Scheme of Instruction, Examination and Syllabi

For

M.E Civil (Structural Engineering)

As Per

AICTE MODEL CURRICULUM

(With effect from the academic year 2019-20)

DEPARTMENT OF CIVIL ENGINEERING

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A), HYD-75

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
SCHEME OF INSTRUCTION AND EXAMINATION
M.E. (STRUCTURAL ENGINEERING)
(With effect from the academic year 2019-20)

SEMESTER – I

S.No.	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	p		CIE	SEE	
THEORY									
1	19CE C101	Advanced Structural Analysis	3	0	0	3	30	70	3
2	19CE C102	Advanced Solid Mechanics	3	0	0	3	30	70	3
3	Program Specific Elective-I		3	0	0	3	30	70	3
4	Program Specific Elective-II		3	0	0	3	30	70	3
5	19ME C103	Research Methodology and IPR	2	0	0	2	25	50	2
6	Audit Course-I		2	0	0	2	-	50	Pass/Fail
PRACTICALS									
7	19CE C103	Structural Design Lab	0	0	4	-	50	-	2
8	19CE C104	Advanced Concrete Lab	0	0	4	-	50	-	2
TOTAL			**16**	**0**	**8**	-	**245**	**380**	**18**

L: Lecture T: Tutorial P: Practical
CIE - Continuous Internal Evaluation SEE - Semester End Examination

Course Code	Program Specific Elective-I
19CE E101	Theory of Thin Plates and Shells
19CE E102	Theory and Applica tions of Cement Composites
19CE E103	Theory of Structural Stability

Course Code	Program Specific Elective-II
19MT E103	Analytical and Numerical Methods for structural Engineering
19CE E104	Structural Health Monitoring
19CE E105	Structural Optimization

Audit Course- I and II	
Course Code	**Course**
19EG A101	English for Research Paper Writing
19CE A101	Disaster Mitigation and Management
19EE A101	Sanskrit for Technical Knowledge
19EC A101	Value Education
19EG A102	Indian Constitution and Fundamental rights
19IT A101	Pedagogy Studies
19EG A103	Stress Management by Yoga
19EG A104	Personality Development through Life Enlightenment Skills

19CE C101

ADVANCED STRUCTURAL ANALYSIS

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student

1. Gain knowledge of using matrix methods of structural analysis stiffness and flexibility methods to analyse beams and trusses
2. Learns the basic concepts of analyse of frames and grids using flexibility methods.
3. Learns the basic concepts of analysis frames and slides using stiffness method
4. Understand the concepts of beams on elastic foundations with semi infinite and infinite lengths
5. Grasps the fundamentals of solving boundary value problems using approximate methods

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

1. Analyse continuous beams and redundant trusses using force and displacement approaches (flexibility & stiffness approaches) of matrix methods
2. Analyse rigid jointed plane frames and grids by flexibility methods.
3. analyse rigid jointed plane frames and grids by stiffness methods.
4. Applies the concepts of (beams of semi-infinite and infinite lengths) an elastic foundation to field problems and analytical models.
5. Solve the boundary value problems using approximate methods.

UNIT-I:
Introduction to matrix methods of structural analysis: Static and kinematic indeterminacies, Matrix formulations by force and displacement methods, Analysis of continuous beams and redundant trusses by force and displacement methods with degree redundancy and freedom not exceeding three.

UNIT-II:
Analysis of rigid jointed plane frames and grids: by Flexibility approach with degree of redundancy not exceeding three**.**

UNIT-III:
Analysis of rigid jointed plane frames and grids: by Stiffness approach with degree of freedom not exceeding three.

UNIT-IV:

Beams on elastic foundation: Introduction - Modulus of foundation and basic equation - Beams of infinite length under concentrated and uniformly distributed loads - Analysis of semi-infinite beams making use of functions for infinite beams.

UNIT-V:

Boundary Value Problems (BVP): Approximate Solution of Boundary Value Problems, Modified Galerkin Method for One-Dimensional BVP, Matrix Formulation of the Modified Galerkin Method.

References:

1. William Weaver and James M. Gere, "*Matrix Analysis Framed Structures* ", CBS, 2004.
2. Devadas Menon," *Advanced Structural Analysis*", Narosa, 2009.
3. A. K. Jain, "*Advanced Structural Analysis*", Nem Chand & Bros. 2015.
4. R. C. Hibbler," *Structural Analysis*", Pearson, 2015.
5. P. Seshu," *Text Book of Finite Element Analysis*", PHI, 2003.

19CE C102

ADVANCED SOLID MECHANICS

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course objectives: To enable the student

1. To make the students understand the concepts of elasticity and equip them with the knowledge to independently handle the problems of elasticity.
2. To enhance the competency level and develop the self-confidence through quality assignments in theory of Elasticity and plasticity.
3. To inculcate the habit of researching and practicing in the field of elasticity and plasticity.

Course Out Comes: The students

1. Will be able to solve the problems of 3-D elasticity with confidence.
2. Can independently work with the problems of 2-D elasticity in Cartesian/Polar Coordinates.
3. Are familiarized with the use of Airy's stress function in 2-D problems of elasticity in Cartesian/Polar Coordinates.
4. Are equipped with the knowledge of various theories of torsion of prismatic bars of various cross sections and can solve the problems of torsion.
5. Will be able to solve plasticity problems in Structural engineering

UNIT-I:

Definition of stress and strain: Notation of stresses in three dimensions – Generalized Hooks law.

General Theorems: Differential equations of equilibrium in 3-D - Equations of Equilibrium in terms of displacements – Boundary Conditions - conditions of compatibility - Transformation of stress components under change of co-ordinate system.

UNIT-II:

Plane stress and plane strain: differential equations of equilibrium - boundary conditions - compatibility equations

Stresses on an oblique plane – Stress Invariants - principal stresses - stress ellipsoid - max shear stresses - Octahedral shear stress – Strain energy per unit volume - Strain of a line element - principal strains.

UNIT-III:

Two dimensional problems in rectangular coordinates: Stress function - Applications - solution by polynomials - Saint- Venant's principle - determination of displacements - bending of simple beams - gravity loading.

Two dimensional problems in polar coordinates: Airy's stress function - general solution of two- dimensional problem in polar coordinates - stress distribution symmetrical about an axis – Effect of hole on stress distribution in a plate in tension, Stresses in a circular disc under diametrical loading - strain components in polar coordinates

UNIT-IV:

Torsion of Prismatic Bars: torsion of prismatic bars - bars with elliptical cross sections – other elementary solution - membrane analogy - torsion of rectangular bars - solution of torsion problems by energy method - use of soap films in solving torsion problems

UNIT-V:

Theory of Plasticity: Introduction – Idealized Stress-Strain curve, concepts and assumptions - yield criterions – Von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-strain relations- Principle of Normality and plastic potential.

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References:

1. Timoshenko S. and Goodier, "*Theory of Elasticity*", Mc Graw hill Publications, 2015.
2. J.Chakraborty,"*Theory of Plasticity*", Mc Graw hill Publications, 2007.
3. S. Singh, "*Theory of Elasticity*", Khanna Publishers, 2003.

19CE E101

THEORY OF THIN PLATES AND SHELLS
(ELECTIVE-I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the students to

1. Understand the analysis of thin rectangular plates under pure bending and also the classical solutions to plate problems using Navier' s and Levy approaches.
2. Understand the analysis of axi-symmetric circular plates and know the application of approximate methods to rectangular plate problems.
3. Comprehend the stability analysis of thin rectangular plates and know the thermal analysis of rectangular and circular plates
4. Get acquainted with the classification of shells and analysis of thin shells using DKJ and Schorer's theories
5. Understand the membrane theory of shell analysis and determining the stresses & displacements in shells of different geometrical shapes subjected to dead and snow loads.

Course Outcomes: At the end of the course, the student will be

1. Able to analyze thin rectangular plates under pure bending and provide classical solutions to plate problems.
2. Capable of analyzing axi-symmetric circular plates and employ approximate methods to rectangular plate problems.
3. Able to analyze the plate problems for stability and thermal stresses.
4. Capable of distinguishing between different shell roofs and analyze thin shells by DKJ and Schorer's theories.
5. Able to perform the shell analysis using membrane theory.

UNIT-I:

Static Analysis of Thin Plates: Introduction, Pure bending of plates, Relations between slope and curvature of slightly bent plates Moment-curvature relations in pure bending. Strain energy in pure bending.

Governing Differential Equation for a Rectangular Plate, Solution of simply supported rectangular plates under various loading conditions Viz. uniformly distributed load (full or partial) concentrated load by Navier approach. Levy type solution for rectangular plates under U.D.L with all four edges simply supported or two opposite edges simply supported and other two fixed.

UNIT-II:

Circular Plates: Analysis under axi-symmetric Loading, Governing Differential Equation in Polar Co-ordinates, Uniformly loaded plates at centre, Circular plates with circular holes at the centre.

Approximate Methods of Analysis: Rayleigh-Ritz approach for Simple Cases like UDL and Point load in Rectangular Plates.

UNIT-III:

Buckling of Plates: Calculation of critical loads-buckling of simply supported rectangular plates- uniformly compressed in one and two directions with different edge conditions, and web crippling.

Thermal Stresses in Plates: Introduction, Stress-strain & displacement relations, Stress resultants, governing differential equations, simply supported rectangular plate subjected to an arbitrary temperature distribution, simply supported rectangular plate with temperature distribution varying over the thickness, Axi-symmetrically heated circular plates

UNIT-IV:

Thin shells: Introduction**,** Definitions and classification of shell Surfaces, Space Curves, Shell Co-ordinates, Strain Displacement Relations, general behavior and common theories of shells, load resistance action of a shell, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions. DKJ and Schorer's theories

UNIT-V:

Static Analysis of Shells: Membrane Theory of Shells**,** Equilibrium equations for a differential shell element, Calculation of stresses and displacements due to dead loads and snow loads for circular cylindrical shell, Conical and Spherical Shells.

References:

1. S. Timoshenko and W. Krieger ," *Theory of Plates and Shells"*, McGraw Hill Education, 2017.
2. C. Ugural Ansel , "*Stresses in Plates and Shells*", CRC, press, 2009.
3. K. Chandrashekhara, "*Theory of Plates*", UniversitiesPress, 2000.
4. G. S. Ramaswamy , "*Design and Construction of Concrete Shells*", CBS, 2005.

19CE E102

THEORY AND APPLICATIONS OF CEMENT COMPOSITES (ELECTIVE-I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student

1. Understand the classification of cement composite materials as per orthotropic and anisotropic behavior.
2. Acquire knowledge of formulating the constitutive relationship and comparing the mechanical behavior of cement composites.
3. Understand the Preparation, analysis and design structural elements made of cement composites. Gain the knowledge of determining the mechanical properties and durability characteristics of cement composites.
4. Understand the constitutive relationships in respect of Ferro cement and Fiber reinforced concretes and their applications in miscellaneous structures.

Course Outcomes: At the end of the course, student is able to

1. Classify the composite materials as per orthotropic and anisotropic behavior.
2. Formulate the constitutive relationship and compare the mechanical behavior of cement composites.
3. Prepare, Analyze and design structural elements made of cement composites.
4. Determine the mechanical properties and durability characteristics of cement composites.
5. Utilize Ferro cement and Fiber reinforced concretes in housing, water storage and boats by understanding the constitutive relationship of materials.

UNIT - I:

Introduction: Classification and characteristics of composite materials - Basic Terminology, Advantages. Stress - Strain Relations - Orthotropic and Anisotropic Materials, Engineering constants for orthotropic Materials, Restrictions on Elastic constants, Plane stress problem, Biaxial Strength, Theories for an Orthotropic Lamina.

UNIT - II:

Mechanical Behavior: Mechanics of Materials Approach to Stiffness - Determination of Relations between Elastic Constants, Elasticity Approach to Stiffness - Bounding Techniques of Elasticity, Exact Solutions - Elasticity Solutions with Continuity, Halpin, Tsai Equations, Comparison of approaches to Stiffness.

UNIT - III:

Cement Composites: Types of cement Composites, Terminology, Constituent Materials and their properties, Construction Techniques for fiber Reinforced concrete - Ferro cement, SIFCON, Polymer concretes, Preparation of Reinforcement, casting and curing. Analysis and design of cement composite structural elements - Ferrocement, SIFCON and fiber reinforced concrete.

UNIT - IV:

Mechanical properties of Cement Composites: Behavior of ferrocement, Fiber reinforced concrete in tension, compression, flexure, shear, fatigue and impact, durability and corrosion.

