OPTIMIZATION TECHNIQUES
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – I

Subject Code	**22CSE11**	CIE Marks	50
Number of Lecture Hours/Week	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites: Engineering Mathematics

Course objectives:

The objective of this course is to make students to learn principles of optimization, To implement the optimization Concepts for the structural engineering problems. To evaluate different methods of optimization.

Modules

Module-1

Introduction: Introduction to optimization, engineering applications of optimization, Formulation of structural optimization problems as programming problems. Optimization Techniques: Classical optimization techniques, single variable optimization, multivariable optimization with no constraints, unconstrained minimization techniques and algorithms constrained optimization solutions by penalty function techniques, Lagrange multipliers techniques and feasibility techniques.

Teaching Learning Process	**L1, L2,L4**

Module-2

Linear Programming: Linear programming, standard form of linear programming, geometry of linear programming problems, solution of a system of linear simultaneous equations, pivotal production of general systems of equations, simplex algorithms, revised simpler methods, duality in linear programming.

Teaching Learning Process	**L2, L4,L5**

Module -3

Non-linear programming: Non-linear programming, one dimensional minimization methods, elimination methods, Fibonacci method, golden section method, interpolation methods, quadratic and cubic methods, Unconstrained optimization methods, direct search methods, random search methods, descent methods

Teaching Learning Process	**L2, L3,L4, L5**

Module -4

Constrained optimization techniques such as direct methods, the complex methods, cutting plane method, exterior penalty function methods for structural engineering problems. Formulation and solution of structural optimization problems by different technique

Teaching Learning Process	**L2, L3,L4, L5**

Module -5

Geometric programming: Geometric programming, conversion ofNLP as a sequence of LP/ geometric programming. **Dynamic programming:** Dynamic programming conversion ofNLP as a sequence of LP/ Dynamic programming	
Teaching Learning Process	**L4, L5**

Course outcomes:

On completion of this course, students are able to:

- Co1:Achieve Knowledge of design and development of problem solving skills.
- Co2: Understand the principles of optimization.
- Co3: Design and develop analytical skills.
- Co4: Summarize the Linear, Non-linear and Geometric Programming
- Co5: Understands the concept of Dynamic programming

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 full questions (with a maximum of four sub questions) from eachmodule.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from eachmodule.

Reference Books:

1. Spunt, "Optimum Structural Design"- Prentice Hall
2. S.S. Rao, "Optimization – Theory and Practice"- Wiley Eastern Ltd.
3. Uri Krisch, "Optimum Structural Design"- McGraw Hill
4. Richard Bronson, "Operation Research"- Schaum's Outline Series
5. Bhavikatti S.S.- "Structural optimization using sequential linear programming"- Vikas publishing house

Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=wEdZLKMMZ8o&list=PLwdnzlV3ogoXKKb9nABDWYltTDgi37lYD
https://www.youtube.com/watch?v=GMTvoKRfxQw&list=PLGbjwqYC00hsy6XGalOBAphm2tdeLbgK0
https://www.youtube.com/watch?v=fszNBvdfKrY

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

	PO										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**X**	**X**		**X**					**X**	**X**	**X**
CO2	**X**	**X**		**X**					**X**	**X**	**X**
CO3	**X**	**X**		**X**					**X**	**X**	**X**
CO4	**X**	**X**		**X**					**X**	**X**	**X**
CO5	**X**	**X**		**X**					**X**	**X**	**X**

Matrix methods of Structural Analysis

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject Code	**22CSE12**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

- **Prerequisites:** Engineering Mechanics
- Strength of Materials
- Structural Analysis
- Matrix Algebra

Course objectives: To understand basic concepts of Matrix Methods of Structural Analysis
- To analyse the behavior of plane trusses, continuous beams, and portal frames

Modules

Module-1

Basic concepts of structural analysis and methods of solvingsimultaneous equations: Introduction, Types of framed structures, Static and Kinematic Indeterminacy, Equilibrium equations, Compatibility conditions, Principle of superposition, Energy principles, Equivalent joint loads, Methods of solvinglinear simultaneous equations- Gauss elimination method, Cholesky method and Gauss-Siedalmethod.

Teaching Learning Process	**L1,L2,L3,L4**

Module-2

Fundamentals of Flexibility and Stiffness Methods: Conceptsof stiffness and flexibility, Local and Global coordinates, Development of element flexibility and element stiffness matrices for truss, beam and grid elements, Force-transformation matrix, Development of global flexibility matrix for continuous beams,plane trusses and 1rigid plane frames, Displacement-transformation matrix, Development of global stiffness matrix for continuous beams, plane trusses and rigid plane frames.

Teaching Learning Process	**L1,L2,L3,L4**

Module-3

Analysis using Flexibility Method: Continuous beams, plane trusses and rigid plane frames

Teaching Learning Process	**L2,L3,L4,L5**

Module-4

Analysis using Stiffness Method: Continuous beams, plane trusses and rigid plane frames

Teaching Learning Process	**L2,L3,L4,L5**

Module-5

Direct Stiffness Method: Stiffness matrix for truss element in local and global coordinates, Analysis of plane trusses, Stiffness matrix for beam element, Analysis of continuousbeams and orthogonal frames.	
Teaching Learning Process	**L2,L3,L4,L5**

Course outcomes:

Upon completing this course, the students will be able to:

C01: Formulate force displacement relation by flexibility and stiffness method

- Co2: Analyze the plane trusses, continuous beams and portal framestransformation approach
- Co3: Analyse the structures by direct stiffness method

Question paper pattern:

The question paper will have ten questions; each question carries equal marks, there will be two full questions or with a maximum of four sub questions from each module, students will have to attend five full questions from each module.

Reference Books:

1. Weaver, W., and Gere, J.M., ***Matrix Analysis of Framed Structures***, CBS Publishers and distributors Pvt. Ltd., 2004.
2. Rajasekaran, S., and Sankarasubramanian, G., ***Computational Structural Mechanics***, PHI, New Delhi, 2001.
3. Martin, H, C., ***Introduction to Matrix Methods of Structural Analysis***, McGraw-Hill, New York, 1966.
4. Rubinstein, M.F., ***Matrix Computer Analysis of Structures*****,** Prentice-Hall, Englewood Cliffs, New Jersey, 1966.
5. Beaufait, F.W., Rowan, W. H., Jr., Hoadely, P. G., and Hackett, R. M., ***Computer Methods of Structural Analysis***, Prentice-Hall, Englewood Cliffs, New Jersey, 1970.
6. Kardestuncer, H., ***Elementary Matrix Analysis of Structures***, McGraw-Hill, New York, 1974.

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=Wa9ZSWlrpnk&list=PLbRMhDVUMngeZatm4MIOKG4sHxXuB_yri

https://www.youtube.com/watch?v=oMSoFeCZL5k&list=PL8pjaLEv3XhmeAp8aEWfp7t2bf2Nh2dYy

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

CO	PO										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	X	X		X						X	
CO2	X	X		X						X	
CO3	X	X		X						X	

ADVANCED DESIGN OF RC STRUCTURES

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject Code	**22CSE13**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:2:0	SEE Marks	50
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Prerequisites: An undergraduate course on reinforced concrete.

Prerequisites (LAB): Concrete Technology, Special Concrete, Structural DynamicsAnalysis,

Course objectives:

The objective of this course is to make students to learn principles of Structural Design, to design different types of structures and to detail the structures. To evaluate performance of the structures

Course objectives:(LAB)

The objective of this course is to make students to learn principles of design of experiments,
To investigate the performance of structural elements.
To evaluate the different testing methodsand equipments.

Modules

Module-1

- Design of R C slabs by yield line method
- Design of flat slabs
- Lab Experiment No-1 : Simple design of Flat Slab using Excel Spreadsheet

Lab Experiments 2: Simple design of Flat Slab using Excel Spreadsheet, contd…

Teaching Learning Process	**L1, L2, L3, L4,L5**

Module-2

- Design of grid or coffered floors
- Design of continuous beams with redistribution of Moments
-

Lab Experiments 3: Simple Design of grid floors using Excel Spread sheets
Lab Experiments 4: Simple Design of grid floors using Excel Spread sheets contd…

Teaching Learning Process	**L1, L2,**

Module -3

- Design of R C Chimneys

Lab Experiments 5: Simple design of RC chimney using Excel Spread sheets
Lab Experiments 6: Simple design of RC chimney using Excel Spread sheets contd…

Teaching Learning Process	L1, L2, L3, L4,

Module -4

- Design of R C silos
- Design of R C bunkers

Lab Experiments 7: Simple design of RC Silos using Excel Spread sheets
Lab Experiments 8: Simple design of RC bunkers using Excel Spread sheets

Teaching Learning Process	L1, L2, L4, L5

Module -5

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

Lab Experiment 9: Concrete mix design using Excel spread sheet
Lab Experiment 10: Concrete mix design using Excel spread sheet contd…

Teaching Learning Process	L1, L2

Course outcomes:

On completion of this course, students are able to:

1. Achieve Knowledge of design and development of problem solving skills
2. Understand the principles of Structural Design.
3. Design and develop analytical skills.
4. Summarize the principles of Structural Design and detailing
5. Understands the structural performance.

Question paper pattern:

The question paper will have ten questions; each question carries equal marks, there will be two full questions or with a maximum of four sub questions from each module, students will have to attend one full questions from each module.

Reference Books:

1. Hsu T. T. C. and Mo Y. L., “Unified Theory of Concrete Structures”, JohnWiley & Sons, 2010
2. Krishnamurthy, K.T., Gharpure S.C. and A.B. Kulkarni – “Limit design of reinforced concrete structures”,Khanna Publishers, 1985
3. Lin T Y and Burns N H., “Reinforced Concrete Design". Wiley, 2004
4. Park & Paunlay.,"Reinforced Concrete Structures". Wiley, 2004
5. Punmia B.C, Ashok Kumar Jain and Arun Kumar Jain, “Comprehensive RCC Design”, Laxmi Publications, New Delhi
6. Purushothaman. P., “Reinforced Concrete Structural Elements : Behaviour Analysis and Design”, TataMc Graw Hill, 1986
7. Sinha. N.C. and Roy S.K., “Fundamentals of Reinforced Concrete”, S. Chandand Company Limited, NewDelhi, 2003

8. Unnikrishna Pillai and Devdas Menon., "Reinforced concrete Design', Tata McGraw Hill PublishersCompany Ltd., New Delhi, 2006
9. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall ofIndia, 2007
10. Varghese. P. C., "Advanced Reinforced Concrete Design", Prentice-Hallof India, New Delhi, 2000

Recommended Reading:

1. Krishna Raju. N., "Advanced Reinforced Concrete Design", CBS Publishers & Distributors
2. Pillai S. U. and Menon D., "Reinforced Concrete Design", Tata McGraw-Hill,3rd Ed, 1999
3. Relevant IS Code Books
4. Shah.H.J, "Reinforced Concrete", Vol-1 and Vol-2, Charotar, 8th Edition –2009 and 6th Edition – 2012 respectively.
5. Gambhir.M.L, "Design of Reinforced Concrete Structures", PHI Pvt. Ltd, NewDelhi, 2008

Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=undsd92MM8w&list=PLbQO4xhI7wEDIYv90NoF7veaJIohpuf0Q

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

	PO										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**X**	**X**		**X**	**X**					**X**	
CO2	**X**	**X**		**X**	**X**					**X**	
CO3	**X**	**X**		**X**	**X**					**X**	
CO4	**X**	**X**		**X**	**X**					**X**	
CO5	**X**	**X**		**X**	**X**					**X**	

MECHANICS OF DEFORMABLE BODIES

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I

Subject Code	**22CSE14**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites:

Basics of Mathematics, Strength of Materials

Course objectives:

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

Modules

Module-1

Theory of Elasticity: Introduction: Definition of stress and strain and strain at a point, components of stress and strain at appoint of Cartesian and polar coordinates. Constitutive relations, equilibrium equations, compatibility equations and boundary conditions in 2-D and 3-D cases.

Teaching Learning Process	**L1, L2**

Module-2

Transformation of stress and strain at a point, Principal stresses and principal strains, invariants of stress and strain, hydrostatic and deviatric stress, spherical and deviatric strains max. shear strain.

Teaching Learning Process	**L2, L3**

Module -3

Plane stress and plane strain: Airy's stress function approach to 2-D problems of elasticity, simple problems of bending of beams. Solution of axisymmetric problems, stress concentrationdue to the presence of a circular hole in plates.

