References:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services
2. Maintenance Engineering, H. P. Garg, S. Chand and Company
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London

Course Outcomes:

1. Understand Importance of Safety and Important related Ac
2. Apply Maintenance techniques as per requirements and able to compare for with different technique for better performance.
3. Understand wear and corrosion, its causes and remedial actions for preventions.
4. Demonstrate fault tracing, its methods and application.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	3	1	1	1	3	-	-	1	--	-	1	-	2
CO-2	3	1	1	1	3	-	-	1	--	-	1	1	2
CO-3	3	2	2	1	3	-	-	-	--	-	2	-	1
CO-4	3	1	1	1	3	-	-	1	--	-	1	-	1

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M.E (STRUCTURAL)
SUBJECT NAME: OPERATION RESEARCH
SUBJECT CODE: FEM135204
SEMESTER:III

Types of course: Open Elective

Prerequisite: Nil

Rationale: Operation research techniques are useful for solving real life Industrial problem, Problems can be of Manufacturing, Service and supply related. Different techniques help for optimization of linear as well as non - linear type problem.

Course Objectives:

- to enable the student to understand and analyse managerial and engineering problems to equip him to use the resources such as capitals, materials, productions, controlling, directing, staffing, and machines more effectively

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	0	3	3	70	30	00	00	100

Th: -Theory, Tu: - Tutorial, P: - Practical, SEE: - Semester End Examinations, PA: - Progressive Assessment

Content:

Sr No.	Subject Content	Teaching Hours	(%) Weightage
1.	**Linear Programming Problems:** Formulation of a LPP, - graphical solution, simplex method, duality in LPP, sensitivity analysis, Integer linear programming, revised simplex method, parametric linear programming, Dynamic programming under certainty, Dynamic programming approach for solving LPP.	**12**	**30**
2.	**Project Management , Inventory Control and Decision Making:** CPM, PERT, Project time cost trade off, Resource allocation, Deterministic inventory control models, Probabilistic inventory control models, Decision making process, Decision making under uncertainty, Decision making under risk, Decision tree analysis, Theory of games, Pure strategies, Mix strategies, Solutions method games without saddle points.	**10**	**25**
3.	**Classical Optimization Methods:** Single variable optimization, Constrained and unconstrained multi-variable optimization, Direct substitution method, Lagrange's method of multipliers, Kuhn- Tucker conditions	**06**	**12**
4.	**Non-linear Programming:** **Constrained Optimization Techniques** Unimodal function, Unrestricted search, Exhaustive search, Dichotomous search, Interval halving method, Fibonacci method, Golden section method **Unconstrained Optimization Techniques** Direct Search Methods: Random search methods, Grid search method, Univariate method, **Constrained Optimization Techniques** Direct Methods: Random search method, Sequential linear programming.	**10**	**25**
5.	**Evolutionary Algorithms** An overview of evolutionary algorithms, Simulated annealing algorithm, Genetic algorithm, Particle swarm optimization	**04**	**8**

Reference Book:

1. J. K. Sharma, Operation Research, Theory and Application, Macmillan Publishers India Ltd,2013
2. H.A. Taha, Operations Research, An Introduction, PHI, 2008
3. S.S.Rao, Engineering Optimization Theory and Practice, New Age International (P) Ltd, Publishers.
4. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Course Outcome:

1. Students should able to apply the Liner programming techniques to solve problems of real life applications and carry out post optimality analysis.
2. Students should able to apply the concepts of non-linear programming and apply them for real life problems.
3. Students should able to obtain quantitative solutions in business decision making under conditions of certainty, risk and uncertainty
4. Students should able to implement various scientific tools and models that are available in the subject to take decisions in a complex environment.
5. develop linear programming (LP) models for shortest path, maximum flow, minimal spanning tree, critical path, minimum cost flow, and transshipment problems.

Tutorial work shall consist of presentations / problems / preparation of learning material based on above topics. Apart from above assignments a group of students has to undertake one open ended design problem based on engineering application.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	3	2	3	1	3	-	-	-	--	-	-	-	-
CO-2	3	2	3	1	3	-	-	-	--	-	-	-	-
CO-3	3	2	3	1	3	-	-	-	--	-	-	-	-
CO-4	3	2	3	1	3	-	-	-	--	-	-	-	-
CO-5	3	2	3	1	3	-	-	-	--	-	-	-	-

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M.E (STRUCTURAL)
SUBJECT NAME: DESIGN OF PRESTRESSED CONCRETE STRUCTURES
SUBJECT CODE: FEM135205
SEMESTER : III

Types of course: Program Elective V

Prerequisite: Mechanics of Solids and Design of Reinforced Concrete Structures and Concrete Technology

Rationale: Prestressed concrete is one of the most reliable, durable and widely used construction materials in building and bridge projects around the world. It has made significant contributions to the construction industry, the precast manufacturing industry and the cement industry as a whole. It has led to an enormous array of structural applications, including buildings, bridges, and foundations, parking garages, water towers, nuclear reactors, TV towers and offshore drilling platforms due to its distinct advantages. This subjects covers basic principles and in depth knowledge of designing prestressed concrete structures.