UNIT - V:

FRC and Ferro cement: Housing, water storage, boats and miscellaneous structures. Composite Materials - Orthotropic and Anisotropic behavior, constitutive relationship, elastic constants.

References:

1. Robert M Jones, "*Mechanics of Composite Materials*", Taylor and Francis, 2017.
2. R. P. Pama, "*Ferrocement - Theory and Applications*, IFIC, 1980.
3. R. N. Swamy, "*New Concrete Materials*", 1st Ed., Blackie, Academic and Professional, Chapman & Hall, 1983.

19CE E103

THEORY OF STRUCTURAL STABILITY
(ELECTIVE-I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student

1. Learn the fundamentals of elastic and inelastic buckling of columns and general principles of elastic stability of framed structures
2. Knows a mathematical treatment to the stability problems of discrete and continuous systems using Eigen value solutions
3. Understand the bucking of thin walled members considering torsion, warping, axial loading and combined bending and torsion
4. Grasp the concepts of lateral buckling of beams and applying energy methods
5. Comprehend the concepts of buckling of rectangular plates for simply supported edge condition and also combination of simply supported and other edge condition.

Course Outcomes: At the end of the cause the student

1. Applied the concepts of elastic and inelastic stability to columns and the concepts of elastic stability to frames.
2. Uses Eigen value solution to solve the stability problems of discrete and continuous systems
3. Analyses the buckling problems of this walled member including torsion, wrapping axial loading and bending.
4. Deals with the problems of lateral buckling of beams & applies energy methods
5. Solve the problems of buckling of rectangular plates with simply supported and other edge conditions

UNIT- I:

Buckling of Columns: Introduction - Methods of finding critical loads, critical loads for straight columns with different end conditions and loading - Inelastic buckling of axially loaded columns - Energy methods - Prismatic and non-prismatic columns under discrete and distributed loadings - General Principles of elastic stability of framed structures.

UNIT-II:

Mathematical Treatment of Stability Problems - Critical loads for discrete systems – Discrete Eigen value problem - Buckling of continuous systems - Continuous Eigen value problem - Orthogonality relation - Methods of converting continuous Eigen value problem to a discrete problem.

UNIT-III:

Buckling of Thin Walled Members of Open Cross Section - Torsion of thin-walled bars – Warping - Non-uniform torsion - Torsional buckling under axial loading - Combined bending and torsion buckling.

UNIT-IV:

Lateral Buckling of Beams - Beams under pure bending - Cantilever and simply supported beams of rectangular and I sections - I Beams under transverse loading - Energy methods - Solution of simple problems.

UNIT-V:

Buckling of Rectangular Plates - Plates simply supported on all edges and subjected to constant compression in one or two directions - Plates simply supported compression in one or two directions - Plates simply supported along two opposite sides perpendicular to the direction of compression and having various edge conditions along the other two sides.

References:

1. Timoshenko and Gere, "*Theory of Elastic Stability*", 2nd Edition, Tata McGraw Hill, 2010.
2. Stephen H. Crandall, "*Engineering Analysis - A Survey of Numerical Procedures*", Krieger Publishing Co., 1986.
3. Bleich," *Buckling of Metal Structures*", McGraw Hill Book Co., New York, 1952.
4. Alexander Chajes, "*Principles of Structural Stability Theory*", Prentice Hall Inc., 1974.
5. N.G.R Iyengar, "*Structural Stability of Columns and Plates"*, Ellis Horwood Ltd, 1988.
6. Coxhl, "*The Buckling of Plates and Shells"*, H.L. Pergaman press, 1963.

19MT E103

ANALYTICAL AND NUMERICAL METHODS FOR STRUCTURAL ENGINEERING
(ELECTIVE-II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student

1. To find the roots of nonlinear and transcendental equations by using numerical techniques
2. To compute the techniques for fitting the data in different curves
3. To know how to solve system of linear equations by using direct indirect methods
4. To find the solution of ODE and PDE by using numerical methods
5. To know how to find scientific computation for structural engineering
6. To know difference between analytic and numerical solutions

Course Outcomes: At the end of the course, student is able to

1. Know the roots of convergence of iterative methods and their importance
2. Develop the skills of finding approximate curve fitting techniques for given data
3. Know the interpolation techniques (Methods) to the approximate the value of the integral for the functions whose ant derivatives can't be found
4. Obtain the solution of IVPS of first order differential equations using numerical techniques
5. Obtain the solution of system of linear equations by using iterative method
6. Understand the mathematical and computational foundations of the numerical approximations and solutions in engineering

UNIT - I:

Errors analysis: Solutions of Non-linear Algebraic and Transcendental equations by

1. Bisection Method
2. Regular Falsie method
3. Newton Raphson method

UNIT - II:

Interpolation and extrapolation, Curve Fitting

1. Straight line
2. Second degree parabola
3. Exponential curves : NFIF; NBIF, NDDIF

UNIT - III:

Elements of Linear Algebra

Solutions of simultaneous equations, Gauss elimination, Gauss seidal methods, Gauss Jordan Method, Jacobe's method and Eigen Value Problems and properties

UNIT - IV:

Numerical Integration and Numerical solutions of ODE & PDE

1. Trapezoidal rule
2. Simpson's rules
3. Euler's Method
4. Runge-Kutta Method (4^{th} order)
5. Predictor & corrector methods
6. Implicit & Explicit schemes for PDE

UNIT - V:

Finite Difference scheme

Numerical Solutions for Different Structural Problems, Fuzzy Logic and Neural Network

References:

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

19CE E104

STRUCTURAL HEALTH MONITORING
(ELECTIVE-II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student to understand the fundamental concepts of

1. Distress in the structure.
2. Assess the health of structure. Audit for structural health monitoring
3. Static and dynamic field tests.
4. Repairs, strategies for repairs and rehabilitation methods of the structure
5. Piezo–electric materials and other smart materials,

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

1. Appraise importance of Diagnosis the distress in the structure, develop an understanding the root causes and factors.
2. Assess the health of structure using static field methods.
3. Assess the health of structure using dynamic field tests.
4. Identify the locations for repairs and various repair methods, can able to suggest rehabilitation methods for structure
5. Adapt and implement EMI technique

UNIT- I:

Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.

Structural Health Monitoring**:** Concepts, Various Measures, Structural Safety in Alteration.

UNIT- II:

Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.

UNIT- III:

Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.

UNIT-IV:

Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.

UNIT –V:

Introduction to Repairs and Rehabilitations of Structures: Case Studies (Site Visits), piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.

References:

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

19CE E105

STRUCTURAL OPTIMIZATION
(ELECTIVE-II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student to

1. Know about the basic principles of optimization and classical methods of optimizations
2. Learn the basic principles & solution methods of Linear programming and also the concepts of network analysis and their applications to Civil Engineering problems.
3. Understand the concepts of Non linear programming and also Geometric and Dynamic programming methods.
4. Grasp fundamentals of optimum structural design of beams and optimization of concrete mix design
5. Comprehends the structural optimization of Reinforced concrete T & L beams, planar trusses, and Grid floor system.

Course Outcomes: As the end of the course the student should be able to

1. Apply the basic principles of optimization and classical methods of optimizations.
2. Solve the problems of Linear programming and Networks analysis and apply them to Civil Engineering problem.
3. Apply the Non linear programming and Geometric & Dynamic programming methods to field problems.
4. Use the principles of optimum structural design to beams and concrete mix design.
5. Optimize the structural design of Reinforced concrete T & L beams, planar trusses and Grid

UNIT-I:

Introduction: General Introduction: basic theory and elements of optimization Terminology and definitions Basic principles and 'procedure of optimization. Classical Methods of Optimization: Trial and error method, MonteCarlo method and Lagrangian Multiplier Method illustrative examples.

UNIT-II:

Linear Programming: Introduction, terminology, standard form of linear programming problem, geometrical interpretation, canonical form of equation graphical and algebraic methods of solving L.P. problems, illustrative examples. Simplex, methods, Dual formulations illustrative examples.

Network analysis: Introduction to network theory, transportation and assignment models formulation of mathematical models and solutions applications to Civil Engineering problems.

UNIT-III:

Non Linear programming: Unconstrained and constrained methods of optimization on. Univariate search, Steepest Descent Methods, Kuhn Tucker conditions – Penalty functions, slack variables and Lagrangian Multiplier methods illustrative examples.

Geometric and Dynamic Programming: illustrative Examples.

UNIT-IV:

Structural Optimization: Optimum structural design of rectangular timber, and reinforced concrete beams Optimization applied to concrete mix proportioning procedure of optimization for reinforced concrete deep beams.

UNIT-V:

Structural Optimization: Optimum structural design of reinforced concrete T and L beams Optimization of planar trusses Procedure of optimization for structural grid and slab floor systems

References:

1. S.S. Rao, "*Engineering Optimization, Theory and Practice*", New Age Internationals, 2013
2. J. O. Paul., "*Systems Analysis for Civil Engineers*", John Wiley & Sons, 1988.
3. Haftka, T. Raphael , Gürdal, Zafer, "*Elements of Structural Optimization*, Springer, NY, 2014
4. Cherkaev Andrej, "*Variational methods for Structural optimization*" , Springer, NY, 2012

19ME C103

RESEARCH METHODOLOGY AND IPR

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	25 Marks
Credits	2

Objectives: To make the students to

1. Motivate to choose research as career
2. Formulate the research problem, prepare the research design
3. Identify various sources for literature review and data collection report writing
4. Equip with good methods to analyze the collected data
5. Know about IPR copyrights

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

1. Define research problem, review and asses the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs
3. Collect the data by various methods: observation, interview, questionnaires
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Understand apply for patent and copyrights

UNIT – I:

Research Methodology: Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

UNIT – II:

Literature Survey Report writing: Literature Survey: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing a report. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

UNIT – III:

Research Design: Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

UNIT – IV:

Data Collection and Analysis: Data Collection: Methods of data collection, importance of Parametric, non parametric test, testing of variance of two normal population, use of Chi-square, ANOVA, Ftest, z-test

UNIT – V:

Patents and Copyright: Patent: Macro economic impact of the patent system, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights? Enforcement of Intellectual Property Rights: Infringement of intellectual property rights, Case studies of patents and IP Protection

References:

1. C.R Kothari, "*Research Methodology, Methods & Technique*"; New Age International Publishers, 2004
2. R. Ganesan, "*Research Methodology for Engineers*", MJP Publishers, 2011
3. Y.P. Agarwal, "*Statistical Methods: Concepts, Application and Computation*", Sterling Publs., Pvt., Ltd., New Delhi, 2004.
4. AjitParulekar and Sarita D' Souza, "*Indian Patents Law – Legal & Business Implications*"; Macmillan India ltd , 2006
5. B. L.Wadehra; "*Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications*"; Universal law Publishing Pvt. Ltd., India 2000.
6. P. Narayanan; "*Law of Copyright and Industrial Designs*"; Eastern law House, Delhi 2010

19CE C103

STRUCTURAL DESIGN LAB

Instruction (Practical)	4 Hours per week
Duration of Semester End Examination	0 Hours
Semester End Examination	0 Marks
CIE	50 Marks
Credits	2

Course Objectives: **Course Objectives: To enable the student**

1. Learn the principles of idealization of beam grids and frames for the given plan of a building
2. Know the methods of calculating loads on the building elements
3. Grasp the concepts of Analysis of building frames manually & also using software elements
4. Understand the concepts of design of building elements with a practical approach, and also concepts of grouping the designs.
5. Learn the professional practices of preparing structural drawings with good detailing.

Course Outcomes: At the end of the course, student is able to

1. Idealize beam grids and frames for the given plan of a building
2. Calculate loads on building elements for a given plan
3. Analyse building frames using a manual method and software
4. Design all structural elements of a given building with a practical approach and grouping the design.
5. Prepare structural drawings with good detailing, in a professional way.

Design Project:

Design and Detailed drawing of complete G+ 3 structures: Idealization of beam grid and frames for a given plan – Load calculations and preliminary design – Analysis of frames using software, manual check for atleast one frame – Design of building elements using software – grouping of members – design of typical elements (manually) - detailing of reinforcement for various groups of elements – preparation of structural drawings – introduction to processional practices in drawing.