Teaching Learning Process	**L2, L3**

Module -4

Elementary problems of elasticity in three dimensions, stretching of a prismatic bar by its own weight, twist of circular shafts, torsion of non-circular sections, membrane analogy, Propagation of waves in solid media. Applications of finite difference equations in elasticity.

Teaching Learning Process	**L2, L3,L4**

Module -5

Theory of Plasticity: Stress – strain diagram in simple tension, perfectly elastic, Rigid – Perfectly plastic, Linear work – hardening, Elastic Perfectly plastic, Elastic Linear work hardening materials, Failure theories, yield conditions, stress – space representation of yield criteria through Westergard stress space, Tresca and Von- Mises criteria of yielding

Teaching Learning Process	**L1, L2**

Course outcomes:

On completion of this course, students are able to:

- Co1: Achieve Knowledge of design and development of problem solving skills.
- Co2: Understand the principles of stress-strain behaviour of continuum
- Co3: Design and develop analytical skills.
- Co4: Describe the continuum in 2 and 3- dimensions
- Co5: Understand the concepts of elasticity and plasticity

Question paper pattern:

The question paper will have ten questions; each question carries equal marks, there will be two full questions or with a maximum of four sub questions from each module, students will have to attend five full questions from each module.

Reference Books:

1. Timoshenko &Goodier, "Theory of Elasticity", McGraw Hill
2. Srinath L.S., Advanced Mechanics of Solids, 10th print, Tata McGraw Hill Publishingcompany, New Delhi, 1994.
3. Sadhu Singh, "Theory of Elasticity", Khanna Publishers
4. Verma P.D.S, "Theory of Elasticity", Vikas Publishing Pvt. Ltd
5. Chenn W.P and Hendry D.J, "Plasticity for Structural Engineers", Springer Verlag
6. Valliappan C, "Continuum Mechanics Fundamentals", Oxford IBH Publishing Co.Ltd.
7. Sadhu Singh, "Applied Stress Analysis", Khanna Publishers
8. Xi Lu, "Theory of Elasticity", John Wiley.

Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=eICv1p8WjgI&list=PLbRMhDVUMngcbhsZgRWuYCi2kKQwQ0Av1
https://www.youtube.com/watch?v=lfEh3yWTBuM

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

	PO										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**X**	**X**		**X**	**X**					**X**	
CO2	**X**	**X**		**X**	**X**					**X**	
CO3	**X**	**X**		**X**	**X**					**X**	
CO4	**X**	**X**		**X**	**X**					**X**	
CO5	**X**	**X**		**X**	**X**					**X**	

STRUCTURAL DYNAMICS

[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – I

Subject Code	**22CSE15**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 04

Course objectives: The objective of this course is to make students to learn principles of Structural Dynamics, To implement these principles through different methods and to apply the same for free and forced vibration of structures. To evaluate the dynamic characteristics of the structures.

Modules

Module-1

Introduction: Introduction to Dynamic problems in Civil Engineering, Concept of degrees of freedom, D'Alembert's principle, principle of virtual displacement and energy principles. Dynamics of Single degree-of-freedom systems: Mathematical models of Single-degree-of-freedom systems system, Freevibration response of damped and undamped systems including methods for evaluation of damping.

Teaching Learning Process	**L_1, L_2, L_5**

Module-2

Response of Single-degree-of-freedom systems to harmonic loading including support motion, vibration isolation, transmissibility. Numerical methods applied to Single-degree-of-freedom systems – Duhamel integral. Principle of vibration measuring instruments– seismometer and accelerometer.

Teaching Learning Process	**L_3, L_4, L_5**

Module -3

Dynamics of Multi-degree freedom systems: Mathematical models of multi-degree-of-freedom systems, Shear building concept, free vibration of undamped multi-degree-of- freedom systems – Natural frequencies and mode shapes –
Orthogonality of modes.

Teaching Learning Process	**L_1, L_2, L_4,L_5**

Module -4

Response of Shear buildings for harmonic loading withoutdamping using normal mode approach. Response of Shearbuildings for forced vibration for harmonic loading with damping using normal mode approach.

Teaching Learning Process	**L_3, L_4, L_5**

Module -5

Approximate methods: Rayleigh's method, Dunkarley's method, Stodola's method. Dynamics of Continuous systems: Flexural vibration of beams with different end conditions. Stiffness matrix, mass matrix (lumped and consistent).

Teaching Learning Process	**L_2, L_4**

Course outcomes:

On completion of this course, students are ableto:

- Co1: Achieve Knowledge of design and development of problem solving skills.
- Co2: Understand the principles of Structural Dynamics
- Co3: Design and develop analytical skills.
- Co4: Summarize the Solution techniques for dynamics of Multi-degree freedomsystems
- Co5: Understand the concepts of damping in structures.

Question paper pattern:

The question paper will have ten questions; each question carries equal marks, there will betwo full questions or with a maximum of four sub questions from each module, students will have to attend five full questions from each module.

Reference Books:

1. Dynamics of Structures – "Theory and Application To Earthquake Engineering"- 2nd ed., Anil K. Chopra, Pearson Education.
2. Earthquake Resistant Design of Building Structures, Vinod Hosur,WILEY (India)
3. Vibrations, structural dynamics- M. Mukhopadhaya : Oxford IBH
4. Structural Dynamics- Mario Paz: CBS publishers.
5. Structural Dynamics- Clough & Penzien: TMH
6. Vibration Problems in Engineering Timoshenko, S, Van-Nostrand Co.

Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=0KiYC8QQOiM&list=PLyVhmjhvTvDbqByamCNEYw2zDBOscOHRb
https://www.youtube.com/watch?v=Jlzo8OzoZ_c&list=RDQMjbIvZOwDdoM&start_radio=1

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

CO	PO										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	X	X		X						X	
CO2	X	X		X						X	
CO3	X	X		X						X	
CO4	X	X		X						X	
CO5	X	X		X						X	

RESEARCH METHODOLOGY AND IPR			
Course Code	22RMI16	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Credits	03	Exam Hours	03

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Teaching-Learning Process	L_1 – Remember,L_2 – Understand

Module-2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Teaching-Learning Process	Remember,L_2 – Understand

Module-3

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale.

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Teaching-Learning Process	L_1 – Remember,L_2 – Understand

Module-4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.

Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests.

Teaching-Learning Process	L_1 – Remember,L_2 – Understand

Module-5

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.

Teaching-Learning Process	L_1 – Remember,L_2 – Understand

Course outcomes:

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

- Co1: Discuss research methodology and the technique of defining a research problem
- Co2: Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
- Co3: Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.
- Co4: Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports
- Co5: Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbooks

(1) Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg,New Age International,4th Edition, 2018.
(2) Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2), RanjitKumar,SAGE Publications,3rd Edition, 2011.
(3) Study Material (For the topic Intellectual Property under module 5),
Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013.

Reference Books

(1) Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.
(2) Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=E2gGF1rburw
https://www.youtube.com/watch?v=5fvpsqPWZac&list=PLyqSpQzTE6M8PuzP1p2hNPXgpbOBhFgja

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

	PO										
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	X	X	X	X	X	X	X	X	X	X	X
CO2	X	X	X	X	X	X	X	X	X	X	X
CO3	X	X	X	X	X	X	X	X	X	X	X
CO4	X	X	X	X	X	X	X	X	X	X	X
CO5	X	X	X	X	X	X	X	X	X	X	X

STRUCTURAL ENGINEERING LAB-1 [As per Choice Based Credit System (CBCS) scheme] SEMESTER – I			
Subject Code	22CSEL17	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	1:2:0	SEE Marks	50
Total Number of Lecture Hours	42	Exam Hours	03
CREDITS – 02			

Prerequisites: Concrete Technology, Special Concrete, Structural Analysis, Structural Dynamics.

Course objectives: The objective of this course is to make students to learn principles of design of experiments, To investigate the performance of structural elements. To evaluate the different testing methods and equipments.

Modules	Teaching Hours	RBT Level
1. Experiments on Concrete, including Mix design	12 Hrs	L1, L2, L3, L4, L5, L6
2. Testing of beams for deflection, flexure and shear	12 Hrs	
3. Experiments on vibration of multi storey frame models for Natural frequency and modes.	12 Hrs	
4. Use of Non destructive testing (NDT) equipments – Rebound hammer, Ultra sonic pulse velocity meter and Profometer	06Hrs	

Course outcomes: On complete of this course the students will able to

Co1: Achieve Knowledge of design and development of experimenting skills.
Co2: Understand the principles of design of experiments
Co3: Design and develop analytical skills.
Co4: Summarize the testing methods and equipment's.

Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=cGTebUY2xQc&list=PLNJ364_NfpLWcp0Hck9f2rOJUIudOlaYi

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

CO	PO										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	X	X	X	X	X			X	X	X	X
CO2	X	X	X	X	X			X	X	X	X
CO3	X	X	X	X	X			X	X	X	X
CO4	X	X	X	X	X			X	X	X	X

ADVANCED DESIGN OF STEEL STRUCTURES

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject Code	**22CSE21**	CIE Marks	50
Teaching Hours / Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites: Engineering Mechanics

- Strength of Materials
- Structural Analysis
- Design of Steel structures

Course objectives: This course will enable students to

1. Understand the background to the design provisions for hot-rolled and cold-formed steel structures, including the main differences between them.
2. Proficiency in applying the provisions for design of columns, beams, beam-columns
3. Design structural sections for adequate fire resistance

Modules

Module-1

Laterally Unrestrained Beams:

Lateral Buckling of Beams, Factors affecting lateral stability, IS 800 code provisions, Design Approach. Lateral buckling strength of Cantilever beams, continuous beams, beams with continuous and discrete lateral restraints , Mono-symmetric and non-uniform beams – Design Examples. Concepts of -Shear Center, Warping, Uniform and Non-Uniform torsion.

Teaching Learning Process	**L1, L2, L3L4, L5**

Module-2

Beam- Columns in Frames: Behaviour of Short and Long Beam - Columns, Effects of Slenderness Ratio and Axial Force on Modes of Failure, Biaxial bending, Strength of Beam Columns, Sway and Non-Sway Frames, Strength and Stability of rigid jointed frames, Effective Length of Columns-, Methods in IS 800 - Examples

Teaching Learning Process	**L1, L2, L3L4, L5**

Module -3

Steel Beams with Web Openings: Shape of the web openings, practical guide lines, and Force distribution and failure patterns. Analysis of beams with perforated thin and thick webs, Design of laterally restrained castellated beams for given sectional properties. Vierendeel girders (design for given analysis results).

Teaching Learning Process	**L1, L2, L3L4, L5**

Module -4

Cold formed steel sections: Techniques and properties, Advantages, Typical profiles, Stiffened and unstiffened elements, Local buckling effects, effective section properties, IS 801& 811 code provisions- numerical examples, beam design, column design.

Teaching Learning Process	**L1, L2, L3L4, L5**

Module -5	
Fire resistance: Fire resistance level, Period of Structural Adequacy, Properties of steel with temperature, Limiting Steel temperature, Protected and unprotected members, Methods of fire protection, Fire resistance Ratings. Numerical Examples.	
Teaching Learning Process	**L1, L2, L3L4, L5**

Course outcomes: After studying this course, students will be able to:

- Co1: Able to understand behavior of Light gauge steel members
- Co2: Able to understand design concepts of cold formed/unrestrained beams
- Co3: Able to understand Fire resistance concept required for present days.
- Co4: Able to analyze beam column behavior

Question paper pattern:

IS 800: 2007, IS 801-2010, IS811-1987 and BS5950 – part 8 to be allowed along with Steel Tables in Exam.
The question paper will have ten questions; each question carries equal marks, there will be two full questions or with a maximum of four sub questions from each module, students will have to attend five full questions from each module.

