THE ASSAM
ROYAL GLOBAL UNIVERSITY
GUWAHATI

ROYAL SCHOOL OF ENGINEERING & TECHNOLOGY
(RSET)

DEPARTMENT OF CIVIL ENGINEERING

COURSE STRUCTURE & SYLLABUS

(BASED ON NATIONAL EDUCATION POLICY 2020)

FOR

Master of Technology
in
Civil Engineering

W.E.F

AY - 2025 – 26

Programme Structure

1st semester							
S. N	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Courses (CC)							
1	CEE024C10S1	Advanced Structural Analysis	3	1	0	4	4
2	CEE024C10S2	Continuum Mechanics	3	1	0	4	4
3	CEE024C10S3	Structural Dynamics	3	1	0	4	4
4	CEE024C10S4	Numerical Methods	3	1	0	4	4
5	CEE024C10S5	Disaster Management	1	0	0	1	1
6	CEE024C11S6	Structural Engineering Lab	0	0	2	1	2
Department Specific Elective (DSE)							
7	CEE024D10S1	Elective-I	3	0	0	3	3
8	CEE024D10S2	Elective-II	3	0	0	3	3
		TOTAL	**19**	**4**	**2**	**24**	**25**
2nd semester							
SN	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Courses (CC)							
1	CEE024C20S1	Finite Element Method	3	1	0	4	4
2	CEE024C20S2	Computer Aided Analysis & Design of Structures	1	0	3	4	4
3	CEE024C20S3	Earthquake Engineering	3	1	0	4	4
4	CEE024C20S4	Research Methodology & IPR	2	0	0	2	2
Department Specific Elective (DSE)							
5	CEE024D20S1	Elective-III	3	0	0	3	3
6	CEE024D20S2	Elective-IV	3	0	0	3	3
Ability Enhancement Elective Courses (AEEC)							
9							
Ability Enhancement Compulsory Courses (AECC)							
11	CEN984A201	English for Research Paper Writing	1	0	0	1	1
		TOTAL	**18**	**3**	**0**	**21**	**21**

3rd semester							
SN	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Courses (CC)							
1	CEE024C32S2	Dissertation (Phase-I) & Presentation	0	0	28	14	28
Department Specific Elective (DSE)							
4	CEE024D30S1	Elective-V	3	0	0	3	3
Ability Enhancement Elective Courses (AEEC)							
5	CEE024S30S1	Repair & Retrofitting of Structures	3	0	0	3	3
Ability Enhancement Compulsory Courses (AECC)							
		TOTAL	**6**	**0**	**28**	**20**	**34**

4th semester							
SN	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Courses (CC)							
1	CEE024C42S1	Dissertation (Phase-II) & Presentation	0	0	36	18	36
2	CEE024C42S2	Publication of Technical Papers	0	0	0	1	0
Department Specific Elective (DSE)							
Ability Enhancement Elective Courses (AEEC)							
Ability Enhancement Compulsory Courses (AECC)							
		TOTAL	**0**	**0**	**36**	**19**	**36**

SEMESTER	CREDITS
I	**24**
II	**21**
III	**20**
IV	**19**

Elective-I (Theory of Structural Stability)
Elective-II (Analysis & Design of Bridges)
Elective-III (Design of High-Rise Structures)
Elective-IV (Advanced Structural Design)
Elective-V (Design of Prestressed Concrete Structures / Advanced Steel Design)

1. Advanced Structural Analysis		Subject Code: CEE024C10S1
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Module	Content	Hrs	Marks
I	**Introduction to Matrix Method:** Review of basic structural analysis concepts, degrees of freedom, static and kinematic indeterminacy, classification of structures, fundamentals of flexibility and stiffness methods, and introductory examples illustrating their application.	**11**	**25**
II	**Flexibility Method:** Development of stiffness matrices for truss, beam, and frame elements, formation of the global structure stiffness matrix, application to continuous beams, pin-jointed frames, and rigid frames.	**13**	**25**
III	**Plastic Analysis:** Basics of plastic behavior of materials, concept of plastic hinges, collapse mechanisms, determination of plastic moment capacity and shape factors, upper and lower bound theorems.	**11**	**25**
IV	**Approximate Analysis of Indeterminate Structures:** Need for approximate methods, basic assumptions, analysis of building frames under vertical and lateral loads using portal and cantilever methods, estimation of internal forces, application in preliminary design.	**10**	**25**
	Total	**45**	**100**