References:

1. V. L. Shah and V. R. Karve, "*Illustrated Design of Reinforced Concrete Buildings (Design of G+3 Storeyed Buildings + Earthquake Analysis & Design)* ", Assorted Editorial; 8th edition (2017).
2. **SP: 34 (1987),"***Handbook on Concrete Reinforcement and Detailing*", Bureau of Indian Standards.
3. **IS: 456 (2000),"***Plain and Reinforced Concrete - Code of Practice*", Bureau of Indian Standards.
4. **SP: 16** (1978),"Design Aids for Reinforced Concrete to IS 456:1978",*Bureau of Indian Standards*.

19CE C104

ADVANCED CONCRETE LAB

Instruction (Practical)	4 Hours per week
Duration of Semester End Examination	0 Hours
Semester End Examination	0 Marks
CIE	50 Marks
Credits	2

Course Objectives: To enable the student

1. Understand the stress- strain behavior of high strength concretes
2. Assesses the correlation between cube strength cylindrical strengths, split tensile strength and modulus of rupture of concrete
3. Knows the effect of cyclic loading on steel
4. Grasps the various procedures of conducting non-destructive tests on existing concrete members.
5. Understand the behavior of concrete beams under flexural and shear.
6. Understands the behavior of concrete beams under torsion.

Course Outcomes: At the end of the course, student is able to

1. Deduce the stress - strain values for a given high strength concrete and checks its suitability for a purpose.
2. Interpret the correlation between the cube strength, cylindrical strength split tensile strength And modulus of rupture and determines any missing value among these, others being known.
3. Suggest suitable grade and quantity of steel for resisting cyclic loads.
4. Conduct suitable non-destructive test for the condition assessment of existing concrete members
5. Take proper precaution to avoid flexural and shear failures in concrete beams
6. Strengthen the concrete members to resist torsion.

List of Experiments / Assignments:

1. Study of stress - strain curve of high strength concrete
2. Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.
3. Effect of cyclic loading on steel.
4. Non-Destructive testing of existing concrete members.
5. Behavior of Beams under flexure, Shear
6. Torsion

References:

1. A. M. Neville," *Properties of concrete*", 5th Edition, Prentice Hall, 2012
2. M. S. Shetty, "Concrete *technology"*, S. Chand and Co., 2006.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
SCHEME OF INSTRUCTION AND EXAMINATION
ME (STRUCTURAL ENGINEERING)
(With effect from the academic year 2019-20)

SEMESTER – II

S. No.	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	p		CIE	SEE	
THEORY									
1	19CE C105	Finite Element Methods in Structural Engineering	3	0	0	3	30	70	3
2	19CE C106	Structural Dynamics	3	0	0	3	30	70	3
3	Program Specific Elective-III		3	0	0	3	30	70	3
4	Program Specific Elective-IV		3	0	0	3	30	70	3
5	Audit Course-II		2	0	0	2	-	50	Pass/Fail
PRACTICALS									
6	19CE C107	Model Testing Lab	0	0	4	-	50	-	2
7	19CE C108	Numerical Analysis Lab	0	0	4	-	50	-	2
8	19CE C109	Mini Project with Seminar	0	0	4	-	50	-	2
TOTAL			**14**	**0**	**12**	**-**	**270**	**330**	**18**

L: Lecture T: Tutorial P: Practical
CIE - Continuous Internal Evaluation SEE - Semester End Examination

Course Code	Program Specific Elective-III
19CE E106	Advanced Steel Design
19CE E107	Repair and Retrofitting of Structures
19CE E108	Design of High Rise Structures
19CE E109	Design of Masonry Structures

Course Code	Program Specific Elective-IV
19CE E110	Design of Advanced Concrete Structures
19CE E111	Advanced Foundation Engineering
19CE E112	Soil Structure Interaction
19CE E113	Design of Industrial Structures

Audit Course- I and II	
Course Code	Course
19EG A101	English for Research Paper Writing
19CE A101	Disaster Mitigation and Management
19EE A101	Sanskrit for Technical Knowledge
19EC A101	Value Education
19EG A102	Indian Constitution and Fundamental rights
19IT A101	Pedagogy Studies
19EG A103	Stress Management by Yoga
19EG A104	Personality Development through Life Enlightenment Skills

19CE C105

FINITE ELEMENT METHODS IN STRUCTURAL ENGINEERING

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student

1. Learn the fundamentals of Finite element method (FEM) and derive elasticity matrices for 2-D and 3-D elasticity problems.
2. Understand basic principles of minimum potential energy methods and variational formulation of FEM know the stiffness matrix formulations using bar element and analyze simple problems.
3. Understand the FEM formulation using truss, beam, and plane frame elements and analyze simple problems with kinematic indeterminacy not greater than 3.
4. Get familiarized with displacement models, Isoparametric elements and quadrilateral elements and know the formulation of global stiffness matrices.
5. Know the formulation of stiffness matrices for Axi-Symmetric elements, Tetrahedron elements.

Course Outcomes: At the end of the course, student is able to

1. The fundamentals of FEM, elements of theory of elasticity.
2. Principle of minimum potential energy and variation formulation of FEM and analyze simple problems using bar elements.
3. The analysis of trusses beams and rigid jointed plane frames.
4. The formulation of Global stiffness matrix, load matrix and analysis structures using 1st order triangular elements, isoparametric elements, and quadrilateral elements.
5. Application of Axi-Symmetric and Tetra-Hedron elements.

UNIT - I:

Introduction to FEM: General description of the method, brief history of the method, applications of the method, advantages of the finite element method, steps in the finite element method. Types of elements; Types of forces, and Boundary conditions.

Strain displacement, and stress- strain relations for 2-D and 3-D problems. Equations of equilibrium and compatibility conditions for 2-D and 3-D problems. Plane stress and plane strain situations and derivation of elasticity matrices (D).

UNIT - II:

Finite Element Formulation: Principle of minimum potential energy, Principle of virtual displacement, Global coordinate system, local coordinate system, Raleigh Ritz method, Weighted Residual method- Galerkin's method, Boundary value problems- with one element and two elements.

Bar Elements: Shape functions, stiffness matrix for a 2- noded bar element, axial bar subjected to point loads-constant cross section and varying cross section bar.

UNIT - III:

Truss Elements: Transformation matrix, Stiffness matrix of truss member in local and global axis, analysis of trusses with kinematic indeterminacy not exceeding three.

Beam Elements: Shape functions, beam element stiffness matrix, element load vector, and analysis of continuous beams with kinematic indeterminacy not exceeding three.

Plane Frame elements: Element stiffness matrix in local coordinates, Transformation or Rotation matrix, and stiffness matrix and load vector in global coordinates.

UNIT - IV:

Displacement models: Selection of displacement models, geometric invariance, conforming and non-conforming elements.

2-D Triangular Elements (CST) and Rectangular Elements: Determination of strain-displacement matrix, shape functions, determination of element stiffness and load matrices, assembling global stiffness and load matrices. Problems with kinematic indeterminacy not exceeding three.

Iso-parametric elements: Iso-parametric concept, Iso-parametric, Sub parametric and Super parametric elements. Gauss Quadrature of numerical integration.

Quadrilateral elements: Construction of shape functions for 4 noded and 8 noded elements, determination of stiffness matrix, and nodal load matrices for 4-noded quadrilateral element.

UNIT - V:

Axi-symmetric elements: Strain-displacement relationship, stress-strain relationship, determination of stiffness matrix for 3-noded ring element and load matrices for body force and surface traction.

Tetrahedron elements: Volume coordinates, Strain-displacement matrix, and stiffness matrix.

Computer Implementation of FEM procedure, Pre-Processing, Post-Processing. Use of Commercial FEA software.

References:

1. David V. Hutton," *Fundamentals of Finite Element Analysis*", McGraw Hill Education (India) Private Limited, Delhi, 2014.
2. P. N. Godbole," *Introduction to Finite Element Method"*, I. K. International Publishing House Pvt. Ltd. New Delhi, 2013.
3. P. Seshu, "*Finite Element Analysis*", Prentice Hall of India Private Limited, New Delhi, 2010.
4. T. R. Chandrupatla and A. D. Belegundu," *Introduction to Finite Elements in Engineering*", Prentice –Hall of India Private Limited, New Delhi, 2009.
5. Daryl L, Logan, "*A first course in the Finite Element Method*", Third Edition, Thomson Brook, Canada Limited, 2007.
6. R. D. Cook, R.D" *Concepts and Applications of Finite Element Analysis*", John Wiley and sons, 1981.
7. O. C. Zienkiewicz. And R. L. Taylor, "*The Finite Element Method*", Vol.1, McGraw Hill Company Limited, London, 1989.

19CE C106

STRUCTURAL DYNAMICS

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student

1. To make the student understand the importance of structural dynamics and appreciate its practical applications.
2. To make the student learn the process of formulation of equations of motion and generate their solutions.
3. To make the student well versed with modal analysis and make him to develop the response by mode superposition.
4. To make him learn the methods of practical vibration analysis and also generate response considering the system as continuous systems.
5. To make him conversant with the numerical solutions to find the response of dynamic systems.

Course Outcomes: At the end of the course, student is able to

1. The student gains expertise and confidence to tackle field dynamic problems, especially in the field of earthquake and wind engineering.
2. Gets the ability to model any dynamic system and get its response.
3. Can carry out modal analysis and can easily handle any software and can correctly interpret the results.
4. Can effectively use practical vibration analysis methods and obtain the dynamic parameters.
5. Gets the ability to apply numerical methods to get the dynamic response of the systems.

UNIT - I:

Introduction to structural Dynamics – Source of dynamic forces – Rotating machinery, wind and seismic forces, blast loads. **Methods of discretization**: Lumped mass Procedure and Consistent mass procedure.

Single Degree Freedom Systems – Formulation of Equation of Motion: D'Alemberts's Principle, Method of Virtual Work, Hamilton's Principle. Generalized SDOF systems and Rigid Body assemblage. Influence of Gravity Forces and Ground Motion on equation of motion.

UNIT - II:

Single Degree of Freedom System: Response to Free Vibration with and without Damping, Logarithmic decrement. Response to Harmonic loading and impulsive loading. Dynamic magnification factor, phase angle and band width. Response to General Dynamic loading using Duhamel's Integral - Fourier analysis for Periodic Loading.

UNIT - III:

Multiple Degree of Freedom System: Evaluation of structural property matrices – Formulation of MDOF equations of motion – Undamped free vibration – Solution of Eigen value problem for natural frequencies and mode shapes- Analysis of dynamic response- Normal coordinates – Orthogonal properties of normal modes -Uncoupled equations of motion –- Mode super position procedure.

UNIT - IV:

Practical Vibration Analysis: Stodola Method – Fundamental mode analysis, Analysis for second and higher modes. Holtzer Method – basic procedure.

Continuous Systems: Flexural vibrations of beams- Elementary case - Derivation of governing differential equation of motion - Analysis of undamped free vibration of beams in flexure – Natural frequencies and mode shapes of simple beams with different end conditions.

UNIT - V:

Numerical Evaluation of Dynamic Response of linear (SDOF/MDOF) systems: Time stepping methods, Central difference method, Newmarks method and Wilson method.

References:

1. Anil. K. Chopra," *Dynamics of Structures"*, Pearson Education India, 2007.
2. Ray W. Clough, Joseph Penzin," *Dynamics of Structures*", CBS Publishing, 2015.
3. Mario Paz,"*Structural Dynamics: Theory And Computation*", CBS Publishing, 2004.
4. PankajAgarwal and Manish Shrikhande," *Earthquake Resistant Design of Structures"*, PHI, 2006.
5. Biggs," *Introduction to Structural Dynamics*", Mc Graw Hill Education, 2013.

19CE E106

ADVANCED STEEL DESIGN
(ELECTIVE-III)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Note:

1. IS Codes required: IS 800, IS 802, IS 805
2. For all units design philosophy is working stress method

Course Objectives: To enable the student

1. Structural steel is used extensively in the construction of Industrial buildings, bridges, roof trusses, water tanks & transmission line towers.
2. The aim of introducing this course is to provide a student to have ability to perform analysis and design of steel structures with reference to relevant IS codes.

Course Out comes:

1. Students will understand behaviour of structural steel, pressed steel and design philosophies of steel structures.
2. Students will be able to analyze and design of grillage foundation.
3. Students will able to analyze and design of overhead steel and pressed steel water tanks.
4. Students will be able to analyze and design of tubular trusses.
5. Students will be able to analyze and design of bunkers and silos.
6. Students will be able to analyze and design of foundations of Transmission line towers overall arrangements and design of members of Transmission line towers.
7. Students will be able to analyze and design of Beam –Columns subjected to uni-axial and bi-axial bending.

