GAYATRI VIDYA PARISHAD COLLEGE FOR DEGREE AND PG COURSES (A)

Rushikonda, Visakhapatnam-530 045 |
website: www.gvpcdpgc.edu.in

(Approved by AICTE | Affiliated to Andhra University | Reaccredited by NAAC | ISO 9001:2015)

ENGINEERING AND TECHNOLOGY PROGRAM

DEPARTMENT OF CIVIL ENGINEERING

Postgraduate Degree

in

Civil Engineering

M.Tech (Structural Engineering)

Postgraduate Degree in Engineering & Technology
Branch /Program: M.Tech in Structural Engineering
Total Credits (2 years course): 68

Semester-wise Structure of the Curriculum
[L= Lectures, P = Practical's, C = Credits]

Semester I [First year] Curriculum

Sl.No.	Type of Course	Course Code	Course Title	Hours per week		Credits
				L	P	C
1	Program Core I		Advanced Reinforced Concrete Design	3	0	3
2	Program Core II		Theory of elasticity	3	0	3
3	Program Elective		Elective-I	3	0	3
4	Program Elective		Elective-II	3	0	3
5	Mandatory Course		Research Methodology and IPR	2	0	2
6	Audit Course I		English for Research Paper Writing	2	0	0
7	Laboratory Course I		Computer applications in Structural Engineering	0	4	2
8	Laboratory Course II		Design Studio I	0	4	2
Total Credits						**18**

Program Elective-I:

a. Precast and prefabricated Structures
b. Advanced Design of Steel structures
c. Matrix methods of Structural Analysis
d. Ground Improvement Techniques

Program Elective-II:

a. Advanced Concrete Technology
b. Stability of Structures
c. Numerical methods for Structural Engineering
d. Structural Health Monitoring

Semester II

[First year] Curriculum

Sl.No.	Type of Course	Course Code	Course Title	Hours per week		Credits
				L	P	C
1	Program Core III		Finite Element Analysis	3	0	3
2	Program Core IV		Structural Dynamics	3	0	3
3	Program Elective		Elective-III	3	0	3
4	Program Elective		Elective-IV	3	0	3
5	Audit Course II		Pedagogy Studies	2	0	0
6	Laboratory Course III		Repair and Rehabilitation Structures	0	4	2
7	Laboratory Course IV		Design Studio II	0	4	2
8	Industrial Seminar			0	0	2
Total Credits						**18**

Elective-III:

a. Optimization Techniques
b. Bridge Engineering.
c. Design of Tall Structures
d. Fracture Mechanics

Elective-IV:

a. Construction Methods and Equipment
b. Reliability of Structures
c. Prestressed concrete structures
d. Fire Resistant Design of Structures

Audit Course:

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

Semester III
[Second year] Curriculum

Sl. No.	Type of Course	Code	Course Title	Hours per week		Credits
				L	P	C
1	Program Elective		Elective-V	3	0	3
2	Open Elective		. Disaster Management	3	0	3
3	Dissertation I			0	0	8
Total Credits						**14**

Elective-V:

a. Earthquake Resistant Design of Structures
b. Analysis and Design of Plates and Shells
c. Advanced Foundation Engineering
d. Port and Harbour Structures

Open Elective:

a. Business Analytics
b. Industrial Safety
c. Operations Research
d. Cost Management of Engineering Projects
e. Composite Materials
f. Waste to Energy
g. Disaster Management

Semester IV [Second year] Curriculum

Sl.No.	Type of Course	Code	Course Title	Hours per week		Credits
				L	P	C
1	Dissertation II			0	0	18
Total Credits						**18**

Total Credits: 68

SEMESTER -I

Program Core I: ADVANCED REINFORCED CONCRETE DESIGN

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Familiarize various types of RCC designs

Course Outcomes:

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

CO 1. Estimate the deflection and crack width in structural elements.
CO 2. Analyse a grid floors
CO 3. Analyse and design a flat Slab System.
CO 4. Design of Reinforced Concrete Members for fire Resistance.
CO 5. Design the concrete deep beams.

SYLLABUS:

UNIT-I: Deflection of Reinforced Concrete Beams and Slabs

Short-term deflection of beams and slabs, Deflection due to imposed loads, Short-term deflection of beams due to applied loads, Calculation of deflection by IS 456, Deflection of continuous beams by IS 456, Deflection of slabs. Estimation of Crack width in Reinforced Concrete Members: Introduction, Factors affecting crack width in beams, Mechanisms of flexural cracking, Calculation of crack width, Simple empirical method, Estimation of crack width in beams by IS 456, Shrinkage and thermal cracking.

UNIT-II: Approximation Analysis of Grid Floors

Introduction, Analysis of flat grid floors, Analysis of rectangular grid floors by Timoshenko's plate theory. Analysis of grid by stiffness matrix method, Analysis of grid floors by equating joint deflections, Comparison of methods of analysis, Detailing of steel in flat grids.

UNIT-III: Design of Flat Slabs

Introduction, Proportioning of Flat Slabs, Determination of Bending moment and Shear Force, Direct Design method, Equivalent Frame method, Slab Reinforcement. Design and Detailing of Reinforced Concrete Deep Beams

UNIT-IV: Design of Reinforced Concrete Members for Fire Resistance

Introduction, ISO 834 standard heating conditions, Grading or classifications, Effect of high temperature on steel and concrete, Effect of high temperatures on different types of structural members, Fire resistance by structural detailing from tabulated data, Analytical determination of the ultimate bending moment, Capacity of reinforced concrete beams under fire, Other considerations.

UNIT-V: Design of Reinforced Concrete Deep Beams

Steps of Designing Deep Beams, Design by IS 456, checking for local failures, Detailing of Deep beams.

Text Books:

1. Varghese P.C. Advanced Reinforced Concrete Design, 2nd Edition, Prentice - Hall of India, 2008.
2. Pillai and Devadas Menon, Reinforced Concrete Design, 2nd Edition, Tata McGraw Hill Publishing Co. Ltd., 2003.

Reference Books:

1.Purushothaman P, Reinforced Concrete Structural Elements, 3rd Edition, Tata McGraw- Hill Publishing Co, 2004.
2. Park and Paulay, "Reinforced Concrete", John Wiley & Sons.
3.IS 456: 2000, Indian standard plain and Reinforced Concrete - code of practice.
4.Special Publications SP-16, Design Aids for Reinforced Concrete, of IS: 456-2000.
5.Special Publications SP-34, Handbook and concrete reinforcement and detailing.
6.Special publications SP-24, Explanatory Hand book on IS 456(1978), Bureau of Indian Standards,1984.

Program Core II: THEORY OF ELASTICITY

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Analyse some real problem and to formulate the conditions of theory of elasticity application
2. Execute a reasonable choice of parameters of the model (geometry, material properties, boundary conditions)
3. Analyse the result of solution by standard computational programs

Course outcomes:

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

CO 1. Apply the conditions of compatibility and equations of equilibrium.

CO 2. Demonstrate the knowledge of fundamental methods of elasticity for 2-D rectangular coordinate problems.

CO 3. Demonstrate the knowledge of fundamental methods of elasticity for 2-D Cartesian and Polar problems.

CO 4. Apply the differential equations of equilibrium and boundary conditions in three dimension

CO 5. Analyze torsional problems and apprise various theories to solve 2-D torsional problems.

SYLLABUS:

UNIT-I: Plane Stress and Plane Strain

Components of stress, Strain, Hooke's law, Stress and strain at a point. Plane stress, Plane strain, Equations of equilibrium, Boundary conditions, Compatibility equations stress foundation.

UNIT-II: Two Dimensional Problems in Rectangular Coordinates

Solution by polynomials, St. Vanant's principle determination of displacements, bending of cantilever loaded at the end, Bending of a beam by uniform load.

UNIT-III: Two Dimensional Problem in Polar Coordinates

General equations of equilibrium, Stress function and equation of compatibility with zero body forces. Analysis of thick cylindrical shells with symmetrical leading about the axis, Pure bending of curves bars, Strain components in polar coordinates, Rotating disks.

UNIT-IV: Three Dimensional State of Stress

Differential equations of equilibrium – Boundary conditions for compatibility – Displacements – Equations of equilibrium in terms of displacements – Principle of superposition – Uniqueness of solution.

UNIT-V: Torsion

Torsion of straight bars – St.Venant solution – Stress function, Warp function – Elliptic cross section – Membrane analogy torsion of bar of narrow rectangular cross section.

Text Books:

1. Sadhu Singh, Theory of Elasticity, 4th Edition, Khanna Publishers 1978.
2. L.S. Srinath, Advanced Mechanics of Solids,3rd edition, McGraw Hill Publishers 2017.

References:

1. Martin H. Sadd, Elasticity: Theory, Applications and Numeric, 2nd edition,Wiley Publishers 2009
2. Stephen Timoshenko & J. N. Goodier, Theory of Elasticity, 3rd edition, Mc.Grawhill Publishers 2017.

Program Elective-I: (a) PRECAST AND PREFABRICATED STRUCTURES

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course objectives:

The objective of this course is to:

1.Create awareness on the need, application, production technology and analysis of prefabricated structures.