Reference Books:

1. N. Subramanian, "Design of Steel Structures", Oxford, IBH
2. Duggal,S.K. Design of Steel Structures, Tata McGraw-Hill3. IS 800: 2007, IS 801-2010 , IS 811-1987
4. BS5950 Part- 8,
5. INSDAG Teaching Resource Chapter 11 to 20:www.steel-insdag.org
6. SP 6(5)-1980

Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=qJV5zdx7NJs&t=10s
https://www.youtube.com/watch?v=aLgdv91U2OQ

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

	PO										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**X**	**X**		**X**				**X**		**X**	
CO2	**X**	**X**		**X**				**X**		**X**	
CO3	**X**	**X**		**X**				**X**		**X**	
CO4	**X**	**X**		**X**				**X**		**X**	

FINITE ELEMENT METHOD OF ANALYSIS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject Code	**22CSE22**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:2:0	SEE Marks	50
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Prerequisites: Computational structural Mechanics

- Theory of Elasticity

Course objectives:

- To provide the fundamental concepts of the theory of the finite element method
- To develop proficiency in the application of the finite element method (modeling, analysis, and interpretation of results) to realistic engineering problems through the use of softwares

Course objectives: (LAB)

- The objective of this course is to make students To analyze the structure using FE based Software To learn principles of design
- To investigate the performance of structural elements.
- To design the structural components using excel sheets

Modules

Module-1

Basic concepts of elasticity, Kinematic and Static variables for various types of structural problems, approximate methods ofstructural analysis–Rayleigh–Ritz method, Finite difference method, Finite element method. Variation method and minimization of Energy approach of element formulation, Principles of finite element method, advantages and disadvantages, Finite element procedure, Finite elements used for one, two and three dimensional problems, C0, C1 and C2 type elements, Element aspect ratio, Mesh refinement vs. higher order elements, Numbering of nodes to minimize bandwidth.

Lab Experiment 1 and 2

Teaching Learning Process	**L1, L2**

Module-2

Nodal displacement parameters, Convergence criterion,Compatibility requirements, Geometric invariance, Shapefunction, Polynomialform of displacement function, Generalized and Natural coordinates, Lagrangian interpolationfunction, shape functions for one, two &three dimensional elements.

Lab Experiment 3 and 4

Teaching Learning Process	**L1, L2,L4, L5**

Module -3

Isoparametric elements, Internal nodes and higher order elements, Serendipity and Lagrangian family of Finite Elements, Sub-parametric and Super- parametric elements, Condensation of internal nodes, Jacobian transformation Matrix, Development of strain-displacement matrix and stiffness matrix, consistent load vector, numerical integration. **Lab Experiment 5 and 6**	
Teaching Learning Process	**L1, L2,L4, L5**
Module -4	
Application of Finite Element Method for the analysis of one& twodimensional problems: Analysis of plane trusses and beams, Application to plane stress/strain, Axisymmetric problems using CST and Quadrilateral Elements **Lab Experiment 7 and 8**	
Teaching Learning Process	**L1, L2, L3, L4,L5**
Module -5	
Application to Plates and Shells, Non-linearity: material, geometric and combined non-linearity, Techniques for Non-linear Analysis. **Lab Experiment 9 and 10**	
Teaching Learning Process	**L1, L2**

Course Outcome: After successful completion of this the course, students shall beable to:

- Co1: Explain the basic theory behind the finite element method.
- Co2: Formulate force-displacements relations for 2-D elements
- Co3: Use the finite element method to analyze real structures.

Co4: Use a Finite Element based program for structuralanalysis

Question paper pattern: The question paper will have ten questions; each question carries equal marks, there will betwo full questions or with a maximum of four sub questions from each module, students willhave to attend five full questions from each module.

Reference Books:

- Zeinkeiwich, O.C. and Tayler, R.L., The Finite Element Method for Solid and Structural Mechanics, Butterworth- Heinemann,2013
- Krishnamoorthy,C.S., Finite Element Analysis: Theory and programming, Tata McGraw Hill Publishing Co. Ltd.,2017
- Desai, C., and Abel, J. F., Introduction to the Finite Element Method: A Numerical method for Engineering Analysis,East West Press Pvt. Ltd.,1972
- Cook, R.D., Malkas, D.S. and Plesha., M.E., Concepts and applications of Finite Element Analysis, John Wileyand Sons., 2007
- Reddy, J., An Introduction to Finite Element Methods, McGraw Hill Co., 2013
- Bathe K J, Finite Element Procedures in Engineering Analysis, Prentice Hall
- Shames,I.H. and Dym,C.J., Energy and Finite Element Methods in Structural Mechanics, McGraw Hill, NewYork,1985

Note:

- Experiment # 1: Analysis and Design of Simple Multistoried structure using any commercially available FEA packages
- Experiment # 2: Analysis and Design of Simple Multistoried structure with earthquake load using any commercially available FEA packages
- Experiment # 3: Analysis and Design of Simple shell structure using any commercially available FEA packages
- Experiment # 4: Analysis and Design of Simple plate structure using any commercially available FEA packages
- Experiment # 5: Analysis and Design of Simple overhead RCC water tanks using any commercially available FEA packages
- Experiment # 6: Analysis and Design of Simple doglegged/ open well/ spiral staircase using any commercially available FEA packages
- Experiment # 7: Analysis and Design of simple bridge decks under IRC loading using any commercially available FEA packages
- Experiment # 8: Analysis and Design of simple multistoried steel framed structures using any commercially available FEA packages
- Experiment # 9: Computation of fire resisting capacity parameters of steel beams using Excel spread sheet/ MatLab programming soft-computing techniques.
- Experiment # 10: Analysis of Unrestrained steel beams as per IS 800-2007 norms using Excel spread sheets / MatLab programming soft-computing techniques.

Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=lbghRDnb-LQ&list=PLFA5C164D77D3B971
https://www.youtube.com/watch?v=UOp6JEiJctA&list=PLSGws_74K018SmggufD-pbzG3thPIpF94

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

	PO										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**X**	**X**		**X**	**X**					**X**	**X**
CO2	**X**	**X**		**X**	**X**					**X**	**X**
CO3	**X**	**X**		**X**	**X**					**X**	**X**
CO4	**X**	**X**		**X**	**X**					**X**	**X**

THEORY OF PLATES AND SHELLS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject Code	**22CSE231**	CIE Marks	50
Number of Lecture Hours/Week	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites: Strength of Materials and Mechanics of Deformable Bodies

Course objectives:

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

Modules

Module-1

Introduction to plate theory, Small deflection of laterally loaded thin rectangular plates for pure bending. Navier's and Levy's solution for various lateral loading and boundary conditions (No derivation), Numerical examples

Teaching Learning Process	**L1, L2**

Module-2

Energy methods for rectangular and circular plates with clampededges subjected to symmetric loadings.

Teaching Learning Process	**L2, L3**

Module -3

Introduction to curved surfaces and classification of shells, Membrane theory of spherical shells, cylindrical shells, hyperbolic paraboloids, elliptic paraboloid and conoids.

Teaching Learning Process	**L2, L3**

Module -4

Axially symmetric bending of shells of revolution, Closed cylindrical shells,water tanks, spherical shells and Geckler's approximation. Bending theory of doubly curved shallow shells.

Teaching Learning Process	**L2, L3**

Module -5

Design and detailing of folded plates with numerical examples Design and Detailing of simple shell problems – spherical domes, water tanks, barrel vaults and hyperbolic paraboloid roofs

Teaching Learning Process	**L2, L3,L4**

Course outcomes:

On completion of this course, students are able to:

- Co1: Achieve Knowledge of design and development of problem solving skills.
- Co2: Understand the principles of Analysis and Design
- Co3: Design and develop analytical skills.
- Co4: Summarize the performance of shells
- Co5: Understand the concepts of energy principle.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from eachmodule.

Reference Books:

1. Timoshenko, S. and Woinowsky-Krieger, W., "Theory of Plates and Shells" 2ndEdition, McGraw-Hill Co., New York, 1959

2. Ramaswamy G.S. – "Design and Constructions of Concrete Shell Roofs" – CBS Publishers and Distributors – New Delhi – 1986.

3. Ugural, A. C. "Stresses in Plates and Shells", 2nd edition, McGraw-Hill, 1999.

4. R. Szilard, "Theory and analysis of plates - classical and numerical methods", Prentice Hall,1994.

5. Chatterjee.B.K. – "Theory and Design of Concrete Shell", – Chapman & Hall, NewYork-third edition, 1988.

Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=tA_LGwTvre4&list=PLwdnzlV3ogoXQR59FK4dNDzxb5I65IIuu
https://www.youtube.com/watch?v=CkolEAtY6jY

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

CO	PO										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	X	X		X						X	
CO2	X	X		X						X	
CO3	X	X		X						X	
CO4	X	X		X						X	
CO5	X	X		X						X	

Design of Precast & Composite Structures

[As perChoice Based Credit System (CBCS) scheme]

SEMESTER –II

Subject Code	**22CSE232**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites: Basics of Strength of materials, Structural Analysis

Course objectives:

1. Understand the concepts and techniques of precast construction and Select or designprecast elements suitable for project specific requirements
2. Design precast systems to ensure integrity and safety of the structure and to avoidprogressive collapse and Design composite floors and beam elements

Modules

Module-1

Concepts, components, Structural Systems and Design of precast concrete floors
Need and types of precast construction, Modular coordination, Precast elements- Floor, Beams, Columns and walls. Structural Systems and connections.

Design of precast Concrete Floors: Theoretical and Design Examples of Hollow core slabs. Precast Concrete Planks, floor with composite toppings with and withoutprops.

Teaching Learning Process	**L1,L2**

Module-2

Design of precast reinforced and pre-stressed Concrete Beams Theoretical and Design Examples of ITB – Full section precast, Semi Precast, propped and unpropped conditions. Design of RC Nibs

Teaching Learning Process	**L3,L4**

Module -3

Design of precast concrete columns and walls Design of braced and unbraced columns with corbels subjected to pattern and full loading. Design of Corbels Design of RC walls subjected to Vertical, Horizontal loads and moments, Design of vertical ties and horizontal joints.

Teaching Learning Process	**L3,L4**

Module -4

Design of Precast Connections and Structural Integrity Beambearing, Beam half Joint, Steel Inserts, Socket Connection, Structural integrity, Avoidance of progressive collapse, Design ofStructural Ties.

Teaching Learning Process	**L3,L4**

Module -5

Design of Steel Concrete Composite Floors and Beams Composite Floors: Profiled Sheeting with concrete topping, Design method, Bending and Shear Resistance of Composite Slabs, Serviceability Criteria, Design Example. **Composite Beams:**Elastic Behaviour, Ultimate Load behavior of Composite beams, Stresses and deflection in service and vibration, Design Example of Simply Supported beams.
Teaching Learning Process **L3,L4**
Course Outcomes: Co1: Analyse , Design and detail PSC elements
Question paper pattern: The question paper will have ten questions; each question carries equal marks, there will be two full questions or with a maximum of four sub questions from each module, students will have to attend five full questions from each module.
Reference Books: 1. Hass A.M. – Precast Concrete – Design and applications Applied Science, 1983. 2. David Sheppard – "Plant cast, Precast and Prestressed concrete – McGraw Hill;1989 3. NBC – 2005 (Part I to Part VII) BIS Publications, New Delhi, IS 15916- 2011, IS 11447,IS6061 – I and III 4. R.P. Johnson: Composite Structure of Steel and Concrete (Volume 1), Blackwell Scientific Publication (Second Edition), U.K., 1994. 5. IS: 11384-1985, Code of Practice for Composite Construction in Structural Steel andConcrete. 6. INSDAG Teaching Resource Chapter 21 to 27: www.steel-insdag.org

Web links and Video Lectures (e-Resources): https://www.youtube.com/watch?v=2qV4osntg6g&t=2558s https://www.youtube.com/watch?v=fRqxXkxApSY&t=74s
Skill Development Activities Suggested • **Conduction of technical seminars on recent research activities** • **Group Discussion**

	PO										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**X**	**X**								**X**	

EARTHQUAKE RESISTANT STRUCTURES

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject Code	**22CSE233**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites:

- Structural Dynamics

Course objectives:

The objective of this course is to make students to learn principles of engineering seismology, To design the reinforced concrete buildings for earthquake resistance. To evaluate the seismic response of the structures

Modules

Module-1

Introduction to engineering seismology, Geological and tectonic features of India, Origin and propagation of seismic waves, characteristics of earthquake and its quantification – Magnitude and Intensity scales, seismic instruments. Earthquake Hazards in India, Earthquake Risk Evaluation and Mitigation. Structural behavior under gravity and seismic loads, Lateral load resisting structural systems, Requirements of efficient earthquake resistant structural system, damping devises, base isolation systems.

Teaching Learning Process	**L1, L2**

Module-2

The Response history and strong motion characteristics. Response Spectrum – elastic and inelastic response spectra, tripartite (D-V-A) response spectrum, use of response spectrum in earthquake resistant design. Computation of seismic forces in multi-storied buildings – using procedures (Equivalent lateral force and dynamic analysis) as per IS-1893.