UNIT - I:

Design of Bolted Connections: Rigid & Semi Rigid Connections.

Steel Columns: Effective Length; PM Interaction; Joint Panel Zones

UNIT – II:

Beam Columns: Introduction, Design for Uni-axial and Bi-axial bending as per IS 800: 2007

Grillage Foundations: Introduction, necessity of grillage foundations, various types, Design of Grillage foundations for axial loads under single and double columns by Limit State Method

UNIT - III:

Steel Tanks: Introduction, Types, loads, permissible stresses - detailed design of elevated rectangular mild steel and pressed steel tanks including staging by working stress method

UNIT - IV:

Bunkers and Silos: introduction - general design principles- design theories - Janssen's Theory and Airy's Theory - Detailed design of bunkers and silos.

UNIT - V:

Transmission Line Towers: Classification, economical spacing and design loads - IS code provisions - Calculation of wind loads and permissible stresses - Overall arrangement and design procedure - Detailed design including foundations.

References:

1. B.C. Punmia by "*Design of Steel Structures*" Laxmi Pub. – 2015.
2. P. Dayaratnam by "*Design of Steel Structures*" S Chand Publications, 2012.
3. I.C. Syal and S. Singh, by "*Design of Steel Structures*", Standard Pub. -2009.
4. Ram Chandra, by "*Design of Steel Structures"*, Scientific Publishers, 2010.

19CE E108

DESIGN OF HIGH RISE STRUCTURES (ELECTIVE-III)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student

1. The student should learn and get a deep insight into various structural systems used for tall buildings
2. The student should get the ability to estimate the lateral forces ,both wind and seismic forces, including dynamic effects on tall buildings using the provisions of IS codes IS:875 Part-3:2015 and IS 1893 (Part 1) : 2016
3. The student should learn the special problems posed by tall buildings like differential shortening of columns, floor leveling problems etc. He should also have a clear understanding of ductility requirements to resist earthquake loads.
4. The student should learn the design considerations and stability checks of steel chimneys.
5. The student shall learn the loadings and design procedures of transmission line towers.

Course Outcomes: The students learns

1. Various structural systems usually considered for the functional design of the tall buildings
2. Various methods of calculation lateral forces (both wind forces and seismic/ earth quake forces) on the tall buildings
3. The provisions of relevant IS codes (IS:875 - Part-3, IS:1893 - Part-1) in calculating the lateral forces mentioned above, on tall buildings
4. Various structural systems for RCC and steel buildings, differential shortening of columns, panel zone effects, second order effects of gravity loading, floor levelling problems and P – Delta Analysis.
5. Design aspects of RCC chimneys and steel transmission line towers.

UNIT- I:

Introduction to Tall Buildings: Design Principles for Lateral Load resistance, ductility considerations in earthquake resistant design of concrete buildings, construction methods, choice of materials, cladding systems and their design principles, types of foundations for tall buildings.

Wind Loads on Tall Buildings: Introduction to wind, characteristics of wind, Computation of wind loads on buildings as per IS code methods, Wind Tunnel testing, Introduction to Computational Fluid Dynamics.

UNIT-II:

Seismic Loads On Tall Buildings: Introduction to Earthquakes, Characteristics of Earthquake, Computation of seismic loads on tall buildings – Response Spectrum Method, , Vibration Control – active control & passive control, Liquefaction effects of earthquake, Introduction to Time history Analysis and Pushover analysis.

UNIT – III:

Structural systems for Tall Buildings : Necessity of special structural systems for tall buildings, Structural Systems for **Steel Buildings -**Braced frames, Staggered Truss System, Eccentric Bracing System, Outrigger & Belt truss system, Tube Systems**;** Structural Systems for Concrete Buildings - shear walls, frame tube structures, bundled tube structures**;** Design of shear wall as per IS code.

Special Topics in Tall Buildings:

Second order effects of gravity loading, Creep and shrinkage in columns, Differential shortening of columns, Floor levelling problems, Panel zone effects, P-Delta analysis.

UNIT – IV:

RCC Chimneys : Introduction, parts of an RCC chimney, design factors, stresses in RC shafts due to self weight and wind loads, stresses in horizontal reinforcement due to shear force, stresses due to temperature difference, design of RCC chimney, design of reinforcements in chimneys using charts, dynamic loads effects on RCC chimneys.

UNIT – V:

Transmission Line Towers: Classification, economical spacing and design loads - IS code provisions - Calculation of wind loads and permissible stresses - Overall arrangement and design procedure - Detailed design including foundations.

References:

1. B. S. Taranath , "*Reinforced Concrete Design of Tall Buildings*", McGraw-Hill Book Company, 2010.
2. E. Simlu, "*Wind Effect on Structures: An Introduction to Wind Engineering*", Wile& Sons, 1986.
3. M. Fintel, "*Hand Book of Concrete Engineering*", Von Nostrand, 2004.
4. Emilio Rosenblueth, "*Design of Earthquake Resistant Structures*", Pentech Press Ltd., 1990.
5. W. Schuellar, "*High Rise Building Structures"* , John Wiley & Sons Inc, 1977.
6. Bryan Stafford Smith & Alex Coull, "*Tall Building Structures: Analysis & Design*", Wiley India Pvt Ltd, 1991.
7. Lynn S. Beedle, "*Advances in Tall Buildings*", CBS Publishers and Distributors Delhi, 1996.

19CE E109

DESIGN OF MASONRY STRUCTURES (ELECTIVE-III)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student to understand the fundamental concepts of

1. Masonry materials and its mechanical properties.
2. Analysis and the behavior of structural masonry
3. Shear and flexural behavior of Reinforced and unreinforced masonry
4. Summarize construction practices, seismic behavior, specifications , for Design of masonry
5. Seismic evaluation and Retrofit of Masonry.

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

1. Select appropriate masonry unit and mortar mixes for masonry construction.
2. Distinguish from a wide range of materials for their suitability to arrive at feasible and optimal solutions for masonry constructions.
3. Apply knowledge of structural masonry for advanced research and construction procedures.
4. Justify the design of masonry buildings for sustainable development.
5. Repair and strengthen the existing masonry structures for seismic loads

UNIT - I:

Introduction - Masonry construction - National and International perspective – Historical development, Modern masonry, Principles of masonry design, Masonry standards: IS 1905 and others.

Material Properties - Masonry units: clay and concrete blocks, Mortar, grout and reinforcement, Bonding patterns, Shrinkage and differential movements.

UNIT - II:

Masonry in Compression - Prism strength, Eccentric loading, Kern distance. Masonry under Lateral loads - In-plane and out-of-plane loads, Analysis of perforated shear walls, Lateral force distribution -flexible and rigid diaphragms.

UNIT - III:
Behaviour of Masonry - Shear and flexure - Combined bending and axial loads - Reinforced and unreinforced masonry - Cyclic loading and ductility of shear walls for seismic design – Infill masonry.

UNIT - IV:
Structural design of Masonry - Working and Ultimate strength design - In-plane and out-of-plane design criteria for load-bearing and infills, connecting elements and ties - Consideration of seismic loads - Code provisions.

UNIT - V:
Seismic evaluation and Retrofit of Masonry - In-situ and non-destructive tests for masonry - properties - Repair and strengthening of existing masonry - structures for seismic loads.

References:

1. P. Dayaratnam and P. Sarah, "*Brick and Reinforced Brick Structures*", Oxford & IBH Publishing Co, 2017.
2. R. G. Drysdale, A. H. Hamid and L. R. Baker, "*Masonry Structures: Behaviour & Design*", Prentice Hall Hendry,1994.
3. A.W. Hendry, B.P. Sinha and S. R. Davis, "*Design of Masonry Structures*", E & FN Spon, UK, 1997.
4. S. Sahlin, "*Structural Masonry*", Prentice Hall, Englewood Cliffs, NJ, 1971.
5. R.S. Schneider and W.L. Dickey, "*Reinforced Masonry Design*", Prentice Hall, 3rd edition, 1994.

19CE E110

DESIGN OF ADVANCED CONCRETE STRUCTURES (ELECTIVE-IV)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course objectives: To enable the student

1. To make the students effectively analyse and design Curved and Deep Beams.
2. To enable the students understand the nuances of internal stresses and design of Domes, and thoroughly learn the analysis and design procedures for bunkers and silos.
3. To make the student attain the detailed knowledge to understand the performance of flat slabs and design them by both DDM and EFM.
4. To make the students understand the structural behaviour Raft, Pile and Machine foundations and be able to design them.
5. To make them understand and appreciate the importance of ductile detailing. The student should also be able to design solid shear walls.

Course out Comes: Upon the completion of this course, the student should be able to

1. Analyse and Design curved and deep beam as per the field requirements.
2. be able to find the stresses in domes for various loads and design them.
3. With the thorough knowledge acquired during the course, the student is able to analyzeand design Bunkers and Silos with ease.
4. be able to assess the structural behaviour of Raft, Pile and Machine foundations and design them.
5. Gets reasonable expertise to implement ductile detailing and also design solid shear walls.

UNIT – I:
Beams curved in plan: Introduction – Design Principles – Structural Design of beams circular and semi-circular in plan, continuously and symmetrically supported, rectangular in cross-section.
Deep Beams: Introduction – flexural and shear stresses in deep beams. – I.S. Code provisions – design of simply supported and continuous Deep beams.

UNIT - II:

Domes: Introduction - Stresses and forces in domes - design of spherical and conical domes.

Bunkers and Silos: Introduction - Design principles and theories - IS Code provision - design of rectangular bunkers - design of cylindrical soils.

UNIT – III:

Flat Slabs: Introduction, components, IS code provisions, Design Methods, design for flexure and shear

UNIT – IV:

Pile foundations: Structural design of piles and pile caps.

Raft Foundations: Definitions, Types – Design of Raft foundation, flat plate type and beam-slab type for buildings with column grids up to five by five.

UNIT - V:

Ductile Detailing: Ductile detailing of RCC beams and columns using IS: 13920 -1993 code

Design of Shear Walls: Design and Detailing of Shear Walls considering shear wall-frame interaction in a tall RC structure subjected to seismic loading.

References:

1. N.KrishnaRaju," *Advanced Reinforced Concrete Design*", CBS Publishers, 2005.
2. H.J. Shah, "*Reinforced Concrete*", Charotar Publishers, 2014.
3. P.C.Varghese, "*Advanced Reinforced Concrete Design*", PHI, 2005
4. B.C.Punmia, Ashok Kumar Jain," *Comprehensive R.C.C. Designs*", Laxmi Pub. 2005.

19CE E111

ADVANCED FOUNDATION ENGINEERING (ELECTIVE-IV)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Outcomes: To enable the student to

1. Deal with field problems.
2. Understand the principle and evaluate bearing capacity and settlements of shallow foundations.
3. Understand the principles and design of pile foundations.
4. Understand the analysis of well foundations and design of well foundations.
5. Understand the concept of coffer dams and sheet piles.

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

1. Decide the sustainability of soil strata for different projects.
2. Design shallow foundations by deciding the bearing capacity of Soil.
3. Analyze and design the pile foundation.
4. Understand analysis methods and design for well foundation.
5. Interpret and implement the concepts of coffer dams and sheet piles.

UNIT - I:

Soil exploration: Planning of Soil Exploration for different Projects, Methods of Subsurface exploration, Methods of boring along with various penetration tests.

UNIT - II:

Shallow Foundation: Requirements for satisfactory performance of foundations, Methods of Estimating bearing capacity by Terzaghi's, Meyerhof, Hansen's, IS code theories and plate load test, settlements of footings, proportioning of footings using field test data.

UNIT - III:

Pile Foundations: Estimation of load carrying capacity of single and pile group under various loading conditions by Static, Dynamic methods and pile load test, settlement of pile foundation, code provisions, design of single pile and pile groups, Negative skin friction.

UNIT - IV:

Well Foundations: Types, components, construction methods, design methods (IS and IRC) approaches, check for stability, base pressure, side pressure and deflection, Elastic theory and ultimate Resistance methods.

UNIT - V:

Coffer Dams, various types, construction methods of various types of coffer dams, analysis and design of flexible sheet piles for cohesive and cohesion less soils, Open cuts, sheeting and bracing systems in shallow and deep open cuts in different soil types.

References:

1. N. P.Kurian," *Design of Foundation System"*, Narosa Publishing House, 2006.
2. J. E. Bowles," *Foundation Analysis and Design*, Tata McGraw Hill Newyork, 2017.
3. Swami Saran, "*Analysis and Design of Substructures*", Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi, 2008.
4. Braja M Das," *Principles of foundation engineering*", **Cengage** India Private Ltd., 2017.