Course Outcomes:

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

CO1 Introduce the need for Prefabrication
CO2 Analyze the prefabricated load carrying members
CO3 Study types of joints in precast construction
CO4 Analyze the production technology of prefabrication
CO5 Design and detailing of precast unit for factories

SYLLABUS:

UNIT -I

Need for prefabrication – General Principles of Prefabrication - Comparison with monolithic construction, types of prefabrication, site and plant prefabrication, economy of prefabrication, modular coordination, standardization – Materials – Modular coordination – Systems – Production – Transportation – Erection.

UNIT -II

Prefabricated Load Carrying Members-Planning for components of prefabricated structures, disuniting of structures, design of simple rectangular beams and I-beams, handling and erection stresses, elimination of erection stresses, beams, columns, symmetric frames. Behaviour of structural components – Large panel constructions – Construction of roof and floor slabs – Wall panels – Columns – Shear walls.

UNIT -III

Joints - Joints for different structural connections, effective sealing of joints for water proofing, provisions for non-structural fastenings, expansion joints in precast construction.

UNIT -IV

Production Technology - Choice of production setup, manufacturing methods, stationary and mobile production, planning of production setup, storage of precast elements, dimensional tolerances, acceleration of concrete hardening. Hoisting Technology - Equipment for hoisting and erection, techniques for erection of different types of members like beams, slabs, wall panels and columns, vacuum lifting pads.

UNIT -V

Applications - Designing and detailing of precast UNIT for factory structures, purlins, principal rafters, roof trusses, lattice girders, gable frames, singe span single storied simple frames, single storied buildings, slabs, beams and columns. Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse.

TEXT BOOKS

1. Precast Concrete Structures- Kim S Elliott, 2nd edition, CRC Press
2. Gerostiza C.Z., Hendrikson C. and Rehat D.R., "Knowledge based process planning for construction and manufacturing", Academic Press Inc., 1994

REFERENCES

1. Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 1978.
2. Koncz T., Manual of precast concrete construction, Vols. I, II and III, Bauverlag, GMBH, 1971.
3. CBRI, Building materials and components, India, 1990
4. Mokk. L, (1964), Prefabricated Concrete for Industrial and Public Structures, Publishing House of the Hungarian Academy of Sciences, Budapest.

Program Elective-I: (b) ADVANCED STEEL STRUCTURES

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Identify different mechanisms in the frame.
2. Explain the properties of light gauge steel and design various structural elements.
3. Analyse of Communication Towers
4. Study the Design of steel chimneys
5. Study the Design of Gantry Girder.

Course Outcomes:

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

CO 1. Classify different mechanisms in the portal frame
CO 2. Design beams and columns using Light Gauge Steel sections
CO 3. Analyse of Communication Towers
CO 4. Design of steel chimneys
CO 5. Design the gantry girder

UNIT-I: Plastic Analysis

Introduction, Limit analysis of steel structures, Mechanical properties of structural steel, Plastic hinge, Moment curvature relations, Limit load, Coplanar load, Upper lower bound theorems. Redistribution of moments continuous beams: Relevant or irrelevant mechanisms, Types of mechanisms method for performing moment check. Portal frame, Mechanisms, Combination of mechanisms, Moment check, Partial complete and over complete collapse.

UNIT-II: Light gauge steel structures

Local buckling of thin sections, Post packing of thin elements, Light gauge steel columns and compression members, Form factor for columns and compression members, Stiffened compression elements, Multiple stiffened compression elements, Unstiffened compression elements effective length of light gauge steel compression members, Basic design stress, Allowable design stress, Light gauge steel beams, laterally supported light gauge steel beams web crippling. Allowable design stress in beams, Beams subjected to combined axial end bending stress, connections.

UNIT-III: Analysis of Communication Towers

Analysis of Transmission Line Towers, loads on towers, Sag (dip) and Tension in uniformly loaded conductors, Analysis of towers (analysis as coplanar assembly), Design of members in towers, Design of foundation of towers.

UNIT-IV: Design of Steel Chimneys for wind and gravity loads

UNIT-V: Design of gantry girder

Text Books:

1. B.C.Punmia,Ashok Kumar Jain, Arun Kumar Jain, "Comprehensive Design of Steel Structures" Laxmi Publications (P) Ltd, 2005
2. Arya & Ajmani,, "Design of Steel Structures" Nem Chand Publishers, 2011

Reference Books:

1. Beedle, "Plastic Design of Steel Frames", 2nd edition, John Wiley and Sons Inc.
2. Arya & Ajmani, "Design of Steel Structures", Nem Chand Publishers, 2011
3. IS: 800-2007 – Code of practice for steel Structures
4. Steel tables

Program Elective-I: (c) MATRIX METHODS OF STRUCTURAL ANALYSIS

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is:

1. To prepare the students to have a basic knowledge in the matrix methods such as flexible matrix method and Stiffness matrix method.
2. To prepare the students to analyse the beams by matrix methods.
3. To prepare the students to analyse the Plane truss problems by matrix methods.
4. To prepare the students to analyse the Plane Frames by matrix methods.

Course Outcomes:

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

CO1. Understand basic elements of matrix methods.
CO 2. Analyse various beams by flexibility and stiffness matrix methods at different loading conditions.
CO 3. Analyse Plane Frames by the matrix methods at different loading conditions.
CO 4. Analyse various Plane truss problems by flexibility and stiffness matrix methods
CO 5. Analyse behaviour of Cables and Suspension Bridges at same and different levels.

SYLLABUS:

UNIT-I: Introduction to Matrix methods

Introduction, coordinate systems, displacement and force transformation matrices, element and structure stiffness matrices, Element and structure flexibility matrices, equivalent joint loads, stiffness and flexibility approaches.

UNIT-II: Matrix methods for beams

Analysis of beams, fixed and continuous beams by flexibility method. Analysis of beams, fixed and continuous beams by stiffness method.

UNIT-III: Matrix methods for Plane Frames

Analysis of 2-D frames by Flexibility matrix methods. Analysis of 2-D frames by Stiffness matrix methods.

UNIT-IV: Matrix methods for Plane truss problems

Analysis of 2-D trusses by flexibility method. Analysis of 2-D trusses by stiffness method

UNIT-V: Cables and Suspension Bridges

Introduction, Equation of cable, Horizontal reaction for uniformly loaded cables, Tension in the cable, Stresses in loaded cables with supports at the same and different levels. Length of cable, Two and Three hinged stiffening girders.

Text Books:

1. G.S.Pandit and S.P.Gupta, "Matrix methods of Structural Analysis" 2nd edition, McGraw Hill Education,2008.
2. W Weaver and Gere, "Matrix Analysis of framed Structures"2nd edition, CBS Publications, 2004

Reference Books:

1. Devdas Menon,"Advanced Structural Analysis" Narosa Publishing House, 2009.
2. Asslam Kassimali, "Matrix Analysis of Structures" Brooks/Cole Publishing Co., USA,1999.
3. C.K Wang, "Analysis of Indeterminate Structures, "McGraw-Hill.

Program Elective –I: (d) GROUND IMPROVEMENT TECHNIQUES

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Describe the various compaction methods.
2. Explain the various vertical drains and its applications.
3. Summarize the various stabilization techniques and its applications.
4. Outline the dewatering techniques used in field.
5. Define the various grouting methods.

Course Outcomes:

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

CO 1. Classify the various compaction methods.

CO 2. Generalized the various vertical drains and its applications.

CO 3. Identify the suitable stabilization technique based on the soil conditions and local available materials.

CO 4. Understand and apply the concept of dewatering techniques.

CO 5. Describe the grouting technology and its application by selecting the suitable grout based on the field conditions.

SYLLABUS:

UNIT-I: Compaction

Theory of compaction, Shallow Surface Compaction - Equipment, Placement water content, factors affecting shallow compaction; Deep compaction: Methods - Vibroflotation, Terra probe method, Pounding, Blasting, Compaction piles; Compaction Control.

UNIT-II: Vertical Drains

Sand drains, Sand wicks, Rope drains, Design of vertical drains, Stone columns, application of the techniques to Marine clays.

UNIT-III: Stabilization

Introduction, objectives, Methods of stabilization – Mechanical, Cement, Lime, Bituminous, Calcium chloride; construction methods, factors affecting stabilization of soils; Deep Mixing methods – Soil lime Columns and Cement Lime Columns, applications.

UNIT-IV: Dewatering

Definition, necessity, Methods of dewatering – Interceptor ditch, Single, Multistage and Vacuum well points, Horizontal wells, Electro-osmosis. Permanent drainage by Foundation drains and Blanket drains.

UNIT-V: Grouting and In-situ Reinforcement

Definition, Objectives of grouting, Grouts and their properties, Categories of Grouting, Grouting methods: Ascending, Descending and Stage Grouting in Soils, Hydro fracture, Grouting Equipment, Post grouting tests, Ground Anchors, Tiebacks and Soil Nailing, Micro piles.

Text Book:

1. Purushothama Raj. P, "Ground Improvement Techniques", 2nd ed., Laxmi Publications (p) Ltd., New Delhi, 2016.
2. Satyendra Mittal, "An Introduction to Ground Improvement Engineering", 1st edition, Medtech, 2013

Reference Books:

1. S.K. Khanna, Justo, C.E.G and Veeraragavan, A," Highway Engineering", 10th edition New Chand & Bro,2017
2. Reinforced Soil and Its Engineering Applications by Swami Saran, I.K. International Pvt. Ltd.

Program Elective –II: (a) ADVANCED CONCRETE TECHNOLOGY

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Familiarize with the concepts of Durability of concrete.
2. Explain mix design using different design philosophies.
3. Familiarize with different types of concretes.
4. Explain the processes and technologies for particular structures.
5. Equip students with different test methods.