Text/Reference Books:

1. Hibbeler, R.C., *Structural Analysis*, Pearson
2. Thandavamoorthy, T.S., *Structural Analysis*, Oxford University Press
3. Weaver, W. and Gere, J.M., *Matrix Analysis of Framed Structures*, CBS Publisher
4. Wang, C.K., *Intermediate Structural Analysis*, McGraw Hill
5. Kanchi, M.B., *Matrix Methods of Structural Analysis*, Wiley Eastern Limited

2. Continuum Mechanics		**Subject Code: CEE024C10S2**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Module	Content	Hrs	Marks
I	**Basic Concepts of the Theory of Continuous Media:** Introduction to tensor algebra; theory of stresses; infinitesimal and finite strains; strain-displacement relationships; compatibility; stress-strain relationships.	13	25
II	**Boundary Value Problem in Elasticity:** Plane stress and plane strain case; stress function approaches; plane problems in Cartesian and polar coordinates; bending of a beam; thick cylinder under pressure.	10	25
III	**Concept of Plasticity:** Elements of plasticity; yield criteria; flow rule and hardening. Plastic stress-strain relationships.	12	25
IV	**Energy Principles and Methods of Analysis:** Energy principles, variational methods and numerical methods; Introduction to Hamilton's principles; Rayleigh-Ritz and Weighted residual methods.	10	25
	Total	45	100

Text Book:

1. D. S. Chandrasekharaiah and L. Debnath, Continuum Mechanics, Prism Books Pvt. Ltd.,Bangalore, 1994.

Reference Books:

1. S. Timoshenko and J.N. Goodier, Theory of Elasticity, McGraw Hill Book Company, International Ed, 1970.
2. J. Chakrabarty, "Theory of Plasticity", 3rd Edition, Elsevier Butterworth, Heinmann, UK, 2006.
3. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, New Delhi 1988.
4. Ansel. C. Ugural and Saul. K. Fenster, " Advanced Strength and Applied Elasticity," 4th Edition, Prentice Hall Professional Technical Reference, New Jersy, 2003

3. Structural Dynamics		**Subject Code: CEE024C10S3**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objective: The objective of this course is to equip students with advanced knowledge of earthquake engineering principles, focusing on the analysis and design of structures subjected to seismic forces. Students will develop skills to critically evaluate and apply seismic design codes, analyze the dynamic response of structures, and assess geotechnical aspects related to earthquakes, such as soil behavior and liquefaction.

Prerequisites: Nil

Detailed Syllabus:

Module	Topics	Course Content	Periods
I.	Single Degree-Of-Freedom (SDOF) Systems	Equations of motion, free vibration, damping, energy dissipated in viscous damping, forced vibrations under harmonic, impulse and general loadings, Fourier analysis and response due to periodic and non-periodic loading, generalized coordinates and Rayleigh's method.	17
II.	Multiple Degree-Of-Freedom (MDOF) Systems	Equations of motion, natural frequencies, mode shapes, modal participation factor, damping matrix, orthogonality condition, analysis of dynamic response - modal superposition method; mode acceleration method, reduction of dynamic matrices, error in dynamic analysis. Numerical methods in dynamics: eigen value analysis, direct integration scheme.	17
III.	Continuous Systems	Equations of motion, Hamilton's principle, Lagrangian formulation, longitudinal vibration, transverse vibration, introduction to random vibration.	17
IV.	Application of Structural Dynamics	Design of block and frame foundation, chimney.	15
TOTAL			66

Text Books

1. Anil K. Chopra, Dynamics of structures: Theory and applications to earthquake engineering, PHI Ltd.
2. R.W. Clough and J. Penzien, Dynamics of Structures, Second edition, McGraw Hill international edition.
3. Humar J. L., Dynamics of Structures., Prentice Hall.