19CE E112

SOIL STRUCTURE INTERACTION
(ELECTIVE-IV)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student

1. To understand the soil behaviour and scope of its interaction analysis with the elastic structure.
2. To understand the interaction analysis between the soil-structure with reference to relative stiffness of beams under different loading conditions.
3. To understand the analysis of infinite and Winkler shapes of plates and numerical solutions for finite plates.
4. To understand the solutions for settlement and load distribution behaviour of pile or pile groups.
5. To understand the behaviour of laterally loaded piles.

Course Outcomes: At the end of the course, student is able to

1. Analyse soil behaviour.
2. Analyse the interaction between soil structures with reference to relative stiffness of beams under different loading conditions.
3. Analyse infinite and Winkler plate and numerical solutions for finite plates.
4. Give theoretical solutions for settlement and load distribution of pile and pile group.
5. Predict load deflection for laterally loaded piles and its subgrade reaction and give solutions with influence charts.

UNIT - I:

Soil-Foundation Interaction: Introduction to soil - Foundation interaction problems, Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil-foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behaviour, Time dependent behaviour.

UNIT - II:

Beam On Elastic Foundation - Soil Models: Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.

UNIT - III:

Plate On Elastic Medium: Infinite plate, Winkler, Two parameters, Isotropic elastic medium, Thin and thick plates, Analysis of finite plates, rectangular and circular plates, Numerical analysis of finite plates, simple solutions.

UNIT - IV:

Elastic Analysis Of Pile: Elastic analysis of single pile, Theoretical solutions for settlement and load
distribution, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.

UNIT - V:

Laterally Loaded Pile: Load deflection prediction for laterally loaded piles, subgrade reaction and elastic analysis, Interaction analysis, and pile raft system, solutions through influence charts.

References:

1. J. A. Hemsley, "*Elastic Analysis of Raft Foundations*", Thomas Telford, 1998.
2. D. F. McCarthy, "*Essentials of Soil Mechanics and Foundations, basic geotechnics*", Prentice Hall, 2002.
3. H. G. Poulos,and E. H. Davis., "*Pile Foundation Analysis and Design*", John Wiley, 1980.
4. A. P. S. Selvadurai, "*Elastic Analysis of Soil Foundation Interaction*", Elsevier, 2015.
5. H. G. Poulos, and E. H. Davis, "*Pile Foundation Analysis and Design*", John Wiley, 1980.
6. R. F. Scott, "*Foundation Analysis*", Prentice Hall, 1981.
7. Structure Soil Interaction - State of Art Report, *Institution of structural Engineers*, 1978. ACI 336,

19CE E113

DESIGN OF INDUSTRIAL STRUCTURES
(ELECTIVE-IV)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student

1. To impart a broad knowledge in load calculations for gantry girders and detailed design of gantry girder cross section.
2. To make the student well versed with the loading theories and design procedures in bunkers and silos.
3. The student should know about various accessories of steel chimneys and get thorough knowledge in the design and stability aspects.
4. The student should know the advantages of cold formed sections and the problems associated with them. A thorough knowledge
5. Will be imparted in the design of beams made out of cold formed sections.
6. The student will be made to learn the fire models, fire engineering design of steel structures and mechanical properties of steel at elevated temperatures. A detailed knowledge about Fireresistance and fire performance assessment for steel will be imparted.

Course Outcomes:

1. The student gets the ability to compute design loads and design Steel Gantry Girders for various complex situations.
2. The student can analyze and design bunkers and silos and can effectively get them executed with the knowledge acquired during the course.
3. The student, with his sound knowledge acquired, can proportion various accessories of steel chimneys and be able to design chimneys along with foundations.
4. The student gets clear understanding of cold formed sections and the related difficulties and problems. He gets the ability to design various structural components using cold formed sections.
5. The student is conversant with the fire effects on structures and has sound knowledge in fire models, fire engineering design
6. Steel structures and mechanical properties of steel at elevated temperatures.

UNIT - I:

Steel Gantry Girders – Introduction, loads acting on gantry girder, permissible stress, types of gantry girders and crane rails, crane data, maximum moments and shears, construction detail, design procedure.

UNIT - II:

Bunkers and Silos: introduction - general design principles- design theories - Janssen's Theory and Airy's Theory - Detailed design of bunkers and silos as per IS 9178 – Part I & II.

UNIT - III:

Steel Chimneys: Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation.

UNIT-IV:

Design of Cold Formed Sections : Introduction to cold formed structures, advantages, stiffened and un stiffened elements, local buckling and post buckling strength, shear lag and flange curling, unusually wide flange section, short span sections, members subjected to axial tension, compression and bending, design of beams and columns. Use of cold formed sections in pre - engineered Buildings.

UNIT – V:

Fire Resistant Design: Introduction, design curves and fire models, fire engineering design of steel structures – calculation approach, Calculation of temperature rise in steel members, mechanical properties of steel at elevated temperatures, time to reach limiting temperature, passive protection for steel work, fire resistance and fire performance assessment for steel.

References:

1. B. C. Punmia , Jain Ashok Kr., Jain Arun Kr, "*Design of Steel Structure*", Lakshmi Publishers,2015.
2. Ram Chandra," *Design of Steel Structures*", Standard Publishers,2009.
3. Subramanian," *Design of Steel Structures*", Oxford University Press, 2016.
4. G. J. Hancock, T. M. Murray and D. S. Ellifritt," *Cold – formed steel structures to the AISC Specification*", Marcel Dekker, Inc. New York.
5. B. Davison and G. W. Owens,"*Steel designers manual", the steel construction institute"*, Wiley Blackwell , 2016

19CE C107

MODEL TESTING LAB

Instruction (Practical)	4 Hours per week
Duration of Semester End Examination	0 Hours
Semester End Examination	0 Marks
CIE	50 Marks
Credits	2

Course Objectives: To enable the student to

1. Understand the evaluation process of dynamic response of a building model using shake table / mini shake table
2. Learn to compute the response of building models to wind loads, using wind tunnel set up.
3. Know the pattern of deflection and cracking in RC slab elements and portal frames under gravity loading.
4. Learn to estimate natural frequencies and mode shapes of a beam.
5. Understands the use of Piezo electric sensors in the determination of vibration characteristics of a beam

Course Outcomes: At the end of the course, student is able to

1. Evaluate the dynamic response of a building model using shake table / mini shake table set up.
2. Evaluate the response of building models under wind loads, using wind tunnel setup.
3. Determine the pattern of deflection and cracks in RC slab elements and portal frames, under static loading.
4. Estimate the natural frequencies and mode shapes of a beam.
5. Use Piezoelectric sensor for the determination of vibration characteristics of a beam.

List of Experiments:

1. Evaluation of dynamic response of building model using shake table set up.
2. Evaluation of response of building models subjected to wind loads using wind tunnel set up.
3. Deflections and crack pattern study of RC slab elements subjected to static loading.
4. Deflections and crack patterns in portal frame subjected to gravity loading.
5. Estimation of natural frequencies and mode shapes of a beam.
6. Demonstration of use of Piezoelectric Sensors for the determination of Vibration Characteristics of a beam

19MT L101

NUMERICAL ANALYSIS LAB

Instruction (Practical)	4 Hours per week
Duration of Semester End Examination	0 Hours
Semester End Examination	0 Marks
CIE	50 Marks
Credits	2

Course Objectives: To enable the student

1. Find Roots of non-linear equations by Bisection method and Newton's method.
2. Do curve fitting by least square approximations
3. Solve the system of Linear Equations using Gauss - Elimination/ Gauss - Seidal Iteration/ Gauss - Jordan Method
4. To Integrate Numerically Using Trapezoidal and Simpson's Rules
5. To Find Numerical Solution of Ordinary Differential Equations by Euler's Method, Runge- Kutta Method.
6. Apply computational methods in engineering using MAT Lab program

Course Outcomes: At the end of the course, student is able to

1. To find roots of non linear equations by using numerical methods
2. To know how to fit the given data in different curves
3. To know how to solve system of linear equations by using direct and indirect methods
4. To know how to integrate by using numerical methods
5. To find solution of first order ODE by numerical methods
6. To know how to apply computational methods in engineering by using MAT Lab program

List of Programmes

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

References:

1. RudraPratap," *Getting started with MATLAB: A quick Introduction for Scientists and Engineers*", Oxford University press, 2010.
2. Grewal B. S," *Numerical Methods in Engineering and Science with Programs in C, C++ & MATLAB*", Khanna Publishers 2014.
3. Dukkipati Rao V, "*Applied Numerical Methods using MATLA"*, New Age International Pvt. Ltd. Publishers, 2011.

19CE C109

MINI PROJECT with SEMINAR

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Outcomes: Students are able to

1. Formulate a specific problem and give solution.
2. Develop model/models either theoretical/practical/numerical form.
3. Solve, interpret/correlate the results and discussions.
4. Conclude the results obtained.
5. Write the documentation in standard format.

Guidelines:

- As part of the curriculum in the II- semester of the programme each students shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
- Each student will be allotted to a faculty supervisor for mentoring.
- Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
- Mini projects shall have inter disciplinary/ industry relevance.
- The students can select a mathematical modeling based/Experimental investigations or Numerical modeling.
- All the investigations are clearly stated and documented with the reasons/explanations.
- The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and references.

Department committee: Supervisor and two faculty coordinators

Guidelines for awarding marks (CIE): Max. Marks: 50

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
Supervisor	20	Progress and Review
	05	Report
Department Committee	05	Relevance of the Topic
	05	PPT Preparation
	05	Presentation
	05	Question and Answers
	05	Report Preparation

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
SCHEME OF INSTRUCTION AND EXAMINATION
ME (STRUCTURAL ENGINEERING)

(With effect from the academic year 2020-21)

SEMESTER – III

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	p		CIE	SEE	
THEORY									
1	Program Specific Elective- V		3	0	0	3	30	70	3
2	Open Elective		3	0	0	3	30	70	3
PRACTICALS									
3	19CE C110	Dissertation Phase- I	0	0	20	-	100	-	10
TOTAL			**6**	**0**	**20**	**-**	**160**	**140**	**16**

L: Lecture T: Tutorial P: Practical

CIE - Continuous Internal Evaluation SEE - Semester End Examination

Course Code	Program Specific Elective-V
19CE E114	Design of Prestressed Concrete Structures
19CE E115	Design of Bridges
19CE E116	Fracture Mechanics of Concrete Structures
19CE E117	Design of Plates and Shells

	OPEN ELECTIVES
Course Code	**Course**
19CS O101	Business Analytics
19ME O101	Industrial Safety
19ME O102	Introduction to Optimization Techniques
19CE O101	Cost Management of Engineering Projects
19ME O103	Composite Materials
19EE O103	Waste to Energy

19CE E114

DESIGN OF PRE-STRESSED CONCRETE STRUCTURES (ELECTIVE-V)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student to understand the basics of

1. Elements of prestressed concrete and systems of prestressing
2. Various Losses and their estimation in pre stressed concrete
3. Analysis and design of section for flexure and shear
4. Analysis and transfer of pre stress through end blocks
5. Analyze pre stressed slab and Partial pre stressing – principles

Course Outcomes: At the end of the course, student is able to

1. Understand the basic aspects of pre stressed concrete fundamentals, and calculate losses in the pre stressed concrete.
2. Analyse and design pre stressed concrete beam/girders.
3. Design pre stressed concrete end blocks and understand the mechanism of anchorage zones.
4. Analyse and Design continuous prestressed beams members.
5. Analyse and design slabs with partial and full pre stressing, and also analyse the crack formations rationally

UNIT – I:

Introduction to pre stressed concrete: types of pre stressing, systems and devices, materials, losses in pre stressed. Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, code provisions.

UNIT – II:

Statically determinate PSC beams: design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions.

UNIT – III:

Transmission of Prestress in Pretensioned members; Anchorage zone stresses for post tensioned members.

UNIT – IV:

Statically indeterminate structures - Analysis and design - continuous beams and frames, choice of cable profile, linear transformation and concordancy.