Teaching Learning Process	**L2, L3,L4, L5**

Module -3

Structural Configuration for earthquake resistant design, Concept of plan irregularities and vertical irregularities, Soft storey, Torsion in buildings. Design provisions for these in IS-1893. Effect of infill masonry walls on frames, modeling concepts of infill masonry walls. Behaviour of masonry buildings during earthquakes, failure patterns, strength of masonry in shear and flexure, Slenderness concept of masonry walls, concepts for earthquake resistant masonry buildings – codal provisions.

Teaching Learning Process	**L2, L4,L5**

Module -4

Design of Reinforced concrete buildings for earthquake resistance-Load combinations, Ductility and energy absorption in buildings. Confinement of concrete for ductility, design of columns and beams for ductility, ductiledetailing provisions as per IS1893. Structural behavior, design and ductile detailing of shear walls.	
Teaching Learning Process	**L2, L4,L5**
Module -5	
Seismic response control concepts – Seismic demand, seismic capacity, Overview of linear and nonlinear procedures of seismic analysis. Performance Based Seismic Engineering methodology, Seismic evaluation and retrofitting of structures.	
Teaching Learning Process	**L2, L5,L6**

Course Outcome: On completion of this course, students are able to:

- Co1: Achieve Knowledge of design and development of problem solving skills.
- Co2: Understand the principles of engineering seismology
- Co3: Design and develop analytical skills.
- Co4: Summarize the Seismic evaluation and retrofitting of structures.
- Co5: Understand the concepts of earthquake resistance of reinforced concrete buildings.

Question paper pattern: The question paper will have ten questions; each question carries equal marks, there will betwo full questions or with a maximum of four sub questions from each module, students willhave to attend five full questions from each module.

Reference Books: 1. Dynamics of Structures – Theory and Application to Earthquake Engineering- 2nd ed. – Anil K. Chopra, Pearson Education.

2. Earthquake Resistant Design of Building Structures, Vinod Hosur, WILEY (india)
3. Earthquake Resistant Design of Structures, Duggal, Oxford University Press.
4. Earthquake resistant design of structures - Pankaj Agarwal, Manish Shrikande -PHI India.
5. 5. IS – 1893 (Part I): 2002, IS – 13920: 1993, IS – 4326: 1993, IS-13828: 1993
6. Design of Earthquake Resistant Buildings, Minoru Wakabayashi, McGraw Hill Pub.
7. Seismic Design of Reinforced Concrete and Masonry Buildings, T Paulay and M JN Priestley, John Wiley and Sons.

Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=kZFtZKzuo3I&list=PL6XkfCIV_u2Now2UXF1DCLrT06Zyg4UtS

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

CO	PO										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	X	X		X						X	
CO2	X	X		X						X	
CO3	X	X		X						X	
CO4	X	X		X						X	
CO5	X	X		X						X	

ADVANCED STRUCTURAL ANALYSIS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – 2

Subject Code	**22CSE234**	CIE Marks	50
Teaching Hours/Week(L:P:SDA)	3:0:0	SEE Marks	50
Total Number ofLecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites: Strength of Materials and Structural Analysis

Course objectives: Students will be given provided with the knowledge of mathematics, science, and engineering in the in the analysis of following structural systems curved beams, Beams on elastic foundation, shear centre and unsymmetrical bending and buckling of non-prismatic columns and beam column.

Modules

Module-1

Curved Beams: Curved beams, Introduction, assumptions, derivation of WINKLER BACH equation, Radius to the neutral surface of simple geometric figures, Limitation, Stress distribution in opencurved members such as Hooks and chain links, Stress distribution in closed rings and chain links. Deformations of open and closed rings.

Teaching Learning Process	**L1,L2,L3,L4**

Module-2

Beams on Elastic Foundations: Governing differential equation for elastic line, Interpretation of constants, Infinite beam with point load, moment & UDL with problems. Semi-infinite beams with point load and moment UDL with problems over fixed and hinged support conditions.

Teaching Learning Process	**L1,L2,L3,L4**

Module -3

Shear Centre: Concept of shear center in torsion induced bending of beams, expression to the Shear Centre for Symmetrical and Unsymmetrical Sections, Derivation of shear centre for angles, channel, semicircular and built-up sections with numerical problems

Teaching Learning Process	**L1,L2,L3,L4**

Module -4

Unsymmetrical Bending (Asymmetrical Bending): Theory behind unsymmetrical bending, Assumptions, obtaining the stresses in beams, simply supported and cantilever unsymmetrical beams subjected to inclined loading, Deflections of unsymmetrical simply supported and cantilever beams with numerical problems.

Teaching Learning Process	**L1,L2,L3,L4**

Module -5

Buckling of Non Prismatic Columns and Beam-Column: Principle behind Euler's theory of buckling, Governing differential equation applied to buckling of columns and evaluation of constants for various boundary conditions, Obtaining the characteristic equation for the buckling load of non-prismatic compound columns, Analysis of Beam-column, conceptual theory of magnification stresses and deformations subjected to axial and different types of lateral loads with numerical problems.

Teaching Learning Process	L1,L2,L3,L4

Course Outcomes: Students will be able to

- Co1: Apply Winkler Bach and Strain Energy principles to obtain stresses and deformation in curved members
- Co2: Derive the expressions to Foundation pressure, Deflection, Slope, BM and SF of infinite and semi-infinite Beams resting on Elastic Foundation
- Co3: Obtain the equations for the shear centre for symmetrical and unsymmetrical from fundamental.
- Co4: Extrapolate the bending theory to calculate the stresses and deformations in unsymmetrical bending.
- Co5: Develop the characteristic equation for the buckling load of compound column and stresses and deformations in beam-column

Question paper pattern: The question paper will have ten questions; each question carries equal marks, therewill betwo full questions or with a maximum of four sub questions from each module, students willhave to attend five full questions from each module.

Text Books

1) Krishna Raju N & Gururaj D R "Advanced mechanics of solids and structures", NAROSA Publishers Company Delhi.

2) Srinath L.S. "Advanced Mechanics of Solids", Tenth Print, Tata McGraw Hill publishing company. New Delhi, 1994.

Reference Books

1) Vazirani V N and Ratwani M M "Advanced theory of structures and Matrix Method".5th Edition, Khanna publishers, Delhi 1995.

2) HetenyiM. "Beams on elastic foundation" 3rd printing, University of Michigan, USA,1952.

3) Alexander Chatjes "Principles of Structural stability theory", Prentice – Hall of India, NewDelhi, 1974.

4) Sterling Kinney "Indeterminate Structural Analysis", Oxford & IBH publishers

Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=s4CN6aVKhPo&list=PLEE5D02698EAAF2C0

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

	PO										
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	X	X		X						X	
CO2	X	X		X						X	
CO3	X	X		X						X	
CO4	X	X		X						X	
CO5	X	X		X						X	

STABILITY OF STRUCTURES

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject Code	**22CSE241**	CIE Marks	50
Number of Lecture Hours/Week	03	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites: Strength of Materials, Finite Element Analysis and Theory of Elasticity

Course objectives:

The objective of this course is to make students to learn principles of stability of structures, To analyse the structural elements for stability. To evaluate the use of strain energy in plate bending and stability.

Modules

Module-1

Beam – Column

Differential equation. Beam column subjected to (i) lateral concentrated load, (ii) several concentrated loads, (iii) continuous lateral load. Application of trigonometric series, Euler's formulation using fourth order differential equation for pined – pined, fixed – fixed, fixed – free and fixed – pinned column.

Teaching Learning Process	**L1, L2**

Module-2

Buckling of frames and continuous beams. Elastic Energy method:

Approximate calculation of critical loads for a cantilever. Exact critical load for hinged – hinged column using energy approach. Buckling of bar on elastic foundation. Buckling of cantilever column under distributed loads. Determination of critical loads by successive approximation. Bars with varying cross section. Effect of shear force on critical load. Column subjected topulsating forces.

Teaching Learning Process	**L2, L3**

Module -3

Stability analysis by finite element approach

Derivation of shape function for a two nodded Bernoulli–Euler beam element (lateral and translation of) – element stiffness and element geometric stiffness matrices – assembled stiffness and geometricstiffness matrices for a discretised column with different boundary condition – calculation of critical loads fora discretised (two elements) column (both ends built in). Buckling of pin jointed frames (maximum of two active DOF) – symmetricalsingle bay portal frame.

Teaching Learning Process	**L2, L3,L4**

Module -4

Lateral buckling of beams Differential equation –pure bending – cantilever beam with tip load – simply supported beam of I section subjected to central concentrated load. Pure Torsion of thin – walled bars of open cross-section. Non – uniform Torsion of thin – walled bars of open cross-section.	
Teaching Learning Process	**L1, L2,L3**
Module -5	
Expression for strain energy in plate bending with in plate forces (linear and non – linear). Buckling of simply supported rectangular plate– uniaxial load and biaxial load. Buckling of uniformly compressed rectangular plate simply supported along two opposite sides perpendicular to the direction of compression and having various edge condition along the other two sides.	
Teaching Learning Process	**L1, L2,L3**
Course Outcomes: On completion of this course, students are able to: • Co1: Achieve Knowledge of design and development of problem solving skills. • Co2: Understand the principles of strength and stability • Co3: Design and develop analytical skills. • Co4: Appraise the Stability analysis by finite element approach. • Co5: Understand the concepts of Lateral buckling of beams.	

Web links and Video Lectures (e-Resources): https://www.youtube.com/watch?v=un_Fjz_dfXI&list=PLFEqFwyPC3WwDLI6jtt2xXVPw2ygj0Jxz https://www.youtube.com/watch?v=_ypvXxOesm4
Skill Development Activities Suggested • **Conduction of technical seminars on recent research activities** • **Group Discussion**

	PO										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**X**	**X**								**X**	
CO2	**X**	**X**								**X**	
CO3	**X**	**X**								**X**	
CO4	**X**	**X**								**X**	
CO5	**X**	**X**								**X**	

DESIGN OF HIGH RISE STRUCTURES

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject Code	**22CSE242**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites: Special Concrete and Structural Dynamics

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

Modules

Module-1

Design Criteria: Design philosophy, loading, sequential loading, and materials – high performance concrete, fiber reinforced concrete, lightweight concrete, design mixes. Loading and Movement: Gravity loading: Dead and live load, methods of live load reduction, Impact, Gravity loading, Construction loads

Teaching Learning Process	**L1, L2**

Module-2

Wind loading: static and dynamic approach, Analytical and wind tunnelexperimentation method. Earthquake loading: Equivalent lateral force,modal analysis, combinations of loading, working stress design, Limit state design, Plastic design.

Teaching Learning Process	**L1, L3,L4, L5**

Module -3

Behavior of Various Structural Systems: Factors affecting growth, Height and structural form; High rise behavior, Rigid frames, braced frames, in-filled frames, shear walls, coupled shear walls, wall-frames,tubular, cores, Futigger – braced and hybrid mega system.

Teaching Learning Process	**L2, L3**

Module -4

Analysis and Design: Modeling for approximate analysis, accurate analysis andreduction techniques, analysis of building as total structural system consideringoverall integrity and major subsystem interaction, analysis for member forces;drift and twist, computerized general three dimensional analyses.

Teaching Learning Process	**L2, L3,L4**

Module -5

Stability of Tall Buildings: Overall buckling analysis of frames, wall frames, approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first order and P-Delta analysis, Transnational, Torsional instability, out of plum effects, stiffness of member in stability, effect of foundation rotation. Structural elements: sectional shapes, properties and resisting capacities, design, deflection, cracking, pre-stressing, shear flow. Design for differential movement, creep and shrinkage effects, temperature effects and fire.

Teaching Learning Process	**L2, L3,L4, L5**

Course outcomes: On completion of this course, students are able to:
Co1: Achieve Knowledge of design and development of problem solving skills.
Co2: Understand the principles of strength and stability
Co3: Design and develop analytical skills.
Co4: Summarize the behavior of various structural systems.
Co5: Understand the concepts of P-Delta analysis

Question paper pattern: The question paper will have ten questions; each question carries equal marks, there will betwo full questions or with a maximum of four sub questions from each module, students willhave to attend five full questions from each module.