Course Outcomes:

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

CO 1. Define and assess durability of concrete.
CO 2. Design mix proportion using different design philosophies.
CO 3. Summarize special concretes
CO 4. Illustrate special processes and technologies for particular types of structures.
CO 5. Categorize the different test methods

SYLLABUS:

UNIT-I: Durability of concrete and concrete construction

Durability concept, pore structure and transport processes, reinforcement corrosion, fire resistance, frost damage, sulphate attack, alkali silica reaction, delayed ettringite formation, methods of providing durable concrete, short-term tests to assess long-term behaviour.

UNIT-II: Mix design

Review of methods and philosophies of IS, BS and ACI methods, mix design for special purposes, Acceptance criteria for compressive strength of concrete.

UNIT-III: Special concretes

Lightweight concrete, autoclaved aerated concrete, no-fines concrete, lightweight aggregate concrete and foamed concrete, High strength concrete, refractory concrete, high density and radiation-shielding concrete, polymer concrete, fibre-reinforced concrete, mortars, renders, recycled concrete, Ferro Cement, Self-Compacting Concrete.

UNIT-IV: Special processes and technology for particular types of structure

Sprayed concrete, underwater concrete, grouts, grouting and grouted concrete, mass concrete, slip form construction, pumped concrete, concrete for liquid retaining structures, vacuum process, concrete coatings and surface treatments.

UNIT-V: Test methods

Analysis of fresh concrete, Accelerated testing methods, Tests on hardened concrete, Core cutting and testing, partially destructive testing, Non-destructive testing of concrete structures.

Text Books:

1. A.M.Neville ,"Properties of Concrete",5th edition, Pearson Education Private Limited, 2011.
2. Gambhir, M.L., "Concrete Technology", 2nd Edition, Tata McGraw Hill Publishers, New Delhi, 2009.

Reference Book:

1. P.K.Mehta, J.M.Monteiro, "Concrete micro-structure, Properties and Materials", Printice Hall INC & McGraw Hill, USA.
2. M.S.Shetty, "Concrete Technology Theory and Practice", S Chand & Company Ltd, New Delhi.
3. Shanta Kumar A.R., "Concrete Technology", Oxford University Press, 2nd Edition, New Delhi, 2000.

IS CODES:

1. IS:9103-1999 Specification for admixtures for concrete (first revision) quotes
2. IS:2386-1963 Methods of test for aggregates (Part-I to V)
3. IS 13311-1 (1992): Method of Non-destructive testing of concrete

Program Elective –II: (b) STABILITY OF STRUCTURES

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Determine critical buckling load carrying capacity of columns using different concepts.
2. Analyses beam columns.
3. Evaluate critical buckling load carrying capacity of columns using approximate methods.
4. Find out critical buckling load on frames.
5. Apply different methods to evaluate buckling of plates

Course Outcomes:

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

CO 1. Determine the buckling loads for simple columns by analytical solution
CO 2. Analyse beam columns for various loads
CO 3. Estimate the critical loads on columns
CO 4. Determine the critical load for buckling in frames
CO 5**.** Determine the critical load for buckling in plate

SYLLABUS:

UNIT-I Buckling of Columns

Method of neutral equilibrium, Critical load of the Euler column, Linear column theory – An eigenvalue problem, Effective length concept, Higher order differential equation for columns initially bent columns, Effect of shear stress on buckling, eccentrically loaded columns

UNIT-II Beam columns

(Beam columns with concreted lateral load, distributed, load end moment), Inelastic buckling of columns, Double modulus theory, Tangent modulus theory, Shanley theory of inelastic column behaviour.

UNIT-III Approximate Methods of Analysis

Conservation of energy principles, Calculation of critical loads using approximate deflection curve, Principle of stationary potential energy, Raleigh-Ritz method, buckling load of column with variable cross-section, Galerkin ’s method, Calculation of critical load by finite differences, unevenly spaced pivot points, Matrix stiffness method, Effect of axial load on bending stiffness-slope deflection equations, buckling of column loaded along the length using energy methods.

UNIT- IV Buckling of Frames

Modes of buckling, Critical load of a simple frame using neutral equilibrium, Slope deflection equations and matrix analysis. Lateral buckling of cantilever and simply supported beams of rectangular and I-sections and use of energy method and finite differences.

UNIT- V Buckling of Plates

Differential equation, Strain energy of bending, Critical load, Finite difference approach inelastic buckling of plates.

Text Books:

1.Alexander Chajes, "Principles of Structural Stability Theory", Waveland Pr Inc, 1993.

2.Stephen P.Timoshenko and James M. Gere,"Theory of Elasticity Stability" 2nd edition Dover Publications Inc, 2009.

Reference Book:

1.Aswini Kumar, "Stability of structures" Allied Publisher Ltd.1998

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Program Elective –II: (c) NUMERICAL METHODS FOR STRUCTURAL ENGINEERING

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course objectives:

The objective of this course is to:

1. Learning linear equations with direct method and indirect methods.
2. Familiarize the concept of interpolation technique.
3. Learning the finite difference and their application using Taylor series, Richardson's extrapolation.
4. Orient the students to learn the Numerical Differentiation.
5. Equip the students to learn Ordinary Differential Equation with different methods.

Course Outcomes:

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

CO 1. Evaluate solutions of linear equations, Eigen Values and Eigen Vectors.

CO 2. Estimate the Interpolation and types of interpolations.

CO 3. Evaluate logical thinking in coding a mathematical problem in algorithmic form.

CO 4. Categorize the Numerical Differentiation with different methods.

CO 5. Solve the Ordinary Differential Equation with different methods.

SYLLABUS:

UNIT-I: Solutions of linear equations

Direct method – Cramer's rule, Gauss – Elimination method- Gauss – Jordan elimination method– Triangulation (LU Decomposition) method – Iterative methods - Jacobi – Iteration method –Gauss – Siedel iteration, Successive over –relaxation method. Eigen values and Eigen vectors: Jacobi method for symmetric matrices- Given's method for symmetric matrices- Householder's method for symmetric matrices-Rutishauser method of arbitrary matrices – Power method.

UNIT-II: Interpolation: Linear Interpolation

Higher Order Interpolation - Lagrange Interpolation – Interpolating polynomials using finites differences- Hermite Interpolation -piece-wise and spline Interpolation.

UNIT-III: Finite Difference and their Applications

Introduction- Differentiation formulas by Interpolating parabolas – Backward and forward and central differences- Derivation of Differentiation formulas using Taylor Series-Boundary conditions- Beam deflection – Solution of characteristic value problems- Richardson's extrapolation- Use of unevenly

spaced pivotal points- Integration formulae by interpolating Parabolas-Numerical solution to spatial differential equations – Application to Simply Supported Beams, Columns & rectangular Plates.

UNIT-IV: Numerical Differentiation

Different methods based on undetermined coefficients- optimum choice of step length– Partial differentiation. Numerical Integration: Newton-Cotes integration formulas- Double integration using Trapezoidal Rule – Romberg Integration -Simpson's method Gaussian quadrature- Errors in integration formulas- Multiple integration with variable limits.

UNIT-V: Ordinary Differential Equation

Euler's method – Backward Euler method – Midpoint method – single step method, Taylor's series method - Boundary value problems and characteristics- Shooting method- Solution through a set of equations.

Text books:

1. M.K.Jain- S.R.K.Iyengar – R.K. Jain , Numerical Methods for Scientific and Engineering Computations. Willey Eastern Limited. New Age International (p) Ltd., Publishers. September 2011
2. Stevan C.Chopra, Raymond P.Canal , Numerical Methods for Engineers , 6th Edition Mc. Graw Hill Book Company. Sixth Edition

Reference Books:

1. C.Xavier by C Language and Numerical methods– New Age International Publisher. Reprint March 2012 ISBN:978-81-224-1174-4.
2. Dr. M.Shanta Kumar by Computer based numerical analysis Khanna Book publishes
3. N. Krishna Raju and K.U. Muthu, Numerical Methods for Engineering Problems by M.C. Millan Publishers, New Delhi.
4. William H. Press, soul A. Teukolsky, villam T. Vetterling , Brian P. Flannery ,Numerical Recipes in C "The Art of Scientific Computing" Cambridge University Press

Program Elective –II: (d) STRUCTURAL HEALTH MONITORING

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course objectives:

The objective of this course is to:

1.Familiarize the different techniques used in Structural Health Monitoring
2. Familiarize the challenges of Structural Health Monitoring

Course Outcomes:

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

CO1. Decide the NDF technique for specific damage
CO2. Analyze the need and challenges of Structural Health Monitoring (SHM)
CO3. Describe various methods of damage detection
CO4. Apply the Structural Health Monitoring technique for building.
CO5 Apply the Structural Health Monitoring techniques for bridge

SYLLABUS:

UNIT-I: NDT Evaluations

Concrete strength assessment –Rebound hammer test – Ultrasonic pulse velocity tests, penetration resistance, pull-out tests, core sampling and testing, chemical tests – carbonation, chloride, content and corrosion problem.

UNIT-II: Introduction to Structural Health Monitoring

Factors affecting the health of structures, SHM scheme, various steps in SHM, damage diagnostic methods, challenges in SHM, Experimental modal analysis, operational modal analysis and combined methods.