UNIT – V:

Composite construction: with precast PSC beams and cast in-situ RC slab - Analysis and design, creep and shrinkage effects. Partial pre stressing - principles, analysis and design concepts, crack- width calculations

References:

1. T. Y. Lin, "*Design of Prestressed Concrete Structures*", Asia Publishing House,2010.
2. N. Krishnaraju, "*Prestressed Concrete*", Tata McGraw Hill, New Delhi,2018.
3. Y. Guyan, "*Limit State Design of Pre stressed Concrete*",., Applied Science Publishers,1972.
4. IS: 1343- Code of Practice for Prestressed Concrete
5. IRC: 112

19CE E115

DESIGN OF BRIDGES
(ELECTIVE-V)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To impart the knowledge in various design principles of Bridge Engineering,

1. The student should be able to design simple bridges individually and be effective contributor in design groups while working on large projects.
2. To make the student conversant with the latest developments in the field of bridge engineering.
3. The student should have a fair familiarity with Indian codes and codes of other countries.

Course Outcomes:

1. Attains ability to design slab and T beam bridges and gets well versed with lateral load distribution for T girders.
2. Acquires sound knowledge about various structural actions of box girder bridges . He also gets the ability to analyse box girders
3. Using some approximate methods and design single cell box girder bridges.
4. Gets thorough knowledge in Railway loadings and can design both Plate girder and Truss girder bridges with ease and efficiency.
5. The student gets comprehensive idea about long span flexible bridges and the problems associated with them. He gets to know the
6. Wind effects and the importance of aerodynamic stability. He also will be able to design elastomeric bearings for bridges.
7. The student gets a clear understanding of bridge foundations and also acquires knowledge about various construction techniques.

UNIT – I:

Introduction: Types of bridges – Materials of construction, Planning and layout, Hydraulic design, Provisions of IRC-6 and IRC-21, Design of slab bridges, Design of T-girder bridges, Lateral load distribution in T-beam slab bridges – Courbon's method, Guyon Massenet method – Design of slabs subjected to concentration loads using Pigeaud's curves.

UNIT – II:

Box girder bridges – various structural actions, Methods of analysis, Beams on elastic foundation method, grillage method and space frame analysis, Shear lag and Edge stiffing effects – Provisions of IRC-18 and IRC-21, Design of simply supported single cell PSC box girder bridge.

UNIT – III:

Steel bridges and composite bridges - Bridge rules and Bridge code of RDSO, Truss girder steel railway bridges – Design of stringer beams, cross girders and truss system, Wind load effects Design of composite bridges as per IRC-22

UNIT – IV:

Long span flexible bridges – suspension bridges and cable stayed bridges – stiffening girders and stress, towers, cables – Importance of wind and aerodynamic stability. Bearings – Types of bearing, Design of elastomeric bearings

UNIT – V:

Sub structure – Piers and towers – Types of forces, Stability analysis of solid type piers, Types of bridge foundations and their design principles, Construction techniques – Cast in-situ, Prefabricated, Incremental launching and Free cantilever construction techniques.

References:

1. Wai-Fah Chen LianDuan , "*Bridge Engineering Handbook*",, CRC Press, USA, 2000
2. R. M. Barker and J. A. Puckett, John Wiley & Sons, "*Design of Highway Bridges*", New York, 1997
3. P. P. Xanthakos, John Wiley & Sons, "*Theory and Design of Bridges*", New York, 1994
4. Raja Gopalan, "*Bridge Superstructure"* – Narosa Publishing – 2010.
5. N. KrishnamRaju, "*Design of Bridges"* Oxford and IBH Publishing – 2010.
6. Johnson Victor, "*Essentials of Bridge Engineering*", Oxford & IBH Publishers, Sixth edition 2018.

19CE E116

FRACTURE MECHANICS OF CONCRETE STRUCTURES (ELECTIVE-V)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objective:

1. To make the students understand the mechanisms of failure and non-linear fracture mechanics.
2. To impart knowledge on prediction, prevention and control of fracture in structural components with different materials.
3. To make the students know the background for damage tolerant design and various models

Course Outcomes: At the end of the course students will be able:

1. To predict the effects of crack like defects on the performance of civil engineering structures.
2. To employ modern numerical methods to determine critical crack sizes and fatigue crack propagation rates in engineering structures.
3. To know the behavior of concrete subjected to tension and compression failure
4. To select appropriate materials for engineering structures to insure damage tolerance.
5. To analyse the CTOD and CMD problems using various models

UNIT-I:

Fracture mechanics principles: Introduction and historical review, Sources of micro and macro cracks. Mechanisms of fracture and crack growth- Fracture mechanics approach to design - NDT and Various NDT methods used in fracture mechanics.

UNIT-II:

Plasticity effects: Plastic zone at crack tip - Irwin plastic zone correction-shape of the plastic zone- Dugdale's approach for size of the crack tip - Determination of Stress intensity factors - Cleavage fracture, ductile fracture, fatigue cracking, Environment assisted cracking, Quasi brittle materials.

UNIT-III:

Criteria for crack growth: crack resistance (R curves), compliance, J Integral, nonlinear analysis, Review of concrete behaviour in tension and compression, Basic frameworks for modelling of quasi-brittle materials.

UNIT-IV:

Nonlinear Fracture Mechanics: Discrete crack concept/Smeared crack concept, Size effect, Plasticity models for concrete – Associated and non-associated flow, Failure surfaces for quasi-brittle materials.

UNIT-V:

Concept of CTOD and CMD: Material models, crack models, band models, and models based on continuum damage mechanics - Principles of crack arrest - Crack arrest in practice - FRC.

References:

1. David Broek, "*Elementary Engineering Fracture Mechanics*", Springer Netherlands,2011
2. SurendraP.Shah, Stuart E.Swartz, ChengshengOuyang, "*Fracture Mechanics of Concrete: Applications of Fracture Mechanics to Concrete, Rock, and other Quasi-Brittle Materials*", John Wiley & Sons, 1995.
3. Karen Hellan , "*Introduction to fracture mechanics*" , McGraw Hill, 2nd Edition
4. S.A. Meguid , "*Engineering fracture mechanics*" Elsevier Applied Science, 1989
5. "*Fracture mechanics of concrete structures – Theory and applications – Rilem Report*" – Edited by L. Elfgreen – Chapman and Hall – 1989.
6. "*Fracture mechanics – applications to concrete*" – Edited by Victor, C. Li, & Z.P. Bazant – ACI SP 118.
7. S. Valliappan, "*Continuum Mechanics Fundamentals*", Oxford IBH, N D. New Delhi, 1982.

19CE E117

DESIGN OF PLATES AND SHELLS
(ELECTIVE-V)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student

1. To understand the structural behavior of theory shells & folded plates
2. To grasp the concept of designing shells with double curvature
3. To gain insight into the design of cylindrical shells
4. To comprehend the philosophy of designing hyperbolic paraboloid shells
5. To understand the analysis and design of folded plates

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

1. Analyze the thin shells and folded plates with the knowledge of their behavior
2. Design the shells with double curvature
3. Design the cylindrical shells
4. Design the hyperbolic paraboloid shells
5. Analyze and design folded plates

UNIT – I:

Introduction: Structural behavior of thin shells and folded plates – membrane theory of shells – classification of shells, translation and rotational shells, ruled surfaces, methods of generating the surface of different shells like hyperboloid, elliptic paraboloid, conical.

UNIT – II:

Design of shells with double curvature: Design of the following types of shells, spherical shell, conical shell, parabolic and ellipsoid, cooling towers

UNIT – III:

Design of Cylindrical shells: Design of Cylindrical shell with edge beam using theory for long shells

UNIT – IV:

Design of hyperbolic Paraboloid: Surface definition, determination of forces, forces with the edge members

UNIT – V:

Design of folded plate roofs: Assumptions in the analysis of folded plates, design of folded plates, theory of bending of thin plates with lateral loads and in plane loads scheme for de-shuttering.

References:

1. G. S. Ramaswamy, *"Design and constructions of concrete shell Roofs"* – CBS Publishers and distributors – New Delhi – 1986.
2. B. K. Chatterjee, "*Theory and Design of Concrete Shell*", - Chapman & Hall, Newyork, 3rd Edition 1988
3. J. N. Bandhopadhyay, *"Thin Shell Structures"*, Classical and Modern Analysis" New Age International Publishers – New Delhi, 1986.

19CS O101

BUSINESS ANALYTICS
(OPEN ELECTIVE – Common to All Branches)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	

Course Objectives: The main objectives of this course are to

1. Understanding the basic concepts of business analytics and applications
2. Study various business analytics methods including predictive, prescriptive and prescriptive analytics
3. Prepare the students to model business data using various data mining, decision making methods

Course Outcomes: After completion of the course, students will be able

1. To understand the basic concepts of business analytics
2. Identify the application of business analytics and use tools to analyze business data
3. Become familiar with various metrics, measures used in business analytics
4. Illustrate various descriptive, predictive and prescriptive methods and techniques
5. Model the business data using various business analytical methods and techniques

Unit-I:

Introduction to Business Analytics: Introduction to Business Analytics, need and science of data driven (DD) decision making, Descriptive, predictive, prescriptive analytics and techniques, Big data analytics, Web and Social media analytics, Machine Learning algorithms, framework for decision making, challenges in DD decision making and future.

Unit-II:

Descriptive Analytics: Introduction, data types and scales, types of measurement scales, population and samples, measures of central tendency, percentile, decile and quadrille, measures of variation, measures of shape-skewness, data visualization

Unit-III:

Forecasting Techniques: Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt's method, Holt-Winter model, Croston's forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil's coefficient

Unit-IV:

Decision Trees: CHAID, Classification and Regression tree, splitting criteria, Ensemble and method and random forest. **Clustering**: Distance and similarity measures used in clustering, Clustering algorithms, K-Means and Hierarchical algorithms, **Prescriptive Analytics**- Linear Programming(LP) and LP model building,

Unit-V:

Six Sigma: Introduction, introduction, origin, 3-Sigma Vs Six-Sigma process, cost of poor quality, sigma score, industry applications, six sigma measures, DPMO, yield, sigma score, DMAIC methodology, Six Sigma toolbox

References:

1. U Dinesh Kumar, "*Data Analytics*", Wiley Publications, 1st Edition, 2017
2. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, "*Business analytics Principles, Concepts, and Applications with SAS*", Associate Publishers, 2015
3. S. Christian Albright, Wayne L. Winston, "*Business Analytics - Data Analysis and Decision Making*", 5th Edition, Cengage, 2015

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18-mg11/preview
2. https://nptel.ac.in/courses/110105089/

19ME O101

INDUSTRIAL SAFETY
(OPEN ELECTIVE – Common to All Branches)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Objectives: The students will be able to understand

1. Causes for industrial accidents and preventive steps to be taken.
2. Fundamental concepts of Maintenance Engineering.
3. About wear and corrosion along with preventive steps to be taken
4. The basic concepts and importance of fault tracing.
5. The steps involved in carrying out periodic and preventive maintenance of various equipment's used in industry

Outcomes: At the end of the course the students will be able to

1. Identify the causes for industrial accidents and suggest preventive measures.
2. Identify the basic tools and requirements of different maintenance procedures.
3. Apply different techniques to reduce and prevent Wear and corrosion in Industry.
4. Identify different types of faults present in various equipment's like machine tools, IC Engines, boilers etc.
5. Apply periodic and preventive maintenance techniques as required for industrial equipment's like motors, pumps and air compressors and machine tools etc.

UNIT – I:

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes, Fire prevention and firefighting, equipment and methods.

UNIT – II:

Fundamentals of Maintenance Engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for

maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT – III:

Wear and Corrosion and their Prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications of Screw down grease cup, Pressure grease gun, Splash lubrication, Gravity lubrication, Wick feed lubrication, Side feed lubrication, Ring lubrication, Definition of corrosion, principle and factors affecting the corrosion, Types of corrosion, corrosion prevention methods.

UNIT–IV:

Fault Tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, any one machine tool, Pump, Air compressor, Internal combustion engine, Boiler, Electrical motors, Types of faults in machine tools and their general causes.

UNIT – V:

Periodic and Preventive Maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of Machine tools, Pumps, Air compressors, Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

References:

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

19ME O102

INTRODUCTION TO OPTIMIZATION TECHNIQUES
(OPEN ELECTIVE – Common to All Branches)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Objectives: The students will

1. Come to know the formulation of LPP models
2. Understand the Transportation and Assignment techniques
3. Come to know the procedure of Project Management along with CPM and PERT techniques
4. Understand the concepts of queuing theory and inventory models
5. Understand sequencing techniques

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

1. Formulate a linear programming problems (LPP)
2. Build and solve Transportation Models and Assignment Models.
3. Apply project management techniques like CPM and PERT to plan and execute project successfully
4. Apply queuing and inventory concepts in industrial applications
5. Apply sequencing models in industries

UNIT – I:

Operations Research: Definition, scope, Models, Linear programming problems (LPP), Formulation, Graphical Method, and Simplex Method

UNIT – II:

Transportation Models: Finding an initial feasible solution - North West Corner Method, Least Cost Method, Vogel's Approximation Method, Finding the optimal solution, Special cases in Transportation problems - Unbalanced Transportation problem, Degeneracy in Transportation, Profit Maximization in Transportation.