Reference Books:

1. Mario Paz, Structural dynamics, CBS Publishers.
2. K. Rao, Vibration analysis and foundation dynamics, Wheeler.
3. E. Siniu and R. H. Scanlan, Wind effects on structures: fundamentals and applications to design, John Wiley and Sons.

4. Numerical Methods		**Subject Code: CEE024C10S4**
L-T-P-C – 3-1-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objectives:

The objectives of the course are:

- To impart knowledge to solve ordinary and partial differential equations in structural mechanics using numerical methods.

Module	Content	Hrs.	Marks
I	**Fundamentals of Numerical Methods:** Error Analysis, Polynomial Approximations and Interpolations, **Curve Fitting;** Interpolation and extrapolation.	**11**	**25**
II	**Solution of Non-linear Algebraic and Transcendental Equations** **Elements of Matrix Algebra**: Solution of Systems of Linear Equations, Eigen Value Problems.	**10**	**25**
III	**Numerical Differentiation & Integration:** Solution of Ordinary and Partial Differential Equations.	**12**	**25**
IV	**Finite Difference scheme**: Implicit & Explicit scheme. **Computer Algorithms:** Numerical Solutions for Different Structural Problems, Fuzzy Logic and Neural Network.	**13**	**25**
	Total	**45**	**100**

Text Book:

1. *An Introduction to Numerical Analysis*, Atkinson K.E., J. Wiley and Sons, 1989.

Reference:

1. *Theory and Problems of Numerical Analysis*, Scheid F, McGraw Hill Book Company, (Shaum Series),1988.
2. *Introductory Methods of Numerical Analysis*, Sastry S. S, Prentice Hall of India, 1998.

5. Disaster Management		**Subject Code: CEE024C10S5**
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Module	Content	Marks
I	**Introduction:** Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude. **Disaster Prone Areas in India:** Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics	25
II	**Repercussions of Disasters and Hazards**: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.	25
III	**Disaster Preparedness and Management:** Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.	25
IV	**Risk Assessment:** Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival. **Disaster Mitigation:** Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.	25
	Total	**100**

Text Book:

1. *Disaster Management in India: Perspectives, issues and strategies*, R. Nishith, Singh AK, New Royal Book Company.

Reference Books:

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

6. Structural Engineering Lab		Subject Code: CEE024C21S6
L-T-P-C –0-0-2-1	Credit Units: 01	Scheme of Evaluation: P

Experiments:

- Study of stress strain curve of high strength concrete, correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.
- Effect of cyclic loading on steel
- Non-Destructive testing of existing concrete members
- Behavior of beams under flexure, shear and torsion

Text Books:

1. *Properties of Concrete*, Neville A.M., 5th Edition, Prentice Hall, 2012

Reference Books:

1. Shetty M. S., *Concrete Technology*., S. Chand and Co., 2006.

7. Stability of Structures (CEE024D10S1**)** Credits L T P Cr
3 0 0 3

UNIT I BUCKLING OF COLUMNS 9
States of equilibrium - concept of equilibrium, energy, imperfection and vibration approaches to stability analysis. Governing equation for column buckling - critical load using Equilibrium, Energy methods - Approximate methods - Rayleigh Ritz, Galerkins approach - Numerical Techniques – Finite difference method.

UNIT II BUCKLING OF BEAM-COLUMNS AND FRAMES 10
Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load and end couples - Analysis of rigid jointed frames with and without sway – Use of stability function to determine the critical load.

UNIT III TORSIONAL AND LATERAL BUCKLING 10
Torsional buckling – Combined Torsional and flexural buckling - Local buckling - Buckling of Open Sections - Lateral buckling of beams - simply supported and cantilever beams.