Teaching & Evaluation Scheme:

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	0	3	3	70	30	0	0	100

Th:-Theory, Tu: - Tutorial, P:- Practical, SEE:- Semester End Examinations, PA :- Progressive Assessment

Course Objective:

- To analyze the structure using Ultimate strength in flexure with code provisions.
- To apply Application in the design of prestressed pipes and prestressed concrete

- To understand of determining structural response and design of various structural elements like slab, column, beam-column

Content:

Sr No.	Subject Content	Teaching Hours	(%) Weightage
1.	**Introduction:** Principles of prestressing - types and systems of prestressing, need for High Strength materials, Loading stages, Determination of losses, deflection (short-long term), camber, cable layouts.	**05**	**10**
2.	**Statically determinate PSC beams**: Analysis and design for ultimate and serviceability limit states for flexure, shear, bond and torsion, code provisions.	**06**	**15**
3.	**Transmission of prestress:** Prestress Transmission in pre-tensioned members; Anchorage zone stresses and design for post-tensioned members.**Statically indeterminate structures:** Analysis and design of continuous beams, choice of cable profile, linear transformation and concordance	**10**	**25**
4	**Design of structural elements:** Analysis and design of various structural elements like slab, column, beam-column. Application in the design of prestressed pipes and prestressed concrete cylindrical water tanks.	**10**	**25**
5.	**Composite construction:** Analysis and design of precast PSC beams and cast in-situ RC slab, creep and shrinkage effects. Partial prestressing - principles, analysis and design concepts, crack width calculations. **Miscellaneous structures:** Introduction to the special prestressed structures like prestressed folded plates, Prestressed cylindrical shells, prestressed concrete poles.	**10**	**25**

Reference Books:

1. Prestressed concrete - Krishna Raju

2. Design of Prestressed Concrete Structures - T.Y.Lin

3. Fundamentals of Prestressed Concrete - N.C.Sinha&S.K.Roy S.Chand & Co.,

4. Prestressed Concrete- Design and Construction – Leonhardt F., Wilhelm Ernst and Shon, Berlin

5. Prestressed Concrete - Freyssinet

6. Prestressed Concrete, - Evans, R.H. and Bennett, E.W., Chapman and Hall

7. Prestressed concrete - Rajgopalan

8. IS:1343-Code for Practice for Prestressed Concrete.

9. IS:3370-3 (1967): Code of Practice Concrete structures for the storage of liquids, Part 3: Prestressed concrete structures

Course Outcome:

After learning the course the students should be able to:

1. Analyse and design for flexure shear, bond and torsion

2. Design of tension members

3. Design of compression members with and without flexure

4. Analysis and design of composite beams

5. Understand design principles of the special prestressed structures like prestressed folded plates, prestressed cylindrical shells, prestressed concrete poles.

List of Suggested Experiments/Tutorials:

At least 15 problems based on above mentioned.

List of Open Source Software/learning website:

www.nptel.iitm.ac.in/courses/

Course Outcomes		Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*											
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PSO-1**	**PSO-2**	**PSO-3**
CO-1	3	2	3	1	-	3	2	1	1	1	-	1	-
CO-2	3	2	3	1	-	3	2	1	-	-	-	2	-
CO-3	3	2	3	1	-	3	2	1	-	-	-	1	-
CO-4	3	2	3	1	-	3	2	1	2	1	-	1	-
CO-5	3	2	3	1	-	3	2	1	1	1	-	1	-

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M.E (STRUCTURAL)
SUBJECT NAME: EARTHQUAKE RESISTANT DESIGN OF STRUCTURES
SUBJECT CODE: FEM135206
SEMESTER:III

Type of Course: Program Elective-V

Prerequisite: Design of concrete structures**,** Structural Dynamics and Engineering Mathematics

Rationale: Earthquake force is time-dependent force acting on the structure and thereby it induces vibration in the structures. Structures are designed as earthquake resistant structures which allow damage in the structures. Therefore, it is very challenging to design structures which remain safe during earthquake disaster. ERD of Structures becomes very important for the structural engineers to make them safe.