UNIT – III:

Project Management: Definition, Procedure and Objectives of Project Management, Differences between PERT and CPM, Rules for drawing Network diagram, Scheduling the activities, Fulkerson's rule, Earliest and Latest times, Determination of ES and EF times in forward path, LS & LF times in backward path, Determination of critical path, duration of the project, Free float, Independent float and Total float

UNIT – IV:

Queuing Theory and Inventory::Kendols Notation, single server models, Inventory control - deterministic inventory models - Probabilistic inventory control models.

UNIT – V:

Sequencing Models: Introduction, Objectives, General assumptions, processing 'n' jobs through two Machines, processing 'n' jobs through three machines

References:

1. H.A. Taha, "*Operations Research, An Introduction*", PHI, 2008
2. H.M. Wagner, "*Principles of Operations Research*", PHI, Delhi, 1982
3. J.C. Pant, "*Introduction to Optimisation: Operations Research*", Jain Brothers, Delhi, 2008
4. Hitler Libermann, "*Operations Research*", McGraw Hill Pub. 2009
5. Pannerselvam, "*Operations Research*", Prentice Hall of India 2010
6. Harvey M Wagner, "*Principles of Operations Research*", Prentice Hall of India 2010

19CE O101

COST MANAGEMENT OF ENGINEERING PROJECTS
(OPEN ELECTIVE – Common to All Branches)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. To enable the students to understand the concepts of Project management.
2. To provide knowledge on concepts of Project Planning and scheduling.
3. To create an awareness on Project Monitoring and Cost Analysis
4. To provide adequate knowledge to the students on Recourse Management Costing-Variance Analysis
5. To train the students with the concepts of Budgetary Control for cost management and to provide basic platform on Quantitative techniques for cost management.

Course Outcomes: At the end of course students will able to

1. Acquire in-depth knowledge about the concepts of project management and understand the principles of project management.
2. Determine the critical path of a typical project using CPM and PERT techniques.
3. Prepare a work break down plan and perform linear scheduling using various methods.
4. Solve problems of resource scheduling and levelling using network diagrams.
5. Learn the concepts of budgetary control and apply quantitative techniques for optimizing project cost.

UNIT-I:

Project Management: Introduction to project managements, stakeholders, roles, responsibilities and functional relationships. Principles of project management, objectives and project management system. Project team, organization, roles, responsibilities. Concepts of project planning, monitoring, staffing, scheduling and controlling.

UNIT-II:

Project Planning and Scheduling: Introduction for project planning, defining activities and their interdependency, time and resource estimation. Work break down structure. Linear scheduling methods-bar charts, Line of Balance (LOB), their limitations. Principles, definitions of network-based scheduling methods: CPM, PERT. Network representation, network analysis-forward and backward passes.

UNIT-III:

Project Monitoring and Cost Analysis: introduction-Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making, Time cost tradeoff-Crashing project schedules, its impact on time on time, cost. Project direct and indirect costs.

UNIT-IV:

Resources Management and Costing-Variance Analysis: Planning, Enterprise Resource Planning, Resource scheduling and levelling. Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis
Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement

UNIT-V:

Budgetary Control:: Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.
Quantitative techniques for cost management: Linear Programming, PERT/CPM, Transportation Assignment problems, Simulation, Learning Curve Theory.

References:

1. Charles T Horngren "*Cost Accounting A Managerial Emphasis*", Pearson Education; 14 edition (2012),
2. Charles T. Horngren and George Foster, "*Advanced Management Accounting*" Prentice-Hall; 6th Revised edition (1 February 1987)
3. Robert S Kaplan Anthony A. Atkinson, "*Management & Cost Accounting*" , Pearson; 2 edition (18 October 1996)
4. K. K Chitkara, "*Construction Project Management: Planning, scheduling and controlling*", Tata McGraw-Hill Education. (2004).
5. Kumar NeerajJha "*Construction Project Management Theory and Practice*",Pearson Education India; 2 edition (2015)

19ME O103

COMPOSITE MATERIALS
(OPEN ELECTIVE – Common to All Branches)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to learn the

1. Composite materials and their constituents.
2. Classification of the reinforcements and evaluate the behavior of composites.
3. Fabrication methods of metal matrix composites.
4. Manufacturing of Polymer matrix composites.
5. Failure mechanisms in composite materials.

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

1. Classify and characterize the composite materials.
2. Describe types of reinforcements and their properties.
3. Understand different fabrication methods of metal matrix composites.
4. Understand different fabrication methods of polymer matrix composites.
5. Decide the failure of composite materials.

UNIT – I:

Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II:

Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III:

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostaticpressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV:

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepegs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V:

Strength: Lamina Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength;

References:

1. R.W.Cahn – VCH , "*Material Science and Technology*", (Vol 13) Composites , West Germany.
2. WD Callister, Jr., Adapted by R. Balasubramaniam , "*Materials Science and Engineering, An introduction*"., John Wiley &Sons, NY, Indian edition, 2007.
3. Ed-Lubin, "*Hand Book of Composite Materials*"
4. K.K.Chawla, "*Composite Materials*".
5. Deborah D.L. Chung, "*Composite Materials Science and Applications*"
6. Daniel Gay, Suong V. Hoa, and Stephen W. Tsai, "*Composite Materials Design and Applications*"

19EE O101

WASTE TO ENERGY
(OPEN ELECTIVE – Common to All Branches)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course objectives: To make the students to

1. To know the various forms of waste
2. To understand the processes of Biomass Pyrolysis.
3. To learn the technique of Biomass Combustion.

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

1. Understand the concept of conservation of waste
2. Identify the different forms of wastage
3. Chose the best way for conservation to produce energy from waste
4. Explore the ways and means of combustion of biomass
5. Develop a healthy environment for the mankind

UNIT-I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT-II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT-III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT-V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Desai, Ashok V.," *Non-Conventional Energy"*, Wiley Eastern Ltd., 1990.
2. Khandelwal, K. C. andMahdi, S. S., *Biogas Technology - A Practical Hand Book"*, Vol.I &II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Challal, D. S, "*Food, Feed and Fuel from Biomass"*, IBH Publishing Co. Pvt. Ltd., 1991.
4. C. Y. WereKo-Brobby and E. B. Hagan," *Biomass Conversion and Technology*", John Wiley & Sons, 1996.

19CE C110

DISSERTATION PHASE-I

Instruction	20 Hours per week
Duration of Semester End Examination	0 Hours
Semester End Examination	0 Marks
CIE	100 Marks
Credits	10

Course Outcomes: At the end of the course:

1. Students will be exposed to self-learning various topics.
2. Students will learn to survey the literature such as books, national/ international refereed Journals and contact resource persons for the selected topic of research.
3. Students will learn to write technical reports.
4. Students will develop oral and written communication skills to present.
5. Student will defend their work in front of technically qualified audience.

Guidelines:

- The Project work will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.
- Seminar should be based on the area in which the candidate has undertaken the dissertation work.
- The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.
- The preliminary results (if available) of the problem may also be discussed in the report.
- The work has to be presented in front of the committee consists of Head, Chairperson-BoS, Supervisor and Project coordinator.
- The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

Guidelines for the award of Marks:	Max. Marks: 100	
Evaluation by	**Max .Marks**	**Evaluation Criteria / Parameter**
Supervisor	30	Project Status / Review(s)
	20	Report
Department Committee	10	Relevance of the Topic
	10	PPT Preparation(s)
	10	Presentation(s)
	10	Question and Answers
	10	Report Preparation

Note: Department committee has to assess the progress of the student for every two weeks.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
SCHEME OF INSTRUCTION AND EXAMINATION
ME (STRUCTURAL ENGINEERING)
(With effect from the academic year 2020-21)

SEMESTER – IV

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
PRACTICALS									
1	19CE C111	Dissertation Phase-II	0	0	32	-	100	100	16
TOTAL			**0**	**0**	**32**	**-**	**100**	**100**	**16**

L: Lecture T: Tutorial P: Practical
CIE - Continuous Internal Evaluation SEE - Semester End Examination

19CE C111

DISSERTATION PHASE-II

Instruction	32 Hours per week
Duration of Semester End Examination	Viva
Semester End Examination	100 Marks
CIE	100Marks
Credits	16

Course Outcomes: At the end of the course

1. Students will be able to use different experimental techniques and will be able to use different software/ computational/analytical tools.
2. Students will be able to design and develop an experimental set up/ equipment/test rig.
3. Students will be able to conduct tests on existing set ups/equipment's and draw logical conclusions from the results after analyzing them.
4. Students will be able to either work in a research environment or in an industrial environment.
5. Students will be conversant with technical report writing and will be able to present and convince their topic of study to the engineering community.

Guidelines:

- It is a continuation of Project work started in semester III.
- The student has to submit the report in prescribed format and also present a seminar.
- The dissertation should be presented in standard format as provided by the department.
- The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.
- The report must bring out the conclusions of the work and future scope for the study.The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner (HoD and BoS Chair Person) guide/co-guide.
- The candidate has to be in regular contact with his/her guide/co-guide.

Guidelines for awarding marks in CIE:		Max. Marks: 100
Evaluation by	**Max .Marks**	**Evaluation Criteria / Parameter**
Department Review Committee	05	Review 1
	10	Review 2
	10	Review 3
	15	Final presentation with the draft copy of the report reportstandard format
	10	Submission of the report in a standard format
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Analytical / Programming / Experimental Skills Preparation
	10	Report preparation in a standard format

Guidelines for awarding marks in SEE: (Max. Marks: 100)Max. Marks: 100

Evaluation by	**Max .Marks**	**Evaluation Criteria / Parameter**
External and Internal Examiner(s) together	20	Power Point Presentation
	40	Quality of thesis and evaluation
	20	Quality of the project ● Innovations ● Applications ● Live Research Projects ● Scope for future study ● Application to society
	20	Viva-Voce

AUDIT COURSES

19EGA101

ENGLISH FOR RESEARCH PAPER WRITING
(Audit Course I and II - Common to all branches)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	0 Marks
Credits	Pass/Fail

Course Objectives: The Course will introduce the students to

1. To understand the nuances of language and vocabulary in writing a Research Paper.
2. To develop the content, structure and format of writing a research paper.
3. To enable the students to produce original research papers without plagiarism.

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

1. Interpret the nuances of research paper writing.
2. Differentiate the research paper format and citation of sources.
3. To review the research papers and articles in a scientific manner.
4. Avoid plagiarism and be able to develop their writing skills in presenting the research work.
5. Create a research paper and acquire the knowledge of how and where to publish their original research papers.

UNIT -1:
Academic Writing
Meaning & Definition of a research paper– Purpose of a research paper – Scope – Benefits – Limitations – outcomes.

UNIT-II:
Research Paper Format
Title – Abstract – Introduction – Discussion – Findings – Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation of sources.

UNIT –III:
Research Methodology
Methods (Qualitative – Quantitative) Review of Literature. Criticizing, Paraphrasing & Plagiarism.

UNIT-IV:

Process of Writing a research paper

Choosing a topic - Thesis Statement – Outline – Organizing notes - Language of Research – Word order, Paragraphs – Writing first draft–Revising/Editing - The final draft and proof reading.

UNIT-V:

Research Paper Publication

Reputed Journals – National/International – ISSN No, No. of volumes, Scopus Index/UGC Journals – Free publications - Paid Journal publications– / Advantages/Benefits

References:

1. C. R Kothari, Gaurav, Garg, **Research Methodology Methods and Techniques,** New Age International Publishers. 4th Edition.
2. Day R (2006) "*How to Write and Publish a Scientific Paper***",** Cambridge University Press
3. **MLA "***Hand book for writers of Research Papers***"**, East West Press Pvt. Ltd, New Delhi, 7th Edition.
4. LauriRozakis, Schaum's, "*Quick Guide to Writing Great Research Papers***"**,Tata McGraw Hills Pvt. Ltd, NewDelhi.