UNIT-III: Methods of Damage Detection

Vibration Control & SHM Damage Diagnostic methods based on vibration response, Method based on modal frequency/shape/damping, Curvature and flexibility method, Modal strain energy method, Sensitivity method, Baseline-free method.

UNIT-IV: Health Monitoring Systems of Building Structures

Numerical modelling– Use of sensors – Data acquisition techniques – Data Processing – Diagnostic techniques – Wireless sensor network – Rehabilitation techniques.

UNIT-V: Health Monitoring of Bridges

Measurement of Parameters, Sensors/Transducers technologies, Measurement & Health monitoring Techniques: Vibration signal analysis, Strain gage based Instrumentation, Destructive & Non-destructive testing, Load Test, etc.

Text books:

1. Charles R Farrar, and Keith Worden, Structural Health Monitoring: A Machine Learning Perspective, first edition, John Wiley & Sons ,2012-2013.
2. Nagayama, T. and Spencer Jr, B.F., Structural health monitoring using smart sensors, Newmark Structural Engineering Laboratory. University of Illinois at Urbana-Champaign,2007.

Reference Books:

1. Glisic, B. and Inaudi, D., "Fibre optic methods for structural health monitoring", John Wiley &Sons, 2008.
2. Do, Richard, "Passive and active sensing technologies for structural health monitoring", University of California, San Diego,2014.

Mandatory Course: RESEARCH METHODOLOGY AND IPR

Subject code:	**Credits : 2**
Instruction : 2 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Create awareness on various aspects of research starting from problem identification to dissertation.
2. Create exposure on IPR.

Course Outcomes:

At the end of this course, students will be able to

CO1: Illustrate research problem formulation.

CO2: Analyse research related information and research ethics

CO3: Summarise the present day scenario controlled and monitored by Computer and Information Technology, where the future world will be ruled by dynamic ideas, concept, creativity and innovation.

CO4: Explain how IPR would take such an important place in growth of individuals & nation, to summarise the need of information about Intellectual Property Right to be promoted among student community in general & engineering in particular.

CO5: Relate that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about economic growth and social benefits.

SYLLABUS:

UNIT-I: Research Methodology an introduction

Meaning of research problem, Sources of research problem, Criteria and Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT-II: Literature Survey and Ethics

Effective literature studies approaches, analysis Plagiarism, Research ethics.

UNIT-III: Interpretation and Report Writing

Effective technical writing, how to write a report, Paper Developing a Research Proposal, Format of research proposal, presentation and assessment by a review committee.

UNIT-IV: Intellectual Property Rights and Patents

Nature of Intellectual Property: Patents, Designs, Trade and Copyrights. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property, Procedure for grants of patents, Patenting under PCT.

UNIT-V: Intellectual Patent Rights and Developments

Scope of Patent Rights. Licensing and transfer of technology, Patent information and databases, Geographical Indications. New Developments in IPR: Administration of the Patent System, New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge, Case Studies, IPR and IITs / NITs/ IIITs.

Text Books:

1. C.R.Kothari, "Research Methodology", 3rd Edition, New Age International, 2017.
2. Ranjit Kumar, "Research Methodology – A Step by Step for Beginner's", 2nd Edition, Pearson, Education, 2016.
3. T. Ramappa, "Intellectual Property Rights Under WTO", 2nd Edition, S Chand, 2015
4. Kompal Bansal&Parshit Bansal,"Fundamentals of IPR for Beginner's", 1st Edition, BS Publications, 2016.

Reference Books:

1. Mark Saunders, Philip Levis, Adrian Thornbill, "Research Methods for Business Students", 3rd Edition (Reprint), Pearson Education, 2013.
2. KVS Sharma, "Statistics made simple, Do it yourself", 2nd Edition (Reprint), Prentice Hall, 2010.

Audit Course 1: ENGLISH FOR RESEARCH PAPER WRITING

Subject code:	**Credits : 2**
Instruction : 2 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

Create awareness on research paper writing skills.

Course Outcomes:

At the end of this course, students will be able to

CO1: Demonstrate writing meaningful sentences and coherent paragraphs.

CO2: Show conciseness, clarity and avoid redundancy in writing.

CO3: Summarize, evaluate literature, and write methodology, results and conclusion.

CO4: Describe how to develop title, write abstract and introduction.

CO5: Apply correct style of referencing and use punctuation appropriately.

SYLLABUS:

UNIT I:

Planning and preparation, word order & breaking up long sentences, structuring sentences and paragraphs

UNIT II:

Being concise, avoiding redundancy, ambiguity and vagueness, literature survey - highlighting your findings, hedging, paraphrasing and plagiarism.

UNIT III:

Sections of a paper – abstract, introduction, etc. review of the literature, writing - methods, results, discussion, conclusions and final check.

UNIT- IV:

Writing – Title, Abstract and Introduction, Review of Literature and Methods.

UNIT -V:

Useful phrases and punctuation, in-text citation and bibliography – MLA/APA styles.

Text Books:

1. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg, London, 2011.
2.Day R. How to Write and Publish a Scientific Paper, Cambridge University Press, 2006.

References:

1.Goldbort R. Writing for Science, Yale University Press, 2006.
2.Highman N. Handbook of Writing for the Mathematical Sciences, SIAM.
Highman's book, 1998

LABORATORY COURSE I: COMPUTER APPLICATIONS IN STRUCTURAL ENGINEERING

Subject code:	**Credits : 2**
Instruction : 4 Practical / week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Course objectives:

The objective of this course is to

1. Familiarize the student on various methods of design of structural members using STAAD.PRO and ETABS

Course Outcomes:

At the end of this course, students will be able to

CO 1. Analyse the structural elements using software designs.

CO 2. Design the structures for the dynamic loads using softwares.

CO 3. Solve the finite elements application problems of structural engineering by softwares.

Application of software in Structural Engineering (by using STAAD Pro, ETABS) for the following problems.

1. Analysis and Design of Beams.
2. Analysis and Design of Footings.
3. Analysis and Design of Trusses.
4. Analysis and Design of Two Dimensional Frames.
5. Analysis and Design of Three Dimensional Frames.
6. Analysis and Design of Water Tanks.
7. Analysis and Design of Steel Members.
8. Implementation of Concepts of FEM using a Computer Language.

Reference Books:

1. Computer Applications In Structural Engineering by David R.Jenkins, American Society of Civil Engineers
2. Computer aided Design-Software and Analytical tools by C.S. Krishnamoorthy & S. Rajesh.
3. Computer aided design in reinforced concrete, V.L.Shah.

LABORATORY COURSE II: DESIGN STUDIO I (VIVA-VOCE)

Subject code:	**Credits : 2**
Instruction : 4 Practical / week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Course objectives:

The objective of this course is to

Familiarize the student on various design methods

Course Outcomes:

At the end of this course, students will be able to

CO 1. Design of Folded Plates and elevated Service Reservoir
CO 2. Design of Retaining walls and Grid floor
CO 3. Design of Flat slab
CO 4. Design of pressed steel tank
CO 5. Design of buried pipes

Any **THREE** of the following:

1. Design of Folded Plates
2. Elevated Service Reservoirs
3. Retaining walls
4. Grid floor
5. Flat slab
6. Pressed steel tank
7. Buried pipes

SEMESTER - II

Program Core III: FINITE ELEMENT ANALYSIS

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course objectives:

The objective of this course is to:

1. Apply vector mechanics as a tool for problem solving
2. Understand the need in Design for the Finite Element Method
3. Analyse a physical problem, develop experimental procedures for accurately investigating the problem, and effectively perform and document findings.
4. Understand forces associated with different parts of a machine

Course outcomes:

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

CO1 Develop finite element formulations of 1 degree of freedom problems and solve them
CO2 Understand any Finite Element software to perform stress, thermal and modal analysis
CO3 Compute the stiffness matrices of different elements and system
CO4 Interpret displacements, strains and stress resultants
CO5 Understand the formulation of two-dimensional elements (triangle and quadrilateral continuum and shell elements)

SYLLABUS:

UNIT-I: Introduction

A brief history of F.E.M. Need of the method, Review of basic principles of solid mechanics-Equations of equilibrium, Boundary conditions, Compatibility, Strain displacement relations, Constitutive relationship in matrix form, plane stress & plane strain and axisymmetric bodies of revolution with axi-symmetric loading, Energy principles - Raleigh - Ritz method of functional approximation.

UNIT-II:

Theory relating to the formulation of the finite element method, Coordinate system (local and global), generalized coordinates, Concept of the element, Various element shapes, Discretisation of a structure, Mesh refinement Vs. Higher order element, Interconnections at nodes of displacement models, inter element compatibility, -shape functions.

UNIT-III: Basic component – One dimensional FEM

single bar element, Beam element**:** Derivation of stiffness matrix, Assembly of stiffness, Matrix boundary conditions, shape functions for 1 D elements, Initial strain and temperature effects, and trusses under axial forces.

UNIT-IV: Two dimensional FEM

Different types of elements for plane stress and plane strain analysis – Displacement models Generation of element stiffness and nodal load matrices –static condensation.

UNIT-V:

Isoparametric representation and its formulation for 2d analysis. Formulation of 4-noded and 8-noded isoparametric quadrilateral elements – Lagrangian elements-serendipity elements.

Text Books:

1. C.S. Krishnamoorthy, "Finite Element Analysis", 2nd edition, Tata McGraw Hill Publishing Co. Ltd. 2002.
2. Tirupathi Chandra Patla and Belugundu, "Introduction to Finite Elements in Engineering", 4th edition, Pearson Education India,2015.