Teaching and Examination Scheme:

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	0	3	3	70	30	00	00	100

Th:-Theory, Tu: - Tutorial, P:- Practical, SEE:- Semester End Examinations, PA :- Progressive Assessment.

Course Objectives:

- This course integrates information from various engineering and scientific disciplines in order toprovide a rational basis for the design of earthquake-resistant structures.

Content:

Sr.	Content	Total Hrs	% Weightage
1	**Earthquake Ground Motion:** Engineering seismology - Causes of earthquakes; seismic waves; magnitude, intensity and energy release, Seismic zoning map of India - Strong motion studies in India - Strong motion characteristics - Evaluation of seismic design parameters.	03	10
2	**Concepts of earthquake resistant design & Effects of Irregularities in RC Structures:** Earthquake Resistant Design Philosophy, Earthquake Proof v/s Earthquake Resistant Design, four virtues of good earthquake resistant structures (strength, stiffness, ductility and configuration), Earthquake resistant building architecture. Effect of various structural irregularities like improper Load Transfer Path, Floating Columns, Short Column, Soft Storey, Improper gap between adjacent structures (Pounding), Eccentric loading, Unsymmetrical plan/elevation, Setbacks and Improper Detailing of reinforcement on performance of RCC buildings during earthquakes, Effect of Masonry Infill Walls, Performance of buildings in past earthquakes, Identification of seismic damages & Lessons learnt from past earthquakes.	10	20
3	**Lateral Load Distribution, Seismic analysis and modeling of RCC structures:** Rigid diaphragm effect, centers of mass and stiffness, lateral load distribution in torsionally coupled and uncoupled system. Lateral load resisting systems- moment resisting frame, Building with shear wall system, building with dual system;	06	15

	Code based procedure for determination of design lateral loads - Seismic analysis procedure as per IS 1893 code - Equivalent static force method - Response spectrum method - Time history analysis - Advantages and disadvantages of these methods, Estimation of earthquake forces using equivalent static force method & response spectrum method as per IS:1893- 2016, Calculation of design horizontal seismic base shear and story drift, Mathematical modeling of multi-storey RCC buildings with Infill walls		
4	**Ductility considerations in earthquake resistant design of RCC buildings :** Impact of ductility; Requirements for ductility; Assessment of ductility– Member/element ductility, Structural ductility; Factor affecting ductility; Ductility considerations as per IS 13920-2016, Design and detailing of typical flexural member, typical column, footing and beam-column joint as per IS13920-2016, Importance of Beam Column Joints.	**06**	**15**
5	**Earthquake resistant design of RCC structures:** Development of structural framing plan from architectural plan. Ductility considerations - Earthquake resistant design & detailing of multi-storey RCC buildings and shear walls based on Capacity Design Concept - IS 13920-2016, 3D modeling and analysis of RC Framed Building Structures under design load combinations including earthquake loads using standard commercial software such as STAAD Pro, SAP/ETABS etc. Post-processing of analysis results for design of structural Elements. Comparison with design output of the software.	**10**	**20**
6	**Structural controls:** Active & Passive Controls systems & their suitability. **Passive Control Systems:** Base isolation of structures; Considerations for seismic isolation; Basic elements of seismic isolation; seismic isolation design principle; Feasibility of seismic isolation; Seismic-isolation configurations Characteristics of Viscous Dampers, Visco-Elastic	**08**	**20**

	Dampers, Yielding Dampers, Tuned Mass Dampers, Tuned Liquid Dampers, Friction Pendulum Dampers, MR Dampers etc. & their suitability Concepts of Active, Semi-active & Hybrid Control Systems Application of controls in design of structures		

Reference Books:

1. B.C. Punmia, Ashok K. Jain and Arun K. Jain, "Reinforced Concrete Structures, Vol, 1", Laxmi Publications
2. M.L. Gambhir, "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Private Limited.
3. P.C. Varghese, "Design of Reinforced Concrete Foundations", Prentice Hall of India Private Limited,
4. T. Paulay and M.J.N. Priestley, "Seismic Design of Reinforced Concrete and Masonry Buildings", John Wiley and Sons Inc.
5. P. Agarwal and M. Shrikhande, "Earthquake Resistant Design of Structures", Prentice-Hall of India Private Limited
6. S.K. Duggal, "Earthquake Resistant Design of Structures", Oxford University Press
7. IS 456:2000, Indian Standard Plain and Reinforced Concrete - Code of Practice, Bureau of Indian Standards, New Delhi.
8. IS 875 (Part 1 to 5): Indian Standard Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures & load combination
9. IS:1893-2016, Indian Standards Criteria for Earthquake Resistant Design of Structures, Bureau of Indian Standards, New Delhi.
10. IS:13920-2016, Indian Standard Code of Practice for Design & Ductile Detailing of Reinforced Concrete Structures subjected to Seismic Forces, Bureau of Indian Standards, New Delhi.