Online Resources:

1. NPTEL:https://onlinecourses.nptel.ac.in/noc18_mg13/preview

19CE A101

DISASTER MITIGATION AND MANAGEMENT

(Audit Course I and II - Common to all branches)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
CIE	0 Marks
Credits	Pass/Fail

Course Objectives: To enable the student

1. To equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts
2. To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
3. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
4. To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.
5. To equip the students with the knowledge of the chronological phases ina disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions

Course Outcomes: At the end of the course the student

1. Ability to analyse and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels
2. Ability to understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan
3. Ability to understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management
4. To understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same
5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various

participatory approaches/strategies and their application in disaster management

UNIT-I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and man-made; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT-II:

Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

UNIT-III:

Human induced hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related to major power break downs, fire accidents, traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multi-storeyed buildings.

UNIT- IV: Disaster Impacts: Disaster impacts- environmental, physical, social, ecological, economical, political, etc.; health, psycho-social issues; demographic aspects- gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT-V:

Concept of Disaster Management: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; Post-disaster environmental response-water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

References:

1. Pradeep Sahni,*" Disaster Risk Reduction in South Asia*", Prentice Hall, 2003.
2. B. K. Singh,*" Handbook of Disaster Management*: *techniques & Guidelines*", Rajat Publication, 2008.
3. Ministry of Home Affairs". *Government of India, "National disaster management plan, Part I and II"*,
4. K. K. Ghosh,*" Disaster Management"*, APH Publishing Corporation, 2006.
5. http://www.indiaenvironmentportal.org.in/files/file/disaster_management_india1.pdf
6. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)
7. Hazards, Disasters and your community: A booklet for students and the community, Ministry of home affairs.

19EE A101

SANSKRIT FOR TECHNICAL KNOWLEDGE
(Audit Course I and II - Common to all branches)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	0 Marks
Credits	Pass/Fail

Course Objectives: To enable the student

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. To make the novice Learn the Sanskrit to develop the logic in mathematics, science & other subjects
3. To explore the huge knowledge from ancient Indian literature

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

1. Develop passion towards Sanskrit language
2. Decipher the latent engineering principles from Sanskrit literature
3. Correlates the technological concepts with the ancient Sanskrit history.
4. Develop knowledge for the technological progress
5. Explore the avenue for research in engineering with aid of Sanskrit

UNIT-I:

Introduction to Sanskrit language: Sanskrit Alphabets-vowels-consonants-significance of Amarakosa-parts of speech-Morphology-creation of new words-significance of synonyms-sandhi-samasa-sutras-active and passive voice-Past/ Present/Future Tense-syntax-Simple Sentences (elementary treatment only)

UNIT-II:

Role of Sanskrit in Basic sciences: Brahmagupthas lemmas (second degree indeterminate equations), sum of squares of n-terms of AP- sulba_sutram or baudhayana theorem (origination of pythogorous theorem)-value of pie-Madhava's sine and cosine theory (origination of Taylor's series).
The measurement system-time-mass-length-temp, Matter elasticity-optics-speed of light (origination of michealson and morley theory).

UNIT-III:

Role of Sanskrit in Engineering-I (Civil, Mechanical, Electrical and Electronics Engineering):
Building construction-soil testing-mortar-town planning-Machine definition-crucible-furnace-air blower- Generation of electricity in a cell-magnetism-Solar

system-Sun: The source of energy, the earth-Pingalachandasutram (origination of digital logic system)

UNIT-IV:

Role of Sanskrit in Engineering-II (Computer Science Engineering & Information Technology): Computer languages and the Sanskrit languages-computer command words and the vedic command words-analogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

UNIT-V:

Role of Sanskrit in Engineering-III (Bio-technology and Chemical Engineering):
Classification of plants-plants, the living-plants have senses-classification of living creatures
Chemical laboratory location and layout-equipment-distillation vessel-kosthiyanthram-

References:

1. M Krishnamachariar, "*History of Classical Sanskrit Literature"*, TTD Press, 1937.
2. *M.R. Kale, "A Higher Sanskrit Grammar: For the Use of School and College Students*", Motilal Banarsidass Publishers, ISBN-13: 978-8120801783, 2015
3. KapailKapoor,"*Language, Linguistics and Literature: The Indian Perspective*", ISBN-10: 8171880649, 1994.
4. "*Pride of India, Samskrita Bharati Publisher*", ISBN: 81-87276-27-4, 2007
5. ShriRamaVerma, "*Vedas the source of ultimate science*", Nag publishers, ISBN:81-7081-618-1, 2005

19EC A101

VALUE EDUCATION
(Audit Course I and II - Common to all branches)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	0 Marks
Credits	Pass/Fail

Course Objectives: This course aims to

1. Understand the need and importance of Values for self-development and for National development.
2. Imbibe good human values and Morals
3. Cultivate individual and National character.

Course outcomes: After completion of the Course, Students will be able to

1. Gain necessary Knowledge for self-development
2. Learn the importance of Human values and their application in day to day professional life.
3. Appreciate the need and importance of interpersonal skills for successful career and social life
4. Emphasize the role of personal and social responsibility of an individual for all-round growth.
5. Develop a perspective based on spiritual outlook and respect women, other religious practices, equality, non-violence and universal brotherhood.

UNIT I:

Human Values, Ethics and Morals: Concept of Values, Indian concept of humanism, human values; Values for self-development, Social values, individual attitudes; Work ethics, moral and non- moral behaviour, standards and principles based on religion, culture and tradition.

UNIT II:

Value Cultivation, and Self-management: Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

UNIT III:

Spiritual outlook and social values: Personality and Behavior, Scientific attitude and Spiritual (soul) outlook; Cultivation of Social Values Such as Positive Thinking, Punctuality, Love & Kindness, Avoiding fault finding in others,

Reduction of anger, forgiveness, Dignity of labour, True friendship, Universal brotherhood and religious tolerance.

UNIT IV:

Values in Holy Books : Self-management and Good health; **and internal & external Cleanliness,** Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

UNIT V:

Dharma, Karma and Guna: Concept of soul; Science of Reincarnation, Character and Conduct, Concept of Dharma; Cause and Effect based Karma Theory; The qualities of Devine and Devilish; Satwic, Rajasic and Tamasicgunas.

References:

1. Chakroborty, S.K. "*Values & Ethics for organizations Theory and practice*", Oxford University Press, New Delhi, 1998.
2. Jaya DayalGoyandaka, "*Srimad Bhagavad Gita", withSanskrit Text"*, Word meaning and Prose meaning, Gita Press, Gorakhpur, 2017.

19EGA102

INDIAN CONSTITUTIONAND FUNDAMENTAL RIGHTS
(Audit Course I and II -Common to all branches)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	0 Marks
Credits	Pass/Fail

Course Objectives: The course will introduce the students to

1. The history of Indian Constitution and its role in the Indian democracy.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Have knowledge of the various Organs of Governance and Local Administration.

Course Outcomes: After successful completion of the course he students will be able to

1. Understand the making of the Indian Constitution and its features.
2. Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies.
3. Have an insight into various Organs of Governance - composition and functions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
5. Understand Electoral Process, special provisions.

UNIT-I:

History of making of the Indian constitutions: History, Drafting Committee (Composition &Working).

Philosophy of the Indian Constitution: Preamble, Salient Features.

UNIT-II:

Contours of Constitutional Rights and Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT-III:

Organs of Governance Parliament: Composition, Qualifications, Powers and Functions

Union executives : President, Governor, Council of Ministers, Judiciary, appointment and transfer of judges, qualifications, powers and functions

UNIT-IV:

Local Administration: District's Administration head: Role and importance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: ZillaPanchayat, Elected Officials and their roles, CEO ZillaPanchayat: positions and role.

Block level: Organizational Hierarchy (Different departments)Village level: role of elected and appointed officials. Importance of grass root democracy.

UNIT-V:

Election commission: Election Commission: Role and functioning, Chief Election Commissioner and Election Commissioners, State Election Commission :Role and functioning. Institute and Bodies for the welfare of SC/ST/OBC and women**.**

References:

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

Online Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

19IT A101

PEDAGOGY STUDIES
(Audit Course I and II - Common to all branches)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	0 Marks
Credits	Pass/Fail

Course Objectives: The students will be able

1. To present the basic concepts of design and policies of pedagogy studies.
2. To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
3. To familiarize various theories of learning and their connection to teaching practice.
4. To create awareness about the practices followed by DFID, other agencies and other researchers.
5. To provide understanding of critical evidence gaps that guides the professional development.

Course Outcomes: Upon completing this course, students will be able to

1. Illustrate the pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
2. Examine the effectiveness of pedagogical practices.
3. Understand the concept, characteristics and types of educational research and perspectives of research.
4. Describe the role of classroom practices, curriculum and barriers to learning.
5. Understand Research gaps and learn the future directions.

UNIT-I:

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT-II:

Thematic Overview: Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT-III:

Evidence on the Effectiveness of Pedagogical Practices: Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and pedagogic strategies.

UNIT-IV:

Professional Development: alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

UNIT-V:

Research Gaps and Future Directions: Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment – Dissemination and research impact.

References:

1. Ackers J, Hardman F, "*Classroom Interaction in Kenyan Primary Schools, Compare*", 31 (2): 245 – 261, 2001.
2. Agarwal M, "*Curricular Reform in Schools: The importance of evaluation*", Journal of Curriculum Studies, 36 (3): 361 – 379, 2004.
3. Akyeampong K, *"Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER)"*, Country Report 1.London: DFID, 2003.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J, "*Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count"?*, International Journal Educational Development, 33 (3): 272- 282, 2013.
5. Alexander R J, "*Culture and Pedagogy: International Comparisons in Primary Education"*, Oxford and Boston: Blackwell, 2001.
6. Chavan M, "*Read India: A mass scale, rapid, 'learning to read'* campaign", 2003.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc17_ge03/preview
2. www.pratham.org/images/resources%20working%20paper%202.pdf.

19EGA103

STRESS MANAGEMENT BY YOGA
(Audit Course I and II - Common to all branches)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	0 Marks
Credits	Pass/Fail

Course Objectives: The Course will introduce the students to

1. Creating awareness about different types of stress and the role of yoga in the management of stress.
2. Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).
3. Prevention of stress related health problems by yoga practice.

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

1. To understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas
5. Improve work performance and efficiency.

UNIT-I:

Meaning and definition of Yoga - Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali.

UNIT –II:

Meaning and definition of Stress - Types of stress - Eustress and Distress. Anticipatory Anxiety and Intense Anxiety and depression. Meaning of Management- Stress Management.

UNIT -III:Concept of Stress according to Yoga - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress.

UNIT-IV:

Asanas- (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar

UNIT-V:

Pranayama- Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.**Meditation techniques:** Om Meditation - Cyclic meditation : Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT)

References:

1. "*Yogic Asanas for Group Training - Part-I":*Janardhan Swami YogabhyasiMandal, Nagpur.
2. "*Rajayoga or Conquering the Internal Nature*"by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.
3. Nagendra H.R nadNagaratna R, "*Yoga Perspective in Stress Management*", Bangalore, Swami Vivekananda Yoga Prakashan

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. https://freevideolectures.com/course/3539/indian-philosophy/11

19EGA104

PERSONALITY DEVELOPMENT THROUGH LIFE'S ENLIGHTENMENT SKILLS

(Audit Course I and II - Common to all branches)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	0 Marks
Credits	Pass/Fail

Course Objectives: The course will introduce the students to

1. To learn to achieve the highest goal happily.
2. To become a person with stable mind, pleasing personality and determination.
3. To awaken wisdom among themselves.

Course Outcomes: After successful completion of the course the students will be able to

1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. To practice emotional self-regulation.
4. Develop a positive approach to work and duties.
5. Develop a versatile personality.

UNIT-I:

Neetisatakam - Holistic development of personality: Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

UNIT-II:

Neetisatakam – Holistic development of personality (cont'd): Verses 52, 53, 59 (dont's) - Verses 71,73,75& 78 (do's) - Approach to day to day works and duties.

UNIT-III:

Introduction to Bhagavadgeetha for Personality Development - Shrimad Bhagawad Geeta: Chapter 2 – Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter18–Verses 45, 46, 48 Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48

UNIT-IV:

Statements of basic knowledge - ShrimadBhagawadGeeta: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad Bhagawat Geeta.

UNIT-V:

Role of Bahgavadgeeta in the present scenario : Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

References:

1. "*Srimad Bhagavad Gita*" , Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. "*Bhartrihari's Three Satakam* (Niti-sringar-vairagya)",P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi

Online Courses:

1. NTPEL: http://nptel.ac.in/downloads/109104115/