UNIT IV BUCKLING OF PLATES 9
Governing differential equation - Buckling of thin plates with various edge conditions - Analysis by equilibrium and energy approach – Finite difference method.

Recommended Books:
1. Principles of Structural Stability Theory by Alexander Chajes, Prentice Hall, N.J., 1974 by Stephen Timoshenko, Dover Publications inc. New York,1989
2. Zdenek P. Bazant, Luigi Cedolin, Dover Publications, 2003
3. Theory of elastic stability Stability of structures Z. P. Bažant, · 2006
4. Fundamentals of Structural Stability By George Simitses, Dewey H Hodges, Elsevier Science, 2006

8. Analysis and Design of Bridges
Course Code: CEE024D10S2
Credit: 3 (Theory)

Module 1: Introduction to Bridge Engineering
Types of Bridges, Structural Configurations, Bridge Loading Standards – IRC, IRS, AASHTO, Impact Effect on Bridges

Module 2: Specifications and Preliminary Design
Road Bridge Specifications (IRC), Railway Bridge Specifications (IRS), Introduction to Bridge Deck Analysis, Deck Analysis – Solved Examples, RCC Slab Bridge Design Principles, RCC T-Beam Bridge – Concept and Detailing, Balanced Cantilever Bridges, Bearings and Expansion Joints

Module 3: Prestressed Concrete Bridges, Box Girder and Composite Bridges
Basics of Prestressing (Pre-tensioned and Post-tensioned), Flexure, Shear & Bond Analysis, Losses in Prestress, Deflection of Girders, Partial Prestressing, Anchorage Block Design, Analysis and Detailing of Box Girder Bridges, Steel-Concrete Composite Construction, Design of Shear Connectors, Types and Layouts of Bearings

Module 4: Substructure and Foundation Design, Advanced Design and Modeling
Abutments: Functions and Types, Piers: Types and Forces, Scour at Piers and Abutments, Foundation Types, Stress Analysis of Substructure, Basics of Soil-Structure Interaction, Basics of Numerical Modeling in Bridge Structures, Earthquake-Resistant Design of Bridges, Case Studies and Recent Developments

Textbooks and References

- D. J. Victor, Essentials of Bridge Engineering, Oxford IBH, 1980.
- V. K. Raina, Concrete Bridge Practice – Analysis, Design and Economics, Tata McGraw Hill, 2nd Ed., 1994.
- N. Rajagopalan, Bridge Superstructure, Narosa Publishing House, 2006.
- T. Y. Lin & N. H. Burns, Design of Prestressed Concrete Structures, John Wiley & Sons, 1981.

SYLLABUS (2nd SEMESTER)

Element Method in Structural Engineering		**CEE024C20S2Subject Code:**
4L-T-P-C – 3-1-0-	**04Credit Units:**	**TScheme of Evaluation:**

Objective: The course is intended to impart knowledge about finite element method used for structural analysis and also to make students enable to operate FEA software/programme

Modules	Topics/Course content	Hrs.	Marks
I	**Introduction:** History and Applications. Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress.	**10**	**25**
II	**Beam Elements:** Flexure Element, Element Stiffness Matrix, Element Load Vector. **Method of Weighted Residuals**: Galerkin Finite Element Method, Application to Structural Elements,Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications.	**13**	**25**
III	**Types:** Triangular Elements, Rectangular Elements, Three-Dimensional Elements, Isoparametric Formulation, Axi-Symmetric Elements, Numerical Integration, Gaussian Quadrature.	**10**	**25**
IV	**Application to Solid Mechanics**: Plane Stress, CST Element, Plane Strain Rectangular Element, Isoparametric Formulation of the Plane Quadrilateral Element, Axi- Symmetric Stress Analysis, Strain and Stress Computations. **Computer Implementation** of FEM procedure, Pre-Processing, Solution, Post-Processing, Use of Commercial FEA Software.	**12**	**25**
	Total	**45**	**100**

Text Book:

1. *Finite Element Analysis*, Seshu P., Prentice-Hall of India,2005.