Reference Books:

1. Taranath B.S, "Structural Analysis and Design of Tall Buildings"- McGraw Hill
2. Wilf gang Schuller, "High rise building structures"- John Wiley
3. Bryan Stafford Smith & Alexcoull, "Tall building structures Analysis and Design"- John Wiley
4. T.Y Lin & D.Stotes Burry, "Structural concepts and system for Architects and Engineers"-John Wiley
5. Lynn S.Beedle, "Advances in Tall Buildings"- CBS Publishers and Distributors.
6. Dr. Y.P. Gupta – Editor, "Proceedings National Seminar on High Rise Structures- Design andConstruction practices for middle level cities"- New Age International Limited

Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=-syqppgcoVE&t=15s
https://www.youtube.com/watch?v=PYZwAWubUeo

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

	PO										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**X**	**X**		**X**						**X**	
CO2	**X**	**X**		**X**						**X**	
CO3	**X**	**X**		**X**						**X**	
CO4	**X**	**X**		**X**						**X**	
CO5	**X**	**X**		**X**						**X**	

DESIGN OF MASONRY STRUCTURES

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject Code	**22CSE243**	CIE Marks	50
Number of Lecture Hours/Week	03	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites: Construction Technology and Strength of Materials

Course objectives:

The objective of this course is to make students

- To learn performance of masonry structures,
- To design the masonry structures for earthquake resistance.
- To evaluate the strength and stability of the masonry structures

Modules

Module-1

Introduction, Masonry units, materials and types:

History of masonry, Masonry units – Brick- Types of bricks, Tests conducted on bricks. Other masonry units - stone, clay block, concrete block, laterite block, stabilized mud block masonry units Masonry materials – Classification and properties of mortars, selection of mortars. Cracks - Cracks in masonry structures, Type of crack, causes and prevention of crack.

Teaching Learning Process	**L1,L2**

Module-2

Strength of Masonry in Compression:

Behaviour of Masonry under compression, strength and elastic properties, influence of masonry unit and mortar Characteristics, effect of masonry unit height on compressive strength, influence of masonry bonding patterns on strength, prediction of strength of masonry in Indian context, Failure theories of masonry under Compression. Effects of slenderness and eccentricity, effect of rate of absorption, effect of curing, effect of ageing, workmanship on compressive strength

Masonry Bond Strength and Masonry in Shear and Flexure

Bond between masonry unit and mortar, tests for determining flexural and shear bond strengths, factors affecting bond strength, effect of bond strength on compressive strength, orthotropic strength properties of masonry in flexure, shear strength of masonry, test proceduresfor evaluating flexural and shear strength.

Teaching Learning Process	**L2,L3**

Module-3

Design of load bearing masonry wall

Permissible stresses: Types of walls, permissible compressive stress, stress reduction and shape modification factors, increase in permissible stresses for eccentric vertical and lateral load, permissible tensile stress and shear stresses. Design Considerations: Effective height of walls and columns, openings in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action in lintels. Problems on design considerations for solid walls, cavity walls, wall with pillars.

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

Teaching Learning Process	**L2,L3,L4,L5**

Module-4

Design of walls subjected to concentrated axial loads: Solid walls, cavity walls, solid wall supported at the ends by crosswall, walls with piers, design of wall with openings. Design of walls subjected to eccentric loads: Design criteria – stress distribution under eccentric loads – problems on eccentrically loaded solid walls, cavity walls, walls with piers.

Design of Laterally and transversely loaded walls: Design criteria, design of solid wall under wind loading, design of shear wall – design of compound walls.

Teaching Learning Process	**L2,L3,L4,L5**

Module-5

Earthquake resistant masonry buildings:

Behaviour of masonry during earthquakes, concepts and design procedure for earthquake resistant masonry, BIS codal provisions. In- filled frames: Types – modes of failures

Reinforced brick masonry

Methods of reinforcing Masonry, Analysis of reinforcedMasonry under axial, flexural and shear loading.

Teaching Learning Process	**L2,L3,L4,L5**

On completion of this course, students are able to:

- Co1: Achieve Knowledge of design and development of problem solving skills.
- Co2: Understand the principles of design and construction of masonry structures
- Co3: Design and develop analytical skills.
- Co4: Summarize the masonry Characteristics.
- Co5: Evaluate the strength and stability of the masonry structures.

Reference book

- Henry, A.W., "Structural Masonry", Macmillan Education Ltd., 1990.
- K.S. Jagadish, "Structural masonry", I.K. International Publishing House Pvt. Ltd
- Dayaratnam P, "Brick and Reinforced Brick Structures", Oxford & IBH, 1987.
- M. L. Gambhir, "Building and Construction Materials", Mc Graw Hill education Pvt.Ltd.

Guidelines

- IS 1905–1987 "Code of practice for structural use of un-reinforced masonry-(3rd revision) BIS, New Delhi.
- SP 20 (S&T) – 1991, "Hand book on masonry design and construction (1st revision) BIS, New Delhi.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 full questions (with a maximum of four sub questions) from eachmodule.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question fromeach module.

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=RWck4EnfdSE&list=PLyqSpQzTE6M-81uKP3sjj0lZX_nnrOwpV
https://www.youtube.com/watch?v=dhyLWcMrdRs

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

	PO										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**X**	**X**		**X**						**X**	
CO2	**X**	**X**		**X**						**X**	
CO3	**X**	**X**		**X**						**X**	
CO4	**X**	**X**		**X**						**X**	
CO5	**X**	**X**		**X**						**X**	

RELIABILITY ANALYSIS OF STRUCTURES

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – II

Subject Code	**22CSE244**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites: Knowledge of Engineering Statistics and basics of structural analysis and RCC

Course objectives:

1. To impart the concept knowledge on data analysis and probability in the context ofstructural engineering.
2. To demonstrate uncertainty in structural engineering with respect to randomness of variables and knowledge of probability distributions.
3. To demonstrate principles of structural reliability in order to assess safety due to randomness of variables.
4. To perform computations of structural reliability using various methods at componentand system level.

Modules

Module-1

Preliminary Data Analysis:

Graphical representation- Histogram, frequency polygon, Measures of central tendency-grouped and ungrouped data, measures of dispersion, measures of asymmetry. Curve fitting and Correlation: Fitting a straight line, curve of the form $y = ab^x$, and parabola, Coefficient of correlation.

Teaching Learning Process	**L2, L3,L4**

Module-2

Probability Concepts: Random events-Sample space and events, Venn diagram and event space, Measures of probability interpretation, probability axioms, addition rule, multiplication rule, conditional probability, probability tree diagram, statistical independence, total probability theorem and Baye's theorem.

Teaching Learning Process	**L2, L4**

Module -3

Random variables: Probability mass function, probability density function, Mathematical expectation, Chebyshev's theorem. Probability distributions: Discrete distributions-Binomial and Poison distributions, Continuous distributions- Normal, Log normal distributions.

Teaching Learning Process	**L2, L4**

Module -4

Reliability Analysis: Measures of reliability-factor of safety, safety margin, reliability index, performance function and limiting state. Reliability Methods-First OrderSecond Moment Method (FOSM), Point Estimate Method (PEM), and Advanced First Order Second Moment Method (Hasofer-Lind's method).

Teaching Learning Process	L2,L3,L4,L5

Module -5

Simulation Techniques: Monte Carlo simulation- Statistical experiments, Confidence limits, sample size and accuracy, Generation of random numbers- random numbers with standard uniform distribution, continuous random variables (normal and lognormal), discrete random variables. System reliability: series, parallel and combined systems.

Teaching Learning Process	L2,L3,L4L5

Course Outcomes: Students will be able to

1. Understand the concepts of statistics for probabilistic analysis and importance ofuncertainty (randomness) in structural analysis and design.

2. Apply the theoretical principles of randomness of variables in structural engineeringthrough density functions.

3. Analyze components of structure to assess safety using concepts related tostructural reliability by various methods.

4. Evaluate the safety reliability index at system level.

Question paper pattern: The question paper will have ten questions; each question carries equal marks, there will be two full questions or with a maximum of four sub questions from each module, studentswill have to attend five full questions from each module.

Reference Books:

1. Ranganathan, R. (1999). "Structural Reliability Analysis and design"- Jaicopublishing house, Mumbai, India.
2. Devaraj.V & Ravindra.R,(2017),'Reliability based Analysis and Design for CivilEngineers', I.K. International Publishing House Pvt. Ltd, India
3. Ang, A. H. S., and Tang, W. H. (1984). "Probability concepts in engineering planningand design"- Volume –I, John Wiley and sons, Inc, New York.
4. Ang, A. H. S., and Tang, W. H. (1984). "Probability concepts in engineering planningand design"-Volume –II, John Wiley and sons, Inc, New York.
5. Milton, E. Harr (1987). "Reliability based design in civil engineering"- Mc Graw Hill bookCo.
6. Nathabandu, T., Kottegoda, and Renzo Rosso (1998). Statistics, "Probability and reliability for Civil and Environmental Engineers"- Mc Graw Hill international edition, Singapore.
7. Achintya Haldar and Sankaran Mahadevan (2000). "Probability, Reliability and Statistical methods in Engineering design"- John Wiley and Sons. Inc.

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=uutg8jKrL9w
https://www.youtube.com/watch?v=OwuT0B2Uywc&list=PLFEqFwyPC3WwjTp4KDuannMGGtAUVnfE4
https://www.youtube.com/watch?v=n-YMzb6xTsA&list=PLOnJQiDsowogZnvfY3HUR34pjrH7hZLpD

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

	PO										
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	X	X								X	
CO2	X	X								X	
CO3	X	X								X	
CO4	X	X								X	

Mini Project with Seminar			
Course Code	**22CSE25**	CIE Marks	100
Teaching Hours/Week (L:P:SDA)	0:4:2	SEE Marks	--
Credits	03	Exam Hours	--

Course objectives:

The objective of the seminar is to inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas.

Each student, under the guidance of a Faculty, is required to

- Choose, preferably through peer reviewed journals, a recent topic of his/her interest relevant to the Course of Specialization.
- Carryout literature survey, organize the Course topics in a systematic order.
- Prepare the report with own sentences.
- Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
- Present the seminar topic orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculties from the department with the senior most acting as the Chairperson.

Marks distribution

Seminar Report: 30 marks Presentation skill:50 marks Question and Answer:20 marks

STRUCTURAL ENGINEERING LAB-2 [As per Choice Based Credit System (CBCS) scheme] SEMESTER - II			
Subject Code	**22CSEL26**	CIE Marks	50
Teaching Hours/ Week (L:P:SDA)	1:2:0	SEE Marks	50
Total Number of Lecture Hours	42	Exam Hours	03
CREDITS - 02			

Prerequisites: Knowledge of Basic computer programming

Course objectives: The objective of this course is to make students

- To analyze the structure using FE based Software
- To learn principles of design
- To investigate the performance of structural elements.
- To design the structural components using excel sheets

Modules	Teaching Hours	RBT Level
1. Static and Dynamic analysis and design of Multistory Building structures using any FE based software	12 Hrs	L1, L2, L3, L4, L5, L6
2. Design of RCC and Steel Tall structures using any FE based software	12 Hrs	
3. Analysis of folded plates and shells using any FE software.	06 Hrs	
4. Preparation of EXCEL sheets for structural design	12 Hrs	

Course outcomes: On complete of this course the students will able to

- Co1: Achieve Knowledge of design and development of programming skills.
- Co2: Understand the principles of structural analysis and design
- Co3: Design and develop analytical skills.
- Co4: Summarize the performance of structures for static and dynamic forces.

Web links and Video Lectures (e-Resources):

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

	PO										
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	X	X	X	X	X			X	X	X	X
CO2	X	X	X	X	X			X	X	X	X
CO3	X	X	X	X	X			X	X	X	X
CO4	X	X	X	X	X			X	X	X	X

*** END OF II SEMESTER***

DESIGN OF BRIDGES

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	**22CSE31**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 04

Prerequisites:

- Structural Analysis
- Highway Engineering
- Design of RC Structures

Course objectives:

- The students will be exposed to the Engineering aspects of concrete bridges
- Various loads that act on the bridges as per IRC.
- Analysis for the maximum BM and SF at critical section using load distributing theories.
- Design of various components using limit state method with reinforcement details.

Modules

Module-1

Introduction & Design of Slab Culvert:
Bridge Engineering and its development in past, Ideal site selection for Bridges, Bridge classifications, Forces acting onBridge. Analysis for maximum BM and SF at critical sections for Dead and Live load as per IRC class A, B, AA tracked and wheeled vehicles. Structural design of slab culvert using limit state method with reinforcement details.