Reference Books:

1. Zienkiewicz, P, "The Finite Element Method in Engineering Science" McGraw Hill, 1971.
2. Desai,C.S.and Abel, J.F.,Van Nostrand, "Introduction to Finite Element Method", CBS Publishers & Distributors,2005.
3. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition,Wiley publisher,2001.

Program Core IV: STRUCTURAL DYNAMICS

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Demonstrate the principles and methods of dynamic analysis of structures
2. Illustrate dynamics response of single degree freedom system using fundamental theory and equation of motion
3. Interpret methods to analyse structures subjected to any kind of dynamic excitation and computing quantities like displacements, forces, stresses etc.
4. Analyse and study dynamics response of Multi degree freedom system using fundamental theory and equation of motion
5. Develop modal equations for damped and Undamped systems.

Course Outcomes:

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

CO1: Derive response for Undamped and damped SDOF Free vibration systems.
CO2: Derive equation of motion for various forced vibration.
CO3: Analyze the beams for dynamic loads.
CO4: Analyze the behavior for multi-degree of freedom system.
CO5: Apply the concept of continuous system and response to base excitation.

SYLLABUS:

UNIT-I: Basics of Structural Dynamics

Types of Analysis/Static and Dynamic; Degrees of Freedom; Dynamic Equilibrium Equation
Free Vibration**:** Undamped free Vibration and response, Natural Period/Frequency; Energy in Free Vibration; Damped Free Vibration; Types of damping; Logarithmic decrement.

UNIT-II: Single-Degree-Of-Freedom System to Harmonic Loading

Harmonic Excitation: Undamped System, Harmonic Excitation: Damped System.
General Dynamic Loading: General nature of impulsive loading, Response to Unit Impulse; Response to Step and Ramp Forces; Response to Rectangular Pulse, Half Sinusoidal wave, Duhamel's Integral- Undamped System, Duhamel's Integral-Damped System.

UNIT-III: Structures with Distributed Mass and Load

Single span beams, Normal modes of vibration, Forced vibrations of beams, Beams with variable cross-section and mass.

UNIT-IV: Approximate Design of Multi Degree Systems

Determination of natural frequencies, Stiffness Method, Flexibility Method, Stodola-Vianelle method, Rayleigh method, Modified Rayleigh-Ritz method; multi-storey rigid frames subjected to

lateral loads, damping in multi degree systems.

UNIT-V: Dynamic Response of Continuous Systems
Vibration of Continuous systems; Shear behaviour and bending behaviour of beams; Generalized. SDOF Ground Motion**:** Base Excitation, response to base excitation, Transmissibility.

Text Books:

1. Mario Paz and William Leigh," Structural Dynamics", Springer 5/e, 2006.
2. John M. Biggs, "Introduction to Structural Dynamics", McGraw Hill Inc. 1/e,2014.

Reference Books:

1. Anil K. Chopra, "Dynamics of Structures (Theory and Applications to Earthquake Engineering)", Pearson, Third Edition, 2007.
2. Alexander Chajes, "Principles of Structural Stability", Waveland Pr Inc".
3. Mario Paz, "Structural Dynamics: Theory and Computation", Second Edition,2004.

PROGRAM ELECTIVE- III: (a) OPTIMIZATION TECHNIQUES

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Familiarize the student on various methods of optimization and design of structural members.

Course Outcomes:

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

CO1. Explain various design parameters in optimization

CO 2. Solve by method of Lagrange Multiplier and Kuhn-Tucker conditions.

CO 3. Prepare the unconstrained and constrained optimization

CO 4. Estimate minimum weight design of rigid frame

CO 5. Design of beams and frame using dynamic programming technique

SYLLABUS:

UNIT-I: Introduction:

Need and scope of optimization, Historical development, Statement of an optimization problems, Objective function and its surface, design variables, constraints and constraint surface. Classification of optimization problems, various functions (continuous, discontinuous, and discrete) and Function behaviour (Monotonic, Non-Monotonic and Uni- modal)

UNIT-II: Classical Optimization Techniques:

Differential calculus method, Multivariable optimization by method of constrained variation and Lagrange multipliers (generalized problem). Kuhn-Tucker conditions for optimality. Fully stressed design and optimally criterion based algorithms, Introduction, Characteristics of fully stressed design theoretical basis – Examples.

UNIT-III: Non-linear Programming:

Unconstrained minimization – Fibonacci, Golden section, Quadratic and Cubic interpolation methods for a one-dimensional minimization and Univariate Method, Powel's method, Newton's

method and Davidon Fletcher Powell's method for multivariable optimization. Constrained minimization – Cutting plane method, Zoutendijk's method and penalty function methods.

UNIT-IV: Linear programming

Definitions and theorems – Simplex method – Duality in linear programming. Plastic analysis and minimum weight design and rigid frame.

UNIT-V: Introduction to quadratic programming, Geometric programming and Dynamic programming. Design of beams and frame using dynamic programming technique.

Text Books:

1. Rao, S.S, "Optimization Theory and Applications" Wiley Eastern Ltd., New Delhi, 1978.
2. Majid, K.I., Newnes-Butter Worths, "Optimum Design of Structures", London, 1974.

Reference Books:

1. Robert, M. Stark and Robert L. Nicholls, "Mathematical Foundations for Design: Civil Engineering Systems", McGraw Hill Book Company, New York, 1972.
2. Gallegher, R.H. and Zienkiewiez, O.C., "Optimum Structural Design, Theory and Applications" John Wiley and Sons, New York, 1973.

PROGRAM ELECTIVE- III: (b) BRIDGE ENGINEERING

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Familiarize with the design of Steel Bridges and different loads calculations
2. Familiarize with the design of truss girder bridges
3. Familiarize with the concept and design of concrete bridges
4. Familiarize with the analysis and design of T girder bridges

Course outcomes:

At the end of this course students will be able to

CO 1. Design of steel bridges and Characterize different types of loads.
CO 2. Design of Plate girder bridges
CO 3. Design of Truss Girder Bridges
CO 4. Concept of Concrete Bridges
CO 5. Analysis and Design of T Girder Bridges

UNIT-I: Steel Bridges

Introduction, classification of steel bridges, economical span, clearance requirements, dimensions of rolling stock, width of roadway and footway. Loads: Live load for Railway, Highway and combined rail cum road bridges, Impact effect, wind load, lateral force (racking force), longitudinal forces, centrifugal forces, seismic forces, temperature effects.

UNIT-II: Plate girder bridges

Introduction, types, general arrangement, wind load effects, analysis and design of Deck type plate girder bridge for railways, analysis and design of Half-through plate girder bridge for railways, analysis and design of Through type plate girder bridge for railways.

UNIT-III: Truss girder bridges

Introduction, general arrangement of components of truss girder bridge, self-weight of Truss girder bridge, wind load and wind effects, analysis of portal bracing, analysis and design of through type truss girder bridge.

UNIT-IV: Concrete Bridges:

Introduction to bridge engineering. Historical background of bridges and types. Bridge aesthetics and proportioning. Design process. Review of applicable design codes. Loads on bridges and force distribution. Bridge geometry.

UNIT-V: Analysis and design of T-beam bridge:

Deck slab considering IRC loads, longitudinal girders (Interior, Exterior), Cross girder.

Text books:

1. D. Jhonson Victor "Essentials of Bridge Engineering", 6th Edition, Oxford University Press, 2017.
2. B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain "Comprehensive design of steel structures", 2nd Edition, Laxmi Publications (P) Ltd, 2015.

Reference Books:

1. N.Krishna Raju "Design of Bridges",5th Edition, Oxford & IBH Publishing Co.Pvt.Ltd., 2019.
2. N. Subramanian"Design of Steel structures", Oxford University Press, 2018.
3. Ramchandra and Virendra Gehlot "Limit State Design of steel structures –, Scientific Publishers, 2017.

Codes:

1. IS:80 -2007 Indian Standard Code of Practice for Steel.
2. IS: 456-2000 Indian Standard Code of Practice for Plain and Reinforced Concrete.
3. IS: 875-Part I (2018) Code of Practice for Design Loads.
4. IS: 875-Part II (2018) Code of Practice for Design Loads.
5. IS: 875-Part III (2020) Code of Practice for Design Loads.

PROGRAM ELECTIVE- III: (C) DESIGN OF TALL STRUCTURES

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Intended to teach the concept of tall structures.
2. Various methods to analyse the tall structure will be explained in the classes.

Course Outcomes:

At the end of this course students will be able to

CO 1. Know the types of tall buildings.
CO 2. Analyse the plane frame systems by different methods.
CO 3. Design the shear wall system and in filled frame systems.
CO 4. Design Reinforced Concrete chimneys
CO 5. Analyse Multi-storey building frames using various methods.

SYLLABUS:

UNIT-I: Introduction

Basic wind speed, Design wind speed, Design wind pressure, offshore wind velocity, wind pressures and forces in buildings/structures, External pressure coefficients for various roofs, dynamic effects.

UNIT-II: Lateral Load Analysis of multi-storey Building Frames

Analysis of multi-storey Building Frames for lateral loads, Cantilever method, Portal method and Factor method.