Reference Books:

1. Cook R. D.,*Concepts and Applications of Finite Element Analysis,*Wiley J., New York, 1995.
2. Hutton David,*Fundamentals of Finite Element Analysis*, Mc-Graw Hill, 2004.
3. Zienkiewicz O.C. & Taylor R.L.*, Finite Element Method,* Vol. I, II & III, Elsevier, 2000.

2. Computer Aided Analysis & Design of Structures		**Subject Code:**
L-T-P-C – 1-0-3-	**Credit Units:**	**Scheme of Evaluation:**

On successful completion of the course the students will be able to:		
SI No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** the importance and basic principles of CAD tools in civil engineering structural modeling and recognize different types of structures and loadings.	**BT 1**
CO 2	**Explain** structural modeling concepts and analysis techniques including static, dynamic and buckling analysis using structural software tools.	**BT 2**
CO 3	**Apply** software tools to design structural elements (RCC and steel) such as beams, columns, slabs and footings in compliance with relevant IS codes.	**BT 3**
CO 4	**Analyze** real-world structural problems through case studies and evaluate software output to prepare comprehensive technical reports for a complete structural project.	**BT 4**

Objective: The objectives of the course are:

- To provide foundational knowledge and hands-on experience in structural modeling, analysis and design using advanced CAD software tools relevant to civil engineering

- To develop the ability to interpret and apply Indian Standard codes for structural design and to analyze or evaluate real-world structural systems through project-based learning.

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Modules	**Topics/Course content**	**Hrs.**	**Marks**
I	**Introduction:** Importance of CAD in civil engineering, Basics of structural modeling, Overview of structural engineering software, Types of structures and loadings. **Structural Modeling and Analysis:** 2D and 3D modeling of structures; Line diagrams and grid generation; Definition of supports, materials and cross-sections; **Load application:** Dead loads, live loads, wind loads, seismic loads; Load combinations and factors	**10**	**25**
II	**Analysis Techniques:** Linear static analysis, Linear dynamic analysis (Response spectrum and time history methods), Buckling and stability analysis, Modal analysis Introduction to nonlinear analysis.	**13**	**25**

III	**Design of Structural Elements:** Design of RCC and steel members using software: Beams, Columns, Slabs, Footings Code compliance: IS:456, IS:800, IS:875, IS:1893, IS:13920 Drawing and Detailing of the structure	**10**	**25**
IV	**Case Studies and Applications:** Modeling and analysis of: Simply supported beams; Portal frames; multi-story buildings Project-based learning: Complete modeling, analysis and design of a civil engineering structure Report preparation and interpretation of software output	**12**	**25**
	Total	**45**	**100**

Text Books and References:

1. Krishna Raju, *Advanced Reinforced Concrete Design*, CBS Publishers
2. Ramamrutham S., *Design of Reinforced Concrete Structures*
3. STAAD.Pro / ETABS / SAP2000 Manuals and User Guides
4. IS Codes: IS 456:2000, IS 800:2007, IS 875 (Part I – V), IS 1893:2016, IS 13920:2016

3. Earthquake Engineering **Subject Code: CEE024C10S5**
L-T-P-C – 3-1-0-4 **Credit Units: 04** **Scheme of Evaluation: T**

Objective: The objectives of the course are:

- Analyze and study dynamics response of single and multi-degree freedom system
- To make the students understand the concepts behind dynamic analysis of structures.