Teaching Learning Process	**L2, L3**

Module-2

Box Culvert: Introduction to box culvert, advantage of structural continuity, Analysis for maximum BM and SF at critical sections using moment distribution method for various load combinations such as Dead, Surcharge, Soil, Water and Live load as per IRC class A, B, AA tracked and wheeled vehicles. Structural design of box culvert using limit state method with reinforcement details.

Teaching Learning Process	**L2, L3**

Module -3

T Beam Bridge:
Components of T Beam Bridge, Load transfer mechanism, Proportioning the of Components, Analysis of **Slab** using **PigeaudsMethod** for maximum BM and SF at critical sections for Dead and Live load as per IRC class A, B, AA tracked and wheeled vehicles and design of **Slab** using limit state method with reinforcement details. Analysis of **Cross Girder** for maximum BM and SF at critical sections for Dead and Live load as per IRC class A, B, AA tracked and wheeled vehicles and design of slab using limit state method with reinforcement details. Analysis of **Main Girder** using **Courbon's Method** for maximum BM and SF at critical sections for Dead and Live load as per IRC class A, B, AA tracked and wheeled vehicles anddesign of **Main Girder** using limit state method with reinforcement details.

Teaching Learning Process	**L3, l4**

Module -4

PSC Bridge:
Introduction to Pre & Post Tensioning, Proportioning of Components, Analysis & Structural Design of Slab, Analysis of Main Girder Using **Courbon's Method** for IRC Class AA, Tracked vehicle, Calculations of Prestressing Force, Calculations of Stresses, Cable profile, Design of End Block, Detailing of Main Girder.

Teaching Learning Process	**L3, L4**

Module -5

Balanced Cantilever Bridge:
Introduction & Proportioning of Components, Analysis of Main Girder Using **Courbon's Method** for IRC Class AA, Tracked vehicle Design of Simply Supported Portion, Cantilever Portion, Articulation, using limit state method with reinforcement details.

Teaching Learning Process	**L3, L4**

Course outcomes:

After studying this course, students will be able to:

- Co1:Describe historical growth, select ideal site and bridge, calculate values of design parameters of slab culvert at critical section as per IRC, design and detailing required for the execution of the project.
- Co2:Carry out analysis of box culvert as per IRC to obtain the values of design parameters and to design and detail the components following IS code procedure.
- Co3:Demonstrate the use of **Pigeauds Method** and **Courbon's Method** in the analysis of T beam bridge as per IRC, design to obtain the safe dimensions various components, optimum reinforcement required following IS code procedure.
- Co4:Display the use of **Courbon's Method** in the analysis of PSC bridge as per IRC, design to obtain the safe value of prestressing force, obtain the dimensions of various components to keep the stresses within codal provisions following IS code procedure.
- Co5:Analysis a balanced cantilever bridge as per IRC and to obtain the safe values of design parameters and to design and detail the components as per IS code procedure

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from eachmodule.

Text Books:

1. Essentials of Bridge Engineering by Dr D Johnson Victor, Oxford & IBH Publishing CoNew Delhi

2. Design of Bridges by Dr N Krishna Raju, Oxford & IBH Publishing Co New Delhi

References:

1. Principles and Practice of Bridge Engineering by S P Bindra, Dhanpat Rai & Sons New Delhi
2. IRC 6 -1966 Standard Specifications And Course Code Of Practice For Road BridgesSection II Loads and Stresses, The Indian Road Congress New Delhi
3. IRC 21 - 1966 Standard Specifications And Course Code Of Practice For Road Bridges Section III Cement Concrete (Plain and reinforced) The Indian Road Congress New Delhi
4. IS 456 - 2000 Indian Standard Plain and Reinforced Concrete Course Code of Practice (Fourth Revision) BIS New Delhi
5. IS 1343 - Indian Standard Prestressed Concrete Course Code of Practice BIS New Delhi

Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=RB2k5hSYO3U&list=PLXKZsEFKU_HHtsCMaAIPB3tr5Ht2Bdge
https://www.youtube.com/watch?v=RB2k5hSYO3U&list=PL3MO67NH2XxJxMvfgAgdohx5-ksPZruA8

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**
- **Site visit**

CO	PO										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	X	X								X	
CO2	X	X								X	
CO3	X	X								X	
CO4	X	X								X	
CO5	X	X								X	

DESIGN CONCEPTS OF SUBSTRUCTURES

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	**22CSE321**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites: Basic Knowledge of geotechnical Engineering and Structural Analysis

Course objectives: The objective of this course is to make students to learn principles of subsoil exploration, To design the sub structures. To evaluate the soil shear strength parameters.

Modules

Module-1

Introduction, Site investigation, In-situ testing of soils, Subsoil exploration, Classification of foundations systems. General requirement of foundations, Selection of foundations, Computations of Loads, Design concepts.

Teaching Learning Process	**L2, L4,L5**

Module-2

Concept of soil shear strength parameters, Settlement analysis of footings, Shallow foundations in clay, Shallow foundation in sand & C-Φ soils, Footings on layered soils and sloping ground, Design for Eccentric or Moment Loads

Teaching Learning Process	**L2, L4,L5**

Module -3

Types of rafts, bearing capacity & settlements of raft foundation, Rigid methods, Flexible methods, soil structure interaction, different methods of modeling the soil. Combined footings (rectangular & trapezoidal), strap footings & wall footings, Raft – super structure interaction effects & general concepts of structural design, Basement slabs

Teaching Learning Process	**L2, L4,L5**

Module -4

Deep Foundations: Load Transfer in Deep Foundations, Types of Deep Foundations, Ultimate bearing capacity of different types of piles in different soil conditions, Laterally loaded piles, tension piles & batter piles, Pile groups: Bearing capacity, settlement, uplift capacity, load distribution between piles, Proportioning and design concepts of piles.

Teaching Learning Process	**L2, L3, L4, L5**

Module -5

Types of caissons, Analysis of well foundations, Design principles, Well construction and sinking. Foundations for tower structures: Introduction, Forces on tower foundations, Selection of foundation type, Stability and design considerations, Ring foundations – general concepts.

Teaching Learning Process	**L2, L3,L4, L5**

Course outcomes: On completion of this course, students are able to:

- Co1: Achieve Knowledge of design and development of problem solving skills.
- Co2: Understand the principles of subsoil exploration
- Co3: Design and develop analytical skills.
- Co4: Identify and evaluate the soil shear strength parameters.
- Co5: Understand the concepts of Settlement analysis.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Reference Books:

1. Swami Saran – "Analysis & Design of Substructures"- Oxford & IBH Pub. Co. Pvt. Ltd., 1998.
2. Nainan P Kurian – "Design of Foundation Systems"- Narosa Publishing House, 1992.
3. R.B. Peck, W.E. Hanson & T.H. Thornburn – "Foundation Engineering"- Wiley Eastern Ltd.,Second Edition, 1984.
4. J.E. Bowles – "Foundation Analysis and Design"- McGraw-Hill Int. Editions, Fifth Ed., 1996.
5. W.C. Teng – "Foundation Design"- Prentice Hall of India Pvt. Ltd., 1983.
6. Bureau of Indian Standards:IS-1498, IS-1892, IS-1904, IS-6403, IS-8009, IS-2950, IS-11089, IS-11233, IS-2911 and all other relevant codes

Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=lsYFtwwlHIw&list=PLbRMhDVUMngeiZjKPTPEFl1CByXmYX3Kv

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**
- **Site visit**

	PO										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**X**	**X**		**X**						**X**	
CO2	**X**	**X**		**X**						**X**	
CO3	**X**	**X**		**X**						**X**	
CO4	**X**	**X**		**X**						**X**	
CO5	**X**	**X**		**X**						**X**	

COMPOSITE MATERIALS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	**22CSE322**	CIE Marks	50
Number of Lecture Hours/Week	03	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites: Basic knowledge on material properties, Matrix Method of Structural Analysis and Mechanics of Deformable Bodies

Course objectives: Students will be

To impart knowledge of composite materials in the context of structural engineering application. To impart a skill of analyzing macro and micro mechanical behaviour of composites. To develop introductory knowledge about manufacturing of composites and its failure theories.

Modules

Module-1

Introduction: Introduction to Composite materials, classifications (thermoset and thermoplastic) andcivil/structural engineering applications. Constituent materials of composites – Reinforcements and matrix. Rule ofmixture. Selection of materials. Manufacturing techniques – Hand layup method and compression moulding method. Basics of fiber reinforced composite (Synthetic and natural FR Polymer composites).Advantages and Limitations of composites.

Teaching Learning Process **L1, L2,L4**

Module-2

Macro-mechanical Behaviour of a Lamina: Introduction, Stress-Strain Relations For Anisotropic Materials. Stiffness's, compliances, and engineering constants for orthotropic materials. Restrictions on engineering constants. Numerical problems.

Teaching Learning Process **L3, L4,L5**

Module -3

Macro-mechanical Behaviour of a Lamina contd…

Stress-strain relations for plane stress in an orthotropic material. Stress-strain relations for a lamina of arbitrary orientation. Invariant properties of an orthotropic lamina. Strengths of an orthotropic lamina, thermal andmechanical stress analysis. Numerical problems.

Teaching Learning Process **L3, L4,L5**

Module -4

Micro-mechanical behaviour of a lamina: introduction, mechanics of materials approach to stiffness.Determination of E_1. Determination of E_2. Determination of v_{12}. Determination of G_{12}. Numerical problems.

Teaching Learning Process **L3, L4,L5**

Module -5

Classical composite lamination theory, cross and angle – play laminates, symmetric, anti-symmetric and general symmetric laminates. Mechanical coupling. Analysis of simple laminated structural elements ply-stress and strain, lamina failure theories concepts-Maximum Stress Failure Criterion, Maximum Strain Failure Criterion and Tsai-Hill Failure Criterion. Numerical Problems.

Teaching Learning Process **L3, L4, L5**

Course outcomes:

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

1. Define and classify the composite materials.
2. Analyze the macro-mechanical behaviour of composites.
3. Derive the engineering constants of composites.
4. Select the appropriate constituent materials for composite manufacture.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 full questions (with a maximum of four sub questions) from eachmodule.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from eachmodule.

REFERENCE BOOKS:

1. Mechanics of Composite Materials and Structures by M. Mukhopadhya-Universities Press 2009
2. Robart M.Jones, " **Mechanical of Composite Materials**"- McGraw Hill Publishing Co.
3. Bhagwan D Agarvalm, and Lawrence J Brutman, " **Analysis and Performance of Fiber Composites**"- John Willy and Sons.
4. Autar K. Kaw, Mechanics of Composite Materias, Second edition., CRC Press,2006.

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=0kB0G6WKhKE&list=PLSGws_74K01-bdEEUElQ9-obrujIKGEhg

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

	PO										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**X**	**X**		**X**						**X**	
CO2	**X**	**X**		**X**						**X**	
CO3	**X**	**X**		**X**						**X**	
CO4	**X**	**X**		**X**						**X**	

DESIGN OF INDUSTRIAL STRUCTURES

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	**22CSE323**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites: Basic knowledge of steel structures and structural analysis of RCC structures

Course objectives: The objective of this course is to make students to learn principles of Design of industrial building, To design different components of industrial structures and to detail the structures. To evaluate the performance of the Pre-engineered buildings

Modules

Module-1

Analysis of industrial building for Gravity and Wind load. Analysis anddesign of framing components namely, girders, trusses, gable frames

Teaching Learning Process	**L2, L3,L4**

Module-2

Analysis and design of gantry column (stepped column / column with bracket), purlins, girts, bracings including all connections.

Teaching Learning Process	**L2, L3,L4**

Module -3

Analysis of transmission line towers for wind load and design oftowers including all connections.

Teaching Learning Process	**L2, L3,L4**

Module -4

Forms of light gauge sections, Effective width computation of unstiffened, stiffened, multiple stiffened compression elements of cold formed light gauge sections. Concept of local buckling of thin elements. Limiting width to thickness ratio. Post buckling strength.

Teaching Learning Process	**L1, L2,L4**

Module -5

Concept of Pre- engineered buildings, Design of compression and tension members of cold formed light gauge sections, Design of flexural members (Laterally restrained / laterally unrestrained).

Teaching Learning Process	**L2, L3,L4**

Course outcomes: On completion of this course, students are able to

- Co1: Achieve Knowledge of design and development of problem solving skills.
- Co2: Understand the industrial building and the components.
- Co3: Design and develop analytical skills.
- Co4: Summarize the principles of Structural Design and detailing
- Co5: Understands the concept of Pre- engineered buildings.