UNIT-III: Design of Shear Wall

Introduction, Types of shear walls, Behaviour of cantilever wall with rectangular cross-section, flange cantilever shear walls, Moment-Axial load interaction for shear wall section, Interaction of shear walls and rigid joined frames, Shear walls with openings, Coupled shear walls.

UNIT-IV: Design of Chimneys (RCC)

Introduction, Wind pressure, Stress in chimney shaft due to self-weight and wind, Stress in horizontal reinforcement due to wind shear, Stresses due to temperature difference. Design of RC chimney.

UNIT-V: Multi-storey Building Frames

Analysis of multi-storey frames, Method of substitute frames, Bending moments in beams and columns.

TEXT BOOKS:

1. Ashok Kumar & B.C.Punmia Jain, "Limit State Design of Reinforced Concrete" Revised 1st Edition, Laxmi Publications, 2016.
2. N. Subramanian, "Design of Steel Structures" Oxford University Press 2018.

REFERENCE BOOKS:

1. Park, R. & Paulay, "Reinforced Concrete Structures" John Wiley & Sons Inc Publications.
2. N.KrishnaRaju "Advanced Reinforced Concrete Design",TataMcGraw Hill Co, 2016
3. Manohar and S.N "Tall Chimneys", Tata McGraw-Hill Pub. Co.

PROGRAM ELECTIVE- III: (d) FRACTURE MECHANICS

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1.Familiarize on the different types of failures, stress intensity factor

2. Familiarize the test methods

Course Outcomes:

the end of the course:

1. Students will be able to use any one of the four parameters for finding out damage tolerance: stress intensity factor, energy release rate, J integral, Crack tip opening displacement.
2. Students will be able to manage singularity at crack tip using complex variable.
3. Students will understand important role played by plastic zone at the crack tip.
4. Students will learn modern fatigue and will able to calculate the fatigue life of a component with or without crack in it.
5. Students will learn modern sophisticated experimental techniques to determine fracture toughness and stress intensity factor.

SYLLABUS:

UNIT-I: Modes of fracture failure, Brittle and ductile fracture. Energy release rate: crack resistance, stable and unstable crack growth.

UNIT-II: Stress intensity factor: Stress and displacement fields, edge cracks, embedded cracks.

UNIT-III: Crack tip plasticity: Shape and size of plastic zone, effective crack length, effect of plate thickness, J-Integral. Crack tip opening displacement.

UNIT-IV: Test methods for determining critical energy release rate, critical stress intensity factor, J-Integral.

UNIT-V: Fatigue failure: Crack propagation, effect of an overload, crack closure, variable amplitude fatigue load. Environment-assisted cracking. Dynamic mode crack initiation and growth, various crack detection techniques.

Text Books:

1. Brook D, “Elementary engineering fracture mechanics”, 4th Edition, Springer publications, 2012

2. Liebowitz H., “Fracture” Volume I to VII., Academic Press (1972)

Reference Books:

1. A Nadai, W. S. Hemp, “Theory of flow and fracture of solids”, McGraw Hill Book Company, 1950.

2.T.L. Anderson, “Fracture mechanics: Fundamentals and Applications”, 4th Edition. CRC Press, Taylors & Francis, 2017.

PROGRAM ELECTIVE – IV: (a) CONSTRUCTION METHODS AND EQUIPMENT

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Create awareness on the different construction methods in excavation of trenches and errection of Buildings.
2. Familiarize on the different construction equipment.

Course Outcomes:

At the end of the course the student should be able to

CO1: Associate the knowledge of construction of substructures and superstructures.
CO2: Analyse the techniques for Erection of Construction units.
CO3: Demonstrate basic knowledge about earth moving, excavation and compacting equipment.
CO4: Discuss about hoisting equipment.
CO5: Discuss about Hauling equipment.

SYLLABUS:

UNIT–I: Substructure

Digging and excavation of trenches – Grading – Special earth work excavation – Drilling and blasting techniques. Pile driving techniques – sinking wells.

Superstructure: Concrete and reinforced concrete works – forms work – reinforcement – concreting – mechanized methods of errection of Buildings and installations. Cast-insitu and pre-cast concrete. Concreting below G.L. – wall in situ method for cast in situ and precast concrete – under water concreting design of forms.

UNIT-II Errection of construction units – different types – scaffolding. Errection of steel structures–Tunnelling techniques. Pre cast and prefabricated construction–need and advantages. Modular coordination–I.S. recommendations for modular planning, standardization, mass production and methods of transportation.

UNIT-III Earthmoving Equipment

Power shovels, Back hoe, Dragline, Clam shell; Excavating Equipment: Scraper, Bulldozer. Compacting Equipment Smooth wheel roller sheep-foot roller – Pneumatic typed rollers.

UNIT-IV Hoisting equipment

Hoist winch, hoisting chains, and hooks and slings, various types of cranes –tower crane, mobile crane and derric crane. Their characteristics, performance and safety in operation.

UNIT-V Hauling Equipment

Dump trucks and dumpers. Conveying Equipment: Belt Conveyors, Screw conveyor, Bucket conveyor. Agreement and Concrete production equipment: Concrete mixers, truck mixers, pneumatic concrete placer, concrete vibrators.

Pile Driving Equipment: Tunnelling and rock drilling equipment – Pumps and dewatering equipment.

TEXT BOOKS:

1. Mahesh Varma, "Construction Equipment and its Planning and Applications" Metropolitan Book Co.(P) Ltd., New Delhi. India, 1997.
2. B. Sengupta and H. Guha, "Construction Management and Planning ",TMH Publication.

REFERENCES:

1. S. Seetharamam, "Construction Engineering and Management" (Umesh Publications, Delhi.
2. Rangwala, "Construction of Structures and Management of Works", Charotar publishers.
3. Jay P.K. "Hand Book of Construction Management" – Mamillan India Ltd., New Delhi, 1990.
4. National Building Code, ISI, New Delhi, 1983.
5. Levitt, R.E. and Samelson, N.M. "Construction Safety Management", Mc. Graw Hill Book Company, Inc., N.Y. 1991.

PROGRAM ELECTIVE – IV: (b) RELIABILITY OF STRUCTURES

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Orient the students towards safety in structures
2. Impart probability theory and statistical parameters
3. Assist in designing structurally stable and reliable structures

Course Outcomes:

At the end of this course students will be able to

CO1 Explain the concepts of structural safety and design methods
CO2 Explain the concept of Probability theory
CO3 Identify statistical parameters in reliability
CO4 Describe structural reliability and its methods
CO5 Apply reliability parameters to design of simple RCC structures

SYLLABUS:

UNIT-I: Introduction

General concepts of Structural Safety, Design methods.

UNIT-II: Probability Theory

Introduction to Probability Theory, Random events, Random variables, Functions of random variables, Moments and expectation, Common probability distribution, Extremal distribution. Probabilistic Analysis of Gravity loads and Wind load.

UNIT-III: Introduction to Basic Statistics

Introduction to Basic Statistics, Data reduction, Histograms, Sample correlation.
Statistics of properties of concrete, steel, strength of bricks and mortar. Dimensional variations, Characterization of variables, Allowable stresses based on specified reliability.

UNIT-IV: Structural Reliability

Introduction to basic Structural Reliability, Computation of structural reliability, Monte Carlo method and applications. Introduction to Reliability Methods, basic variables and failure surface, First-order second-moment methods (FOSM).

UNIT-V: Design

Introduction to Reliability based Design, determination of partial safety factors, Safety checking formats, Development of reliability based design criteria, Optimal safety factors, Summary of results of study for Indian standard – RCC design. Preliminary concepts of Reliability of Structural Systems as applied to simple structures.

Text Books:

1. R.Ranganatham, "Structural Reliability Analysis and Design", Jaico Publishing House.
2. R.EMelchers ,"Structural Reliability", John Wiley and Sons Ltd,2017.

Reference Book:

1. Thoft-Cristensen, P.Baker, M.J., "Structural Reliability Theory and its applications", springer.

PROGRAM ELECTIVE – IV: (c) PRESTRESSED CONCRETE STRUCTURES

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to:

1. Become familiar with the different types of prestressing systems
2. Familiarize the students with IS code provisions
3. Understand concept of design of members for flexure
4. Familiarize students with design of end block and deflection criteria

Course Outcomes:

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

CO1. Discuss various prestressing methods.

CO2. Analyse the beams for a given prestressing force.

CO3. Discuss various losses and design the beams for flexure.

CO4. Explain the concepts of transfer of prestress and anchorage in end block.

CO5. Compute deflection in prestressed concrete beam.

SYLLABUS:

UNIT-I: Introduction

Basic concepts of prestressing need for high strength steel and concrete, advantages of Prestressed concrete. Materials for Prestressed concrete, high strength concrete and high strength steel.Prestressing systems and losses of prestress: (1) Freyssinet Anchorage System (2) Gifford Udall System (3) Magnel-Blaton System, Tensioning devices, anchoring devices. (d) Pretensioning and Post tensioning.

UNIT-II: Analysis of Prestressed Concrete Beams

Assumptions, Analysis of prestress, Resultant stresses at a section, pressure or thrust line, concept of load balancing, cable profile, kern distance, stress in tendons as per IS 1343, cracking moment.

UNIT-III: Prestressing losses and Design of Prestressed Concrete Members

Prestressing losses, Elastic shortening, loss due to shrinkage, loss due to creep, loss due to friction, loss due to slip etc. I.S.code provisions. Design of sections for flexure and shear, Ultimate moment and shear resistance of Prestressed Concrete Members.