Prerequisites: Structural Dynamics

Course Outcomes

On successful completion of the course the students will be able to:		
SI No.	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Define** the causes, magnitude, and intensity of earthquakes along with historical damage assessments	**BT 1**
CO 2	**Understand** seismic analysis methods to evaluate structural responses to seismic loads.	**BT 2**
CO 3	**Apply** seismic codes and principles of ductility-based design to create earthquake-resistant structures	**BT 3**
CO 4	**Analyze** the dynamic properties of soil and their impact on liquefaction and ground improvement techniques during seismic events.	**BT 4**

Detailed Syllabus:

Module	Topics	Course Content	Periods
I.	**Introduction to Earthquake Engineering**	Earthquakes - causes, magnitude, intensity, Review of damage in past earthquakes. Ground motions and ground motion parameters, Site effects, Sensors, Seismic instruments; Seismic hazard analysis.	**15**
II.	**Seismic Analysis**	Approximate method of analysis- portal method, cantilever method, McLeod's method, equivalent static method. Response spectrum – concept, construction, characteristics, response spectrum for elastic and inelastic systems, design response spectrum; Center of mass and center of stiffness, Torsionally coupled systems. Linear earthquake analysis - idealization of structures, response spectrum analysis. Nonlinear earthquake analysis - force-deformation relationships, equation of motion, controlling parameters, ductility demand, allowable ductility.	**18**
III.	**Seismic Design**	Understand seismic codes, provisions related to earthquake resistant design; Philosophy of ductility-based design – deformability, ductility, ductility ratio; Concepts of structural control, Base isolation; Retrofitting and strengthening of buildings and bridges.	**18**
IV.	**Geotechnical Aspects**	Dynamic properties of soil, dynamic earth pressures, Liquefaction and ground improvement techniques.	**15**
TOTAL			**66**

4. Research Methodology & IPR **Subject Code: CEE024C10S6**

L-T-P-C – 2-0-0-2 **Credit Units: 02** **Scheme of Evaluation: T**

Objective: The main objective is to explain different aspects of research.

Module	Content	Hrs	Marks
I	**Introduction to Research:** Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations	**5**	**25**
II	**Research Ethics & Proposals:** Effective literature studies approach, analysis of Plagiarism, Research ethics Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee	**3** **4**	**25**

III	**Nature of Intellectual Property:** Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	**6**	**25**
IV	**Patent Rights:** Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	**2** **4**	**25**
	Total	**24**	**100**

Text Book:

1. "*Research Methodology: A Step by Step Guidefor beginners"* Ranjit Kumar, 2nd Edition.

Reference Books:

1. Stuart Melville and Wayne Goddard, *"Research methodology: an introduction for science & engineering students"*
2. Wayne Goddard and Stuart Melville, *"Research Methodology: An Introduction"*

5. Elective-III (Design of High Rise Structures) **Subject Code: CEE024D20S1**

L-T-P-C – 3-0-0-3 **Credit Units: 03** **Scheme of Evaluation: T**

Objective:

The objectives of the course are:

- *To teach students to **a**nalyze, design and detail various types of high rise structure.*
- *To teach the students the various structural problems associated with high rise structures*

Modules	*Topics/Course content*	*Hrs.*	*Marks*
I	***Introduction:** Need of tall buildings, Structures elements, Loads on Tall Buildings – Materials for tall buildings, Gravity loads, Live loads, Fire Tender Loading, Wind loads and seismic loading.* ***Design of RC chimney:** Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration.*	*11*	*25*
II	***Structural systems:** Behavior of various Structural Systems, Types of structural systems for tall buildings, factors affecting growth, height and structural form. Gravity systems, lateral load resisting systems. High rise behavior with moment frame system, braced frames, In-filled frames, shear walls, coupled shear walls, wall-frames, tubular structures, outrigger - braced*	*11*	*25*

	and hybrid mega systems. Different foundation systems for tall buildings. ***Analysis of Tall Buildings (With and Without Shear Walls):*** *Shear Walls and their arrangement, Approximate analysis for gravity loads, Lateral loads, Stability, Stiffness and fatigue, Factor of safety and load factor.*		
III	***Design of Tall Buildings:*** *Procedures of elastic design, Ultimate strength design and Limit state design of super structures including structural connections, soil structure interaction.* ***Code Provisions:*** *Discussion of relevant codes of practices and loading standards, detail discussion for Indian code provisions and other foreign codes, Measures to Reduce the Earthquake Response.* ***Seismic isolations****: Introduction to dampers, recent trends in seismic isolations, types of dampers, behavior of friction pendulum system*	***12***	***25***
IV	***Application*** *of software in analysis and design.*	***11***	***25***
	Total	***45***	***100***