Question paper pattern:

The question paper will have ten questions; each question carries equal marks, there will betwo full questions or with a maximum of four sub questions from each module, students willhave to attend five full questions from each module.

Reference Books:

1. Bureau of Indian Standards, IS800-2007, IS875-1987, IS-801-1975. Steel Tables, SP 6(1) – 1984
2. N Subramanian- "Design of Steel Structure" oxford University Press
3. B.C. Punmia, A.K. Jain "Design of Steel Structures", Laxmi Publications, New Delhi.
4. Ramchandra and Virendra Gehlot " Design of Steel Structures " Vol 1 and Vol.2, Scientific Publishers, Jodhpur
5. Duggal "Limit State Design of Steel Structures" TMH

Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=qJV5zdx7NJs
https://www.youtube.com/watch?v=5nLJHnCUMRI

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

	PO										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**X**	**X**		**X**						**X**	
CO2	**X**	**X**		**X**						**X**	
CO3	**X**	**X**		**X**						**X**	
CO4	**X**	**X**		**X**						**X**	
CO5	**X**	**X**		**X**						**X**	

STRUCTURAL HEALTH MONITORING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	**22CSE324**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites: Knowledge of Concrete Technology and steel structures (Construction Materials) and Basic knowledge about structural dynamics.

Course objectives:

1. Learn the fundamentals of structural health monitoring.
2. Study the various vibration-based techniques for structural health monitoring.
3. Learn the structural health monitoring using fiber-optic and Piezoelectric sensors.
4. Study the structural health monitoring using electrical resistance and electromagnetictechniques.

Modules

Module-1

Introduction to Structural Health Monitoring Definition of structural health monitoring (SHM), Motivation for SHM, SHM as a way of making materials and structures smart, SHM and biomimetics, Process and pre-usage monitoring as a part of SHM, SHM as a part of system management, Passive and active SHM,NDE, SHM and NDECS, Variety and multidisciplinarity: the most remarkable characters of SHM, Birth of the SHM Community.

Teaching Learning Process	**L2, L3**

Module-2

Vibration-Based Techniques for SHM Basic vibration concepts for SHM, Local and global methods, Damage diagnosis as an inverse problem, Model-based damage assessment, Mathematical description of structural systems with damage, General dynamic behavior, Statespace description of mechanical systems, Modeling of damaged structural elements, Linking experimental and analytical data, Modal Assurance Criterion (MAC) for modepairing, Modal Scaling Factor (MSF), Co-ordinate Modal Assurance Criterion (COMAC), Damping, Expansion and reduction, Updating of the initial model, Damage localization and quantification, Change of the flexibility matrix, Change of the stiffness matrix, Strain-energy-based indicator methods and curvature modes, MECE error localization technique, Static displacement method, Inverse eigen sensitivity method, Modal force residual method, Kinetic and strain energy- based sensitivity methods, Forced vibrations and frequency response functions, Solution of the equation system, Regularization, Parameter subset selection, Other solution methods, Variances of the parameters, Neural network approach to SHM, The basic idea of neural networks, Neural networks in damage detection, localization and quantification, Multi-layer Perceptron (MLP), A simulation example, Description of the structure, Application of damage indicator methods, Application of the modal force residual method and inverse eigen sensitivity method, Application of the kinetic and modal strain energy methods, Application of the Multi- Layer Perceptron neural network, Time-domain damage

detection methods for linear systems, Parity equation method, Kalman filters, AR and ARX models, Damage identification in non-linear systems, Extended Kalman filter, Localization of damage using filter banks, A simulation study on a beam with opening and closing crack, Applications, I-40 bridge, Steel quake structure, Application of the Z24 bridge, Detection of delamination in a CFRP plate with stiffeners.	
Teaching Learning Process	L2, L3
Module -3	
Fiber-Optic Sensors Classification of fiber-optic sensors, Intensity-based sensors, Phase modulated optical fiber sensors, or interferometers, Wavelength based sensors, or Fiber Bragg Gratings (FBG), The fiber Bragg grating as a strain and temperature sensor, Response of the FBG to uniaxial uniform strain fields, Sensitivity of the FBG to temperature, Response of the FBG to a non-uniformuniaxial strain field, Response of the FBG to transversestresses, Photoelasticity in a plane stress state, Structures with embedded fiber Bragg gratings, Orientation of the optical fiber optic with respect to the reinforcement fibers, Ingress/egress from the laminate, Fiber Bragg gratings as damage sensors for composites, Measurement of strain andstress variations, Measurement of spectral perturbations associated with internal stress release resulting from damage spread, Examples of applications in aeronautics and civil engineering, Stiffened panels with embedded fiber Bragg gratings, Concrete beam repair.	
Teaching Learning Process	**L2, L3**
Module -4	
SHM with Piezoelectric Sensors The use of embedded sensors asacoustic emission (AE) detectors, Experimental results and conventional analysis of acoustic emission signals, Algorithms for damage localization, Algorithms fordamage characterization, Available industrial AE systems, New concepts in acoustic emission, State-the-art and main trends in piezoelectric transducer-based acousto-ultrasonicSHM research, Lamb wave structure interrogation, Sensor technology, Tested structures (mainly metallic or composite parts), Acousto-ultrasonic signal and data reduction methods, The full implementation of SHM of localized damage with guided waves in composite materials, Available industrial acoustoultrasonic systems with piezoelectric sensors, Electromechanical impedance, E/M impedance for defect detection in metallic and composite parts, The piezoelectric implant method applied to the evaluation and monitoring of viscoelastic properties.	
Teaching Learning Process	**L2, L3**
Module -5	
SHM Using Electrical Resistance Composite damage, Electrical resistance of unloaded composite, Percolation concept, Anisotropic conduction properties in continuous fiber reinforced polymer, Influence of temperature, Composite strain and damage monitoring by electrical resistance, 0° unidirectional laminates, Multidirectional laminates, Randomly distributed fiber reinforced polymers, Damage localization. Low Frequency Electromagnetic Techniques Theoretical considerations on electromagnetic theory, Maxwell‘s equations, Dipole radiation, Surfaceimpedance, Diffraction by a circular aperture, Eddy currents, Polarization of dielectrics, Applications to the NDE/NDT domain, Dielectric materials, Conductive materials, Hybrid method, Signal	

processing, Time-frequency transforms, The continuous wavelet transform, The discrete wavelet transform, Multiresolution, Denoising, Application to the SHM domain, General principles, Magnetic method, Electric method, Hybrid method.
Teaching Learning Process **L3, L4**
Course outcomes: On completion of this course, students are able to • Co1: Achieve Knowledge of design and development of problem solving skills. • Co2: Understand the Structural components. • Co3: Design and development analytical skills. • Co4: Summarize the principles of Structural health monitoring
Question paper pattern: The question paper will have ten questions; each question carries equal marks, therewill be two full questions or with a maximum of four sub questions from each module, students will have to attend five full questions from each module.
Reference Books: 1. Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, Structural Health Monitoring, WileyISTE, 2006. 2. Douglas E Adams, Health Monitoring of Structural Materials and Components-Methodswith Applications, John Wiley and Sons, 2007. 3. J.P. Ou, H.Li and Z.D. Duan, Structural Health Monitoring and IntelligentInfrastructure, Vol-1, Taylor and Francis Group, London, U.K, 2006. 4. Victor Giurglutiu, Structural Health Monitoring with Wafer Active Sensors, Academic Press Inc, 2007. 5. Smart Materials and Structures, Gandhi and Thompson 6. Structural Health Monitoring: Current Status and Perspectives, Fu Ko Chang

Web links and Video Lectures (e-Resources): https://www.youtube.com/watch?v=Y_-OrF8lmio&list=PLyqSpQzTE6M8DM5yAH4VgLMkAXiQV7oDw https://www.youtube.com/watch?v=It4aogUfQis https://www.youtube.com/watch?v=IHKoohRHRlI
Skill Development Activities Suggested • **Conduction of technical seminars on recent research activities** • **Group Discussion**

	PO										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**X**	**X**		**X**	**X**			**X**	**X**	**X**	**X**
CO2	**X**	**X**		**X**	**X**			**X**	**X**	**X**	**X**
CO3	**X**	**X**		**X**	**X**			**X**	**X**	**X**	**X**
CO4	**X**	**X**		**X**	**X**			**X**	**X**	**X**	**X**

ADVANCED CONCRETE TECHNOLOGY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	**22CSE331**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites: Knowledge of Material Science and Concrete Technology

Course objectives: The objective of the course is to provide students to obtain an in-depth knowledge of a wide variety of advanced topics in concrete technology and practice. Concrete, being the popular materials for the construction material for civil infrastructure building, is undergoing significant changes in the recent times, in relation to the constituent materials used, production technology, testing methods and performance requirements.

Modules

Module-1

Fibre reinforced concrete:

History, mechanism, different types of fibres, Aspect ratio, Volume of fibres, orientation of fibres, balling effect, properties of fibre reinforced concrete, applications of fibre reinforced concrete. Types of Fibre reinforced concrete.

Ferro cement:

Definition, different materials used, casting techniques, properties of Ferro cement, applications.

Teaching Learning Process	L1,L2 and L3

Module-2

Light Weight Concrete:

Introduction, classification, properties, strength and durability, mix proportioning and problems.

High Density Concrete:

Radiation shielding ability of concrete, materials for high density concrete, mix proportioning, properties in fresh and hardened state, placement methods.

Teaching Learning Process	L1,L2 and L3

Module -3

Ready mix concrete:

Concept, ready mix concrete plants, difficulties faced and their solution , use of admixtures in ready mix concrete, economics and quality control aspects of ready mix concrete.

High Performance Concrete:

Constituents, mix proportioning, properties in fresh and hardened states, applications & limitations.

Teaching Learning Process	L1,L2 and L3

Module -4

Polymer concrete:

Polymers, resins, polymerization, different types of polymer concrete like polymer impregnated concrete, polymer concrete (Resin concrete) and polymer modified concrete, their properties and applications.

Self-compacting concrete: Development of SCC, basic principles and requirements, workability tests for SCC, mix design of SCC, acceptance criteria for SCC, adoption of SCC in the precast industry, present status of SCC	
Teaching Learning Process	L1,L2 and L3
Module -5	
Concrete from Industrial wastes: a. Blast furnace slag cement concrete b. Fly-ash concrete c. Silica fume concrete d. Recycled aggregate Concrete	
Teaching Learning Process	L1,L2 and L3

Course outcomes:

a. Co1: On complete of this course the students will able to understand the construction material, meeting the demanding performance requirements based on men, machines and materials.
b. Co2: Innovative special concrete with mixes, applications and limitations
c. Co3: Testing methods developed to increase the scope of concrete usage as an advanced material

Question paper pattern:
The question paper will have ten questions; each question carries equal marks, therewill be two full questions or with a maximum of four sub questions from each module,
students will have to attend five full questions from each module.

Reference Books:

1. "Concrete Technology" - Theory and Practice, M.S.Shetty, S.Chand and Company, New Delhi, 2002.
2. "Concrete Technology" – M.L.Gambhir, TATA McGRAW HILL, New Delhi.

Recommended Reading:

1. "Properties of Concrete"Neville, A.M. : , ELBS, London
2. "Concrete Technology" – A.R.Santakumar. Oxford University Press (2007)"
3. "Concrete Mix Design" - N.Krishna Raju, Sehgal - publishers.
4. "Recommended guidelines for concrete mix design" - IS:10262,BIS Publication

Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=cx5gPKp9QEc&list=PLbMVogVj5nJQU7M0LdA77p_XaaWBJniNc
https://www.youtube.com/watch?v=cx5gPKp9QEc&list=PLbMVogVj5nJQU7M0LdA77p_XaaWBJniNc
https://www.youtube.com/watch?v=RSnNrQUTEnY&list=PLJAQaaJgEtI11reTaRrGWTDzezOAtGY4q

Skill Development Activities Suggested

- Conduction of technical seminars on recent research activities
- Group Discussion

CO	PO										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	X	X		X						X	
CO2	X	X		X						X	
CO3	X	X		X						X	

Fracture Mechanics in Structural Engineering
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – III

Subject Code	**22CSE332**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites: Concrete Technology and Mechanics of Deformable Bodies

Course objectives: 1. To compute the stress intensity factor, strain energy release rate and the stress and strain fields around a crack tip for linear and nonlinear materials.
2. Know experimental methods to determine the fracture toughness.
3. Use the design principles of materials and structures using fracture mechanics approach.