UNIT-IV: Transfer of prestress and Anchorage members

Transmission length, bond stress, Transverse tensile stress, End Zone reinforcement, flexural bond stress, I.S. Code Provisions.Anchorage zone in post tensioned members: Introduction, stress distribution in End block, Investigation on Anchorage Zone Stresses- Magnel's method, Guyon's method of approach of analysis of end block (Not more than 2 cables).

UNIT-V: Deflection of Prestressed Concrete Members

Importance of Control of Deflections, Factors Influencing Various Codes of Practice.Deflections, Short-Term Deflection of Uncracked members, Prediction of Long Time Deflections, Deflection of Cracked Members, Requirements of various codes of practise.

Text Books:

1. N.Krishna Raju, Prestressed Concrete, Tata McGraw-Hill Publishing Company Limited,5th Edition, 2008.

Reference Books:

1. N. Rajagopalan, Prestressed Concrete, Alpha Science, 2nd edition, 2015.
2. P. Dayaratnam, Prestressed Concrete Structures, Oxford & Ibh, 6th edition, 2018.
3. T.Y. Lin and Ned. H. Burns, Design of Prestressed Concrete Structures, John Wiley and Sons, 3th edition, 2013.

PROGRAM ELECTIVE – IV: (d) FIRE RESISTANT DESIGN OF STRUCTURES

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Explain basic properties of materials for fire resistant design
2. Design of structural assemblies exposed to fire
3. Design of steel buildings exposed to fire
4. Evaluation of fire resistance rating of materials
5. Design of concrete members exposed to fire

Course Outcomes:

At the end of this course students will be able to

CO 1. Summarize the basic properties of materials for fire resistant design.
CO 2. Design structural assemblies exposed to fire.
CO 3. Design steel buildings exposed to fire.
CO 4. Find out fire resistance rating of materials.
CO 5. Determine size of concrete members exposed to fire.

UNIT-I:

Materials Properties in fire, Classification systems for high temperature concretes. Design of Structures at normal temperatures – Loads, Structural analysis, Material Properties, Probability of failures. Design of structures under fire conditions – Design equate loads for fire design, structural analysis.

UNIT-II:

Design structural assemblies exposed to fire – Frames – Redundancy – Disproportionate collapse – continuity – plastic design.

UNIT-III:

Design of steel buildings exposed to fire – Multi-storey steel framed buildings.

UNIT-IV:

Fire resistance ratings, verification methods, Generic ratings Projection System Mechanical properties of concrete at elevated temperature Test methods, Components of strain, Thermal strain, Stress related strain.

UNIT-V: Cylindrical Shells

Design of Concrete members exposed to fire member design, simply supported slabs and beams, Tension and compression members. Design of individual members exposed to fire – Tension members – Compression members – Beams.

Text Books:

1. Jain, V. K., “Fire Safety in Buildings”, 2/e, New Age Publishers, 2013.
2. Andrew H. Buchanan, “Structural Design for Fire safety”, Wiley – Blackwell, 2001.

Reference Books:

1. G.M. Newman and R.M. Lawson,” Fire Resistant Design of Steel Structures”: A Handbook to BS 5950 (1990).

AUDIT COURSE II: PEDAGOGY STUDIES

Subject code:	**Credits : 0**
Instruction : 2 Lectures/week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Course Objectives:
The objective of this course is to

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

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

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SYLLABUS:

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 are being used 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 materials 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, Peer 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.

Text Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

Reference Books:

1. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
2. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.

LABORATORY COURSE III: REPAIR AND REHABILITATION OF STRUCTURES

Subject code:	**Credits : 2**
Instruction : 4 Practical / week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Course Objectives:

The objective of this course is to

1. Emphasize the need for repair and maintenance of existing buildings
2. Discuss materials and methods in rehabilitation of buildings
3. Differentiate between concrete, masonry and temple building rehabilitation
4. Moderate student case study presentations

Course Outcomes

At the end of the course the student should be able to

CO1. Recognize various materials used in repair and rehabilitation of buildings

CO2. Distinguish various methods of testing of existing structures, their strengths and weaknesses

CO3. Apply acquired knowledge to repair and rehabilitate concrete and reinforcement components of structural elements

CO4. Demonstrate knowledge on rehabilitation of masonry and temple buildings

CO5. Study and generate reports for repairs to existing structures using case studies

SYLLABUS:

UNIT I: Materials for repair and rehabilitation

Construction chemicals, Mineral admixtures, Composites, Fibre reinforced concrete, High performance concrete, Polymer-impregnated concrete.

UNIT II: Methods for rehabilitation and repair

Techniques to Test the Existing Strengths, Destructive and non-destructive tests on concrete.

UNIT III: Repairs to Concrete structural elements

Cracks in concrete, Possible damages to the structural beams, Slab, Column, Footing, etc., Repairing techniques like Jack Chu, Grouting, External prestressing, Use of chemical admixtures; Repairs to the fire damaged structure. Rehabilitation of corrosion of Reinforcement: Preventive measures – Coatings – Use of SBR modified cementitious mortar, Epoxy resin mortar, FRP, Acrylic modified cementitious mortar, Flowing Concrete.

UNIT IV: Repairs to Masonry Structures & Temples

Damages to masonry structures – Repairing techniques, Damages to temples – Repairing techniques.

UNIT V: Ancillary techniques for rehabilitation

Foundation Problems: Settlement of soils – Repairs, Sinking of piles – Repairs. Need for temporary structures under any Hazard, Various temporary structures.

At least 2 case studies per each student on existing masonry, temple or concrete structures

References:

1. Sidney M. Johnson "Deterioration, Maintenance and Repair of Structures" Krieger Publishing Company (31 December 1980)

2. R. Dodge Woodson "Concrete Structures: Protection, Repair and Rehabilitation, Butterworth-Heinemann; Illustrated edition (14 September 2009)

LABORATORY COURSE IV: DESIGN STUDIO II (VIVA-VOCE)

Subject code:	**Credits : 2**
Instruction : 4 Practical / week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Any **THREE** of the following:

1. Design of blast resistant structures
2. Design of berth structures
3. Design of Quay Walls
4. Pre-engineered buildings
5. Bow string girder bridge
6. Balanced cantilever bridge
7. Raft design
8. Design of Piles and pile caps

Reference Books:

1.Purushothaman P, Reinforced Concrete Structural Elements, 3rd Edition, Tata McGraw- Hill Publishing Co, 2004.

2.Reinforced Concrete by Park and Paulay, John Wiley & Sons.

MINIPROJECT WITH SEMINAR

Subject code:	**Credits : 2**
Instruction : 4 Practical / week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

SEMESTER - III

PROGRAM ELECTIVE – V: (a) EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Learning the concept of Engineering Seismology.
2. Conceptual design planning and analysis of earthquake engineering
3. Learning Requirements for Ductility and Assessments

Course Outcomes:

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

CO 1. Identify the concept of Engineering Seismology.
CO 2. Design requirements of earthquake engineering
CO 3. Design and analysis of earthquake resistance building as per IS code
CO 4. Differentiate between structural and non-structural elements.
CO 5. Explain the ductility considerations in Earthquake Resistant Design

SYLLABUS:

UNIT – I:

Engineering Seismology: Earthquake phenomenon cause of Earthquakes-Faults- Plate tectonics Seismic waves- Terms associated with earthquakes-Magnitude/Intensity of an earthquake-scales Energy released-Earthquake measuring instruments- Seismoscope, Seismograph, accelerograph Characteristics of strong ground motions- Seismic zones of India.

UNIT – II:

Conceptual design: Introduction- Functional Planning-Continuous load Path-Overall form-simplicity and symmetry-elongated shapes-stiffness and strength-Horizontal and Vertical members-Twisting of buildings-Ductility-definition-ductility relationships-flexible buildings-framing systems-choice of construction materials-unconfined concrete-confined concrete-masonry-reinforcing steel. Introduction to earthquake resistant design: Seismic design requirements-regular and irregular configurations basic assumptions-design earthquake loads-basic load combinations-permissible stresses-seismic methods of analysis-factors in seismic analysis-equivalent lateral force method-dynamic analysis response spectrum Method-Time history method.

UNIT – III:

Reinforced Concrete Buildings: Principles of earthquake resistant deign of RC members- Structural models for frame buildings- Seismic methods of analysis- Seismic deign methods- IS code based methods for seismic design- Seismic evaluation and retrofitting- Vertical irregularities- Plan configuration problems- Lateral load resisting systems- Determination of design lateral forces

Equivalent lateral force procedure- Lateral distribution of base shear. Masonry Buildings: Introduction Elastic properties of masonry assemblage- Categories of masonry buildings- Behaviour of unreinforced and reinforced masonry walls- Behaviour of walls- Box action and bands- Behaviour of infill walls- Improving seismic behaviour of masonry buildings- Load combinations and permissible stresses- Seismic design requirements- Lateral load analysis of masonry buildings.

UNIT – IV:

Structural Walls and Non-Structural Elements: Strategies in the location of structural walls- sectional shapes- variations in elevation- cantilever walls without openings – Failure mechanism of non-structures- Effects of non-structural elements on structural system- Analysis of non-structural elements- Prevention of non-structural damage- Isolation of non-structures.