Text Book:

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

Reference Books:

1. *Taranath B. S, Structural Analysis and Design of Tall Buildings,. S., Mc-Graw Hill, 1988.*
2. *Shah V. L. &Karve S. R, Illustrated Design of Reinforced Concrete Buildings (GF+3storeyed),, Structures Publications, Pune, 2013.*
3. *Design of Multi Storeyed Buildings, Vol. 1 & 2, CPWD Publications, 1976.*

5. Elective-IV (Advanced Structural Design) **Subject Code: CEE024D20S1**

L-T-P-C – 3-0-0-3 **Credit Units: 03** **Scheme of Evaluation: T**

Modules	Topics/Course content	Hours	Marks
I	**Introduction:** Design philosophy, modeling of loads, material characteristics. P-M & M-phi relationships.	10	25
II	**Strut-and-tie method:** Basic Introduction, Method of formulating strut-and-tie method, Limitations of truss analogy, Design of deep beam, Design of corbel, Numerical Examples.	07	25
III	**Design of Shear Walls:**	12	25

	Seismic behavior of shear wall - Lateral Forces on shear wall - Design of shear wall - IS provisions for ductile detailing, Numerical Examples.		
IV	**Steel structures:** Stability design - torsional buckling (pure, flexural and lateral); design of beam-columns, Numerical Examples.	16	25
		45	100

Text/ Reference Books:

1. Pillai, S. U., & Menon, D. (2005). Reinforced concrete design 3rd edition.
2. Varghese, P. C. (2009). Advanced reinforced concrete design. PHI Learning Pvt. Ltd..
3. Ramamrutham S., Design of Reinforced Concrete Structures, Dhanpat Rai Publishing Company Ltd,2007.
4. Krishnaraju N., Design of RCC, CBS publishers.
5. Subramanian, N. (2008). Design of steel structures. Oxford university press.

6. English for Research Paper Writing

English for Research Paper Writing		**Subject Code: CEN984A101**
L-T-P-C – 1-0-0-1	**Credit Units: 01**	**Scheme of Evaluation: T**

Objective: The course is intended to improve the writing skill of students

Modules	Topics/Course content	Hrs.	Marks
I	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	**3**	**25**

II	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	**4**	**25**
III	Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature	**3**	**25**
IV	Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions Useful phrases, how to ensure paper is as good as it could possibly be the first-time submission	**4**	**25**
		14	**100**

Text Books:

1. *Writing for Science*, Goldbort R (2006) Yale University Press (available on Google Books)

Reference Books:

1. Day R (2006) *How to Write and Publish a Scientific Paper*, Cambridge University Press
2. Highman N (1998), *Handbook of Writing for the Mathematical Sciences*, SIAM. Highman's book.
3. Adrian Wallwork, *English for Writing Research Papers*, Springer, New York Dordrecht Heidelberg London, 2011

SYLLABUS (3rd SEMESTER)

1. Elective-V (Advanced Design of Metal)		Subject Code: CEE024C20S3
L-T-P-C – 3-0-0-3	**Credit Units: 03**	**Scheme of Evaluation: T**

Objective:

- Knowledge and understand metal structural systems
- Design structural systems

Modules	Topics/Course content	Hrs.	Marks
I	**Metal Structures:** Introduction, Plastic methods of analysis and design, plastic behavior under static and cyclic loading, static, kinematic and uniqueness theorems, shape factors, moment redistribution, analysis of single and two bay portal frames.	10	25
II	**Design of Connections:** Bolted connections, failure modes of a joint, high strength bolts, HSFG bolts, moment resistant connections. Welded connections, stiffened beam seat connection, moment resistant joint, advance types of welded connections.	12	25
III	**Design of Storage Structures and Tall Structures:** Design of liquid retaining structures, silos, bunkers, and chimneys.	12	25
IV	**Design of Industrial Buildings:** Design of members subjected to lateral loads and axial loads, sway and non-sway frames, bracings and bents, rigid frame joints, knees for rectangular frames and pitched roofs, knees with curved flanges, valley joints, rigid joints in multistorey buildings.	11	25
		45	100