Course Outcome:

After learning the course the students should be able to:

1. Apply the concept of Earthquake Resistant Design & appraise the effect of structural & architectural irregularities of buildings.
2. Determine the lateral loads on SDOF & MDOF structural system subjected to earthquake.
3. Analyze RCC framed structures through Equivalent static force method - Response spectrum method for determining the lateral forces generated due to earthquake. Design & detailing of Multi-storey RC building using the available software.
4. Appraise the concepts of ductile detailing for various structural elements in RC structures.
5. Classify & Describe various control systems & apply to framed structures.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	3	2	3	1	3	1	1	2	--	2	-	1	2
CO-2	3	2	3	1	3	2	1	1	--	1	-	1	1
CO-3	3	2	3	1	3	2	2	1	--	1	-	1	1
CO-4	3	2	3	1	3	-	1	2	--	1	-	-	1
CO-5	3	2	3	1	3	-	-	1	--	2	-	-	-

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M. E (STRUCTURAL)
SUBJECT NAME: INTERNAL REVIEW - 2
SUBJECT CODE: FEM145201
SEMESTER-IV

Types of course: - Dissertation
Prerequisite: - NA

Rationale:
Teaching & Evaluation Scheme:

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	Pr	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
0	0	4	4	2	00	00	00	100	100

Th:-Theory, Tu: - Tutorial, Pr: - Practical, ESE: - Semester End Examinations, PA: - Progressive Assessment

Course Objectives:

- To train the students in preparing project reports and to face reviews and viva-voce examinations.
- To develop the methodology to solve the identified problem.

Content

Sr No.	Subject Content
1.	**Course Objective**: To present a problem oriented in depth knowledge of Mid semester Thesis Progress Review. To address the underlying concepts and methods behind Mid semester Thesis Progress Review

2.	**Instructional Method & Pedagogy** At the start of course, the course delivery pattern, prerequisite of the subject will be discussed. Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations. Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation. Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation. Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.

Course Outcomes:-

At the end of the course, students must be in a position to:

1. The student can identify different areas of mid semester Thesis Progress Review.
2. Can find the applications of all the areas in day to day life.

Course Outcomes	**Expected Mapping with Programme Outcomes** *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PSO-1**	**PSO-2**	**PSO-3**
CO-1	2	1	3	3	-	-	-	-	-	--	-	-	-
CO-2	2	1	3	3	-	-	-	-	-	--	-	-	2

GOKUL GLOBAL UNIVERSITY
DEPARTMENT OF CIVIL ENGINEERING
COURSE: M. E (STRUCTURAL)
SUBJECT NAME: DISSERTATION PHASE II
SUBJECT CODE: FEM145202
SEMESTER-IV

Types of course: - Dissertation
Prerequisite: - NA

Rationale:
Teaching & Evaluation Scheme:

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	Pr	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
0	0	28	28	14	00	00	100	00	100

Th:-Theory, Tu: - Tutorial, Pr: - Practical, SEE:- Semester End Examinations, PA :- Progressive Assessment

Course Objectives:

- To identify a specific problem for the current need of the society and collect information
  related to the same through a detailed review of literature.
- To develop the methodology to solve the identified problem.

Content

Sr No.	Subject Content
1.	**Course Objective**: To present a problem oriented in depth knowledge of Dissertation Phase II. To address the underlying concepts and methods behind Dissertation Phase II
2.	**Instructional Method & Pedagogy** At the start of course, the course delivery pattern, prerequisite of the subject will be discussed. Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations. Attendance is compulsory in lectures and

	laboratory, which may carries five marks in overall evaluation. Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation. Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.

Course Outcomes: -

At the end of the course, students must be in a position to

1. The student can identify different areas of Dissertation Phase II.
2. Can find the applications of all the areas in day to day life

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)												
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	1	1	1	3	2	3	3	-	3	-	-	-	1
CO-2	1	-	-	2	1	2	2	-	2	-	-	-	1