Modules

Module-1

Stress concentration in elastic materials
Theory of stress concentration in elastic materials, stress concentration factors around circular and elliptic holes. Influence of ratio of radii on stress concentration factor in elliptic hole.

Teaching Learning Process	**L1, L2**

Module-2

Linear Elastic Fracture mechanics
Modelling a crack as a flat elliptic hole by Inglis and the limitations of the model, Griffith theory of brittle fracture Theories of linear elastic fracture mechanics, stress intensity factors, Irwin's definition. Fracture toughness KIc, KIIc, KIIIc & corresponding values of GC.

Teaching Learning Process	**L2,L3**

Module-3

Elasto-plastic fracture mechanics
Crack-tip plasticity in metals. Irwin's modification for elasto-plastic material. J integral, CMOD, CTOD. Mixed mode problems and evaluation of critical fracture parameters.

Teaching Learning Process	**L2,L3,L4**

Module-4

Fracture of Concrete
Limitations of theories of linear elastic fracture mechanics in concrete, Review of concrete behaviour in tension and compression. Kaplan's experiments, concept of fracture energy, definition of a quasi-brittle material, concept of softening.

Teaching Learning Process	**L2,L3,L4**

Module-5

Advanced concepts in fracture behavior of concrete
Definition of fracture energy by RILEM, Influence of size on fracture behavior, Bazant's size effect law. Size dependent & independent fracture energies. Application of fracture mechanics in design of concrete structures.

Teaching Learning Process	**L2,L3,L4**

Course Outcomes: After studying this course, students will be able to:

- Apply principles of fracture mechanics.
- Design concrete structures using fracture mechanics approach.
- Explain the importance of fracture mechanics.
- Take special care of very large sized structures.

Question paper pattern: The question paper will have ten questions; each question carries equal marks, therewill be two full questions or with a maximum of four sub questions from each module, students will have to attend five full questions from each module.

Reference Books:

1. Timoshenko & Goodier, “Theory of Elasticity”, McGrawHill
2. Valliappan S. "Continuum Mechanics Fundamentals" (1982), Oxford IBH, ND. New Delhi.
3. Broek, D., "Elementary Engineering Fracture Mechanics", 4th edition, Martinus Nijhoff (1987).
4. T. L. Anderson, “Fracture Mechanics- Fundamentals and Applications”, CRC press
5. Srinath L.S., Advanced Mechanics of Solids, 10th print, Tata McGraw Hill Publishing company, New Delhi,1994
6. Bhushan L Karihaloo “Fracture mechanics and structural concrete “,John Wiley&Sons Inc,
7. Zdenek P. Bazant, Jaime Planas, “Fracture and Size Effect in Concrete and Other Quasibrittle Materials” CRC press

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=PTSFXu19OMg
https://www.youtube.com/watch?v=G5mcTw-PLEI

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

CO	PO										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	X	X		X						X	
CO2	X	X		X						X	
CO3	X	X		X						X	
CO4	X	X		X						X	

Retrofitting and Rehabilitation of Structures

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	**22CSE333**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Prerequisites: basic knowledge of Concrete technology and construction Technology

Course objectives:

1. Learn the fundamentals of maintenance and repair strategies.
2. Study the quality assurance, serviceability and durability of concrete.
3. Know the various materials and techniques used for repair of structures.
4. Educate the different repair, strengthening, rehabilitation and retrofitting techniques.
5. Instruct the various health monitoring and demolition techniques.

Modules

Module-1

Maintenance: Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance various aspects of Inspection, Assessment procedure for evaluating damaged structure, causes of deterioration.

Repair Strategies: Causes of distress in concrete structures, Construction and design failures, Condition assessment and distress-diagnostic techniques, Assessment procedure for Inspection and evaluating a damaged structure,

Teaching Learning Process	**L2,L3**

Module-2

Serviceability and Durability of Concrete: Quality assurance for concrete construction, concrete properties – strength, permeability, thermal properties and cracking. – Effects due to climate, temperature, chemicals, corrosion – design and construction errors – Effects of cover thickness and cracking.

Teaching Learning Process	**L2,L3**

Module -3

Materials and Techniques for Repair: Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, Sulphur infiltrated concrete, ferro cement, Fibre reinforced concrete. Bacterial concrete, Rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coating and cathodic protection

Teaching Learning Process	**L2,L3**

Module -4

Repair, Rehabilitation and Retrofitting Techniques: Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure, Repair of Structure – Common Types of Repairs – Repair in Concrete Structures – Repairs in Under Water Structures – Guniting – Shot Create – Underpinning. Strengthening of Structures – Strengthening Methods – Retrofitting – Jacketing.

Teaching Learning Process	**L2,L3**

Module -5	
Health Monitoring and Demolition Techniques: Long term health monitoring techniques, Engineered demolition techniques for dilapidated structures, Use of Sensors – Building Instrumentation.	
Teaching Learning Process	**L3,L4**

Course outcomes: On completion of this course, students are able to:

- Co1: Achieve Knowledge of design and development of problem solving skills.
- Co2: Understand the cause of deterioration of concrete structures.
- Co3: Design and develop analytical skills.
- Co4: Summarize the principles of repair and rehabilitation of structures
- Co5: Understands the concept of Serviceability and Durability.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 full questions (with a maximum of four sub questions) fromeach module.
- Each full question will have sub questions covering all the topics under amodule.
- The students will have to answer 5 full questions, selecting one full questionfrom each module.

Reference Books:

(1) Sidney, M. Johnson "Deterioration, Maintenance and Repair of Structures".

(2) Denison Campbell, Allen & Harold Roper, "Concrete Structures – Materials, Maintenance and Repair"- Longman Scientific and Technical

(3) R.T.Allen and S.C. Edwards, "Repair of Concrete Structures"-Blakie and Sons

(4) Raiker R.N., "Learning for failure from Deficiencies in Design, Construction and Service"- R&D Center (SDCPL

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=taa4Fq-fERQ&list=PLq46p_ppqQemCi6i4SvZ1kCpFREHQkF_

https://www.youtube.com/watch?v=x9noZ4xEXyg&list=PLNRGMg8U7bLdPXyqgUHSzjL58kH3urQN1

https://www.youtube.com/watch?v=G7S_XocB9G8

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities**
- **Group Discussion**

	PO										
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	X	X		X						X	
CO2	X	X		X						X	
CO3	X	X		X						X	
CO4	X	X		X						X	
CO5	X	X		X						X	

GREEN BUILDING TECHONOLOGY [As per Choice Based Credit System (CBCS) scheme] SEMESTER – III			
Subject Code	22CSE334	CIE Marks	50
Number of Lecture Hours/Week	03	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03
CREDITS – 03			

Prerequisites: Concrete Technology and Basics of Ecology and Environment

Course objectives:

1. Exposure to the green building technologies and their significance.
2. Understand the judicial use of energy and its management.
3. Educate about the Sun-earth relationship and its effect on climate.
4. Enhance awareness of end-use energy requirements in the society.
5. Develop suitable technologies for energy management.

Modules

Module-1

Overview of the significance of energy use and energy processes in building - Indoor activities and environmental control - Internal and external factors on energy use and the attributes of the factors - Characteristics of energy use and its management - Macro aspect of energy use in dwellings and its implications.

Teaching Learning Process	L2,L3

Module-2

Indoor environmental requirement and management - Thermal comfort - Ventilation and air quality – Air-conditioning requirement - Visual perception – Illumination requirement - Auditory requirement.

Teaching Learning Process	L2,L3

Module -3

Climate, solar radiation and their influences - Sun-earth relationship and the energy balance on the earth's surface - Climate, wind, solar radiation, and temperature – Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings.

Teaching Learning Process	L3,L4

Module -4

End-use, energy utilization and requirements - Lighting and day lighting - End-use energy requirements - Status of energy use in buildings Estimation of energy use in a building. Heat gain and thermal performance of building envelope - Steady and non steady heat transfer through the glazed window and the wall - Standards for thermal performance of building envelope - Evaluation of the overall thermal transfer.

Teaching Learning Process	L3,L4

Module -5

Energy management options - Energy audit and energy targeting - Technological options for energy management.

Teaching Learning Process	L3,L4

Course outcomes: On completion of this course, students are able to:

- **CO1:** Select appropriate green building material and technique.
- CO2: Design sustainable and energy efficient civil engineering project.

Question paper pattern:

- The question paper will have ten questions.
- There will be 2 full questions (with a maximum of four sub questions) fromeach module.
- Each full question will have sub questions covering all the topics under amodule.
- The students will have to answer 5 full questions, selecting one full questionfrom each module.

Reference Books:

1. Bryant Edwards (2005): Natural Hazards, Cambridge University Press, U.K.
2. Carter, W. Nick, 1991: Disaster Management, Asian Development Bank, Manila.
3. Sahni, Pardeep et.al. (eds.) 2002, Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi.
4. Bryant Edwards (2005): Natural Hazards, Cambridge University Press, U.K.

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=nFBvLIfFFqI
https://www.youtube.com/watch?v=VE2tpwGCN0U
https://www.youtube.com/watch?v=VE2tpwGCN0U&list=RDCMUCY-ANi3wxkUSGhAel7T0TGw&start_radio=1&t=16s

Skill Development Activities Suggested

- **Conduction of technical seminars on recent research activities in Green Building Technology**
- **Group Discussion**

	PO										
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	X	X		X						X	
CO2	X	X		X						X	

PROJECT WORK PHASE – 1			
Course Code	**22CSE34**	CIE Marks	100
Teaching Hours/Week (L:P:SDA)	0:6:0	SEE Marks	--
Credits	03	Exam Hours	--

Course objectives:

- Support independent learning.
- Guide to select and utilize adequate information from varied resources maintaining ethics.
- Guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- Develop interactive, communication, organisation, time management, and presentation skills.
- Impart flexibility and adaptability.
- Inspire independent and team working.
- Expand intellectual capacity, credibility, judgement, intuition.
- Adhere to punctuality, setting and meeting deadlines.
- Instil responsibilities to oneself and others.
- Train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Phase-1 Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work.
Seminar: Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected project orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.
- The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

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

- Demonstrate a sound technical knowledge of their selected project topic.
- Undertake problem identification, formulation, and solution.
- Design engineering solutions to complex problems utilising a systems approach.
- Communicate with engineers and the community at large in written an oral forms.
- Demonstrate the knowledge, skills and attitudes of a professional engineer

Continuous Internal Evaluation

CIE marks for the project report (50 marks), seminar (30 marks) and question and answer (20 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

INTERNSHIP			
Course Code	**22CSEI36**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	0:6:0	SEE Marks	50
Credits	06	Exam Hours	03

Course objectives:

Internship/Professional practice provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,

To put theory into practice.
To expand thinking and broaden the knowledge and skills acquired through course work in the field.
To relate to, interact with, and learn from current professionals in the field.
To gain a greater understanding of the duties and responsibilities of a professional.
To understand and adhere to professional standards in the field.
To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.
To identify personal strengths and weaknesses.
To develop the initiative and motivation to be a self-starter and work independently

Internship/Professional practice: Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

Seminar: Each student, is required to

- Present the seminar on the internship orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit the report duly certified by the external guide.
- The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

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

- Gain practical experience within industry in which the internship is done.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learned to classroom work.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Identify areas for future knowledge and skill development.
- Expand intellectual capacity, credibility, judgment, intuition.

Acquire the knowledge of administration, marketing, finance and economics.

Continuous Internal Evaluation

CIE marks for the Internship/Professional practice report (20 marks), seminar (10 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Semester End Examination

SEE marks for the internship report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

*** END OF IIi SEMESTER***

PROJECT WORK PHASE – 2			
Course Code	**22CSE41**	CIE Marks	100
Teaching Hours/Week (L:P:SDA)	0:8:0	SEE Marks	100
Credits	18	Exam Hours	03

Course objectives:

- To support independent learning.
- To guide to select and utilize adequate information from varied resources maintaining ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism

Course outcomes:

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

- Present the project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it

Continuous Internal Evaluation:

Project Report: 20 marks. The basis for awarding the marks shall be the involvement of the student in the project and in the preparation of project report. To be awarded by the internal guide in consultation with external guide if any.

Project Presentation: 10 marks.

The Project Presentation marks of the Project Work Phase -II shall be awarded by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Question and Answer: 10 marks.

The student shall be evaluated based on the ability in the Question and Answer session for 10 marks.

Semester End Examination

SEE marks for the project report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.