Text/ Reference Books:

1. *Design of Steel Structures*, Gaylord, McGraw Hill, New York, 2010
2. *Design of Steel Structures,* S K Duggal, 3rd edition.
3. *Design of Steel Structures,* Ram Chandra, Volume 2

Elective-V (Design of Prestressed Concrete Structures)

Elective-V (Design of Prestressed Concrete Structures)		Subject Code: CEE024D30S1
L-T-P-C – 4-0-0-4	**Credit Units: 04**	**Scheme of Evaluation: T**

Objectives:

The objectives of the course are:

- To make the students understand the concepts relating to pre-stressed concrete

Module	Content	Hrs	Marks
I	**Introduction to prestressed concrete**: types of prestressing, systems and devices, materials, losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, code provisions	10	25
II	**Statically determinate PSC beams**: design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions.	9	25
III	**Transmission of prestress**in pre-tensioned members; Anchorage zone stresses for posttensioned members. **Statically indeterminate structures** - Analysis and design - continuous beams and frames, choice of cable profile, linear transformation and concordancy.	12	25
IV	**Composite construction** with precast PSC beams and cast in-situ RC slab - Analysis and design, creep and shrinkage effects. Partial prestressing - principles, analysis and design concepts, crack width calculations **Analysis and design** of prestressed concrete pipes, columns with moments.	14	25
	TOTAL	45	100

Text Book:

1. *Design of Prestressed Concrete Structures*, Lin T.Y., Asia Publishing House, 1955.

References:

1. .*Prestressed Concrete*, Krishnaraju N., Tata McGraw Hill, New Delhi, 1981.
2. Guyan Y.*, Limited State Design of PrestressedConcrete*,, Applied Science Publishers, 1972.
3. IS: 1343- *Code of Practice for Prestressed Concrete*
4. IRC: 112

Paper-V: Repair & Retrofitting of Structures **Subject Code: CEE024S30S1**

L-T-P-C – 2-0-0-2 **Credit Units: 02** **Scheme of Evaluation: T**

Module	Content	Hrs	Marks

I	**Distress and Deterioration of Structures:** Types of structural damage, Causes of deterioration in concrete, masonry, and steel structures, Durability aspects and service life prediction.	**10**	**25**
II	**Inspection, Testing, and Evaluation:** Visual inspection, Non-destructive testing methods – rebound hammer, ultrasonic pulse velocity, half-cell potential, ground penetrating radar, Load testing of structures, Structural health monitoring systems and sensors**.**	**11**	**25**
III	**Repair Materials and Techniques:** Repair materials – polymers, grouts, fiber reinforced composites, Bonding agents, corrosion inhibitors, sealants, Surface preparation and cleaning methods. Repair techniques – epoxy injection, jacketing, shotcreting, stitching, overlays, Design and quality control in repair operations	**13**	**25**
IV	**Retrofitting and Strengthening Methods:** Concepts of retrofitting – local and global strategies, Strengthening of RC members – beams, slabs, columns, joints, Use of steel plates and FRP systems, Seismic retrofitting methods – jacketing, bracing, base isolation, Guidelines and standards.	**11**	**25**
	TOTAL	**45**	**100**

Text Book:

1. *Health Monitoring of Structural Materials and Components- Methods with Applications*, Douglas E. Adams, John Wiley & Sons Ltd., 2007.
2. *Structural Health Monitoring of Civil Infrastructure Systems,* Vistasp M.Karbhari and Farhad Ansari, Woodhead Publihing Limited, Oxford Cambridge, New Delhi, 2009.

References:

1. *Applications of metaheuristic Optimization Algorithms in Civil Engineering*, A.Kaveh, Springer Publications.