UNIT – V:

Ductility Considerations in Earthquake Resistant Design of RC Buildings: Introduction- Impact of Ductility- Requirements for Ductility- Assessment of Ductility- Factors affecting Ductility- Ductile detailing considerations as per IS 13920. Behaviour of beams, columns and joints in RC buildings during Earthquakes-Vulnerability of open ground storey and short columns during earthquakes. Capacity Based Design: Introduction to Capacity Design, Capacity Design for Beams and Columns Case studies.

TEXT BOOKS:

1. S. K. Duggal, "Earthquake Resistant Design of structures", Oxford University Press
2. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of structures", Prentice Hall of India Pvt. Ltd.

REFERENCE BOOKS:

1. T. Paulay and M.J.N. Priestly, "Seismic Design of Reinforced Concrete and Masonry Building", John Wiley & Sons.
2. Miha Tomazevic," Earthquake –Resistant Design of Masonry Building ", Imperial College Press.

REFERENCE CODES:

- IS: 1893 (Part-1) -2016. "Criteria for Earthquake Resistant – Design of structures." B.I.S., New Delhi.
- IS: 4326-1993, "Earthquake Resistant Design and Construction of Building", Code of Practice B.I.S., New Delhi.
- IS: 13920- 2016, "Ductile detailing of concrete structures subjected to seismic force" – Guidelines, B.I.S., New Delhi.

PROGRAM ELECTIVE – V: (b) THEORY OF PLATES AND SHELLS

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Introduce the concept of plate theory.
2. Study the behavior and analysis of thin plates.
3. Study the behavior and analysis of rectangular plates and circular plates.
4. Present the foundations of the classical theory of shells based on the Kirchhoff-Love assumptions.
5. Study the classification of shell surfaces

Course Outcomes:

At the end of this course students will be able to

CO 1. Assess the strength of plate panels under point, linearly varying and uniformly distributed loads.

CO 2. Analyze plates under different boundary conditions by various classical methods and approximate methods.

CO 3. Be familiar with classification of shells and classical shell theories and apply them in engineering design

CO 4. Be exposed to singly curved shells, doubly curved shells and cylindrical shells.CO CO 5. Analyse Multi-storey building frames using various methods

UNIT-I: Introduction to Plate Theory

Thin Plates with small deflection. Laterally loaded thin plates, governing differential equation, various boundary conditions.

UNIT-II: Rectangular Plates

Rectangular plates. Simply supported rectangular plates, Navier solution and Levy's method, Rectangular plates with various edge conditions, plates on elastic foundation.

UNIT-III: Symmetrical Bending of Circular Plates

Differential equation for symmetrical bending of laterally loaded circular plates - Simply supported edges - Clamped edges - Circular plate with a circular hole at the center - Circular plate concentrically loaded.

UNIT-IV: Introduction to Shells

Structural behaviour of shells - classification of shells - translational and rotational shells – ruled surfaces - Gaussian curvature - synclastic and anticlastic surfaces. Principal curvatures and lines of curvature

UNIT-V: Cylindrical Shells

Membrane theory of cylindrical shells; Bending theory of cylindrical shells loaded Symmetrically –Approximate solution by Schorer's method, Beam method of analysis

Text Books:

1. S.P.Timoshenko and S.Woinowsky-Krieger, "Theory of plates and shells" McGraw-Hill, 1959.
2. A.C.Ugural, "Stresses in Plates and Shells", McGraw-Hill, 1999.
3. Chandrashekahara, K., "Theory of Plates", University Press (India) Ltd., Hyderabad, 2001.

Reference Books:

1. T.K.Varadan and K.Bhaskar , "Analysis of plates", Narosa Publishing House, 1999.
2. Flugge. "Stresses in Shells", Blaisdell Publishing Co, 1966
3. G.S.Ramaswamy, "Design and construction of concrete shell roofs", CBS Publishers& Distributors,1986.

PROGRAM ELECTIVE – V: (c) ADVANCED FOUNDATION ENGINEERING

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:
The objective of this course is to

1. Familiarize the design of different types of foundations such shallow, deep and machine.
2. Evaluate the settlements in cohesion less soils.
3. Explain the various problems in expansive soils.

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

CO1. Design combined footings for two and three column loads, raft foundation both flat slab type and slab and beam type.
CO2. Generalized the various types of settlements in cohesion less soils by various methods.
CO3. Design Driven and Bored piles for its soil capacity and also structural capacity.
CO4. Illustrate the foundation problems in expansive soils and remedies.
CO5. Analyse and design Block Type Machine Foundation.

SYLLABUS:

UNIT-I: Design of Shallow Foundations
Bearing Capacity theories, Types of Reinforced Concrete foundations and their behaviour, Design of combined footings with two point loads and three point loads – Reinforcement detailing.
Types of Raft foundation, allowable pressures for raft in cohesive and cohesion less soils, Conventional design of raft foundation, Design of flat slab raft foundation, Design of beam and slab raft foundation.

UNIT-II: Settlement Analysis
Uniform and Differential Settlements, Elastic and Consolidation Settlements, Settlement analysis in cohesion less soils by Schemartmann and Hartman method, Penetration tests; Permissible settlements as per IS 1904-1978, causes of settlement, settlement Control.

UNIT-III: Pile Foundation
Types of piles, Design of driven (pre-cast) and Bored piles, Loads on pile groups, Reinforcement detailing, Design of pile caps, Two, three and four pile caps, Reinforcement detailing.

UNIT-IV: Foundations in Expansive Soils

Introduction, Identification of expansive soils, Swell potential and swelling pressure, Active depth, Foundation Problems, Foundation practices in expansive soils, Soil Replacement and 'CNS' concepts.

UNIT–V: Design of Machine Foundations

Introduction – Types of machine foundations –General requirements – Dimensional criteria – Design data, Dynamic loads, permissible amplitudes, permissible bearing pressures, analysis and design of a Block type machine foundation.

Text Books:

1. Das B.M., Principles of Foundation Engineering, Sixth edition (India), Thomson, 2007.
2. Varghese, P.C., Reinforced concrete Foundations, prentice hall of India pvt. Ltd., New Delhi, 2011.

Reference Books:

1. Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R. Rao, 2nd edition, New Age International Publications.
2. P. Srinivasulu & C.V. Vaidyanathan, Handbook of Machine Foundations, Structural Engineering Research Centre, Madras, Tata McGraw Hill Publishing Company Ltd., 2017.
3. IS: 2911 (Part 1) 2010 Design and construction of pile foundation. Sec 1: Driven cast –in-situ concrete piles. Sec 2: Bored cast-in-situ concrete piles. Sec 3: Driven precast concrete piles.
4. IS: 2950 (Part 1) -1981, Code of practice for Design and Construction of raft foundations.
5. IS: 2974 (Part 2)-1980, Code of Practice for Design and Construction of Machine Foundations, Foundations for Impact Type Machines.

PROGRAM ELECTIVE – V: (d) PORT AND HARBOUR STRUCTURES

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course objectives:

The objective of this course is to:

1.Understand the significance of port and harbours as a mode of transport, integrate port and harbour infrastructure

2.Demonstrate the fundamental principles of wave hydrodynamics, design of port layout .

3.Familiarize maintenance and renovation aspects of ports and inland waterways.

Course outcomes:

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

CO1. Explain the significance of port and harbours as a mode of transport.
CO2. Demonstrate the fundamental principles of wave hydrodynamics and port cargo handling.
CO3. Demonstrate the basic design of port layout.
CO4. Design, plan and integrate port and harbour infrastructure.
CO5. Explain the construction, maintenance and renovation aspects of ports and inland waterways.

SYLLABUS:

UNIT-I: Introduction

Ports and harbours–an infrastructure layer between two transport media, planning of ports and harbours.

The fundamentals: Waves, Tide and current conditions inside harbour, water circulation; breakwaters, jetties and quay walls; mooring, berthing and ship motion inside the port; model studies, physical and mathematical studies.

UNIT-II: Design Issues: Sea port layout with regards to (1) wave action (2) siltation (3) navigability berthing facilities.

Design of Port Infrastructures: Design of port infrastructures with regards to (1) cargo handling (2) cargo storage (3) integrated transport of goods, planning multipurpose port terminals.

UNIT-III: Port Operations

Allowable wave conditions for cargo handling, wave conditions for human safety on quays and breakwaters, forecasting/now casting of wave and current conditions for port operations, dredging and navigability, hazard scenarios; VTMS and management of computerized container terminal, safety and environment (handling of fire, oil spill, rescue, etc.).

UNIT-IV: Inland Waterways and Ports

Maintenance of waterways, construction of environmentally engineered banks, dredging and disposal processing and storing of polluted dredged materials, development of river information services.

UNIT-V: Construction Aspects

Planning and construction, expansion and renovation of port and Inland Port Infrastructure.

Sustainability: Global trade and port restructuring/reforms, impact of possible climate change scenarios, sustainable development strategies for cities and ports.

Text Book:

1. Muir Wood, A.M., and Fleming. C.A."Coastal Hydraulics Sea and Inland Port Structures", 2nd Edition, Hallstead Press, 2014.
2. Ozha & Ozha "Dock and Harbour Engineering", 7th Edition, Charotar publications, Gujarat, 2012.

Reference Book:

1. Seetharaman,S "Construction Engineering and Management", 2nd Edition, Umesh publications, New Delhi, 2000.
2. Richand L. SilIster "Coastal Engineering Volume I & II", Elsevier Publishers,2019.
3. PeraBrunn "Port Engineering", 4th Edition, Gulf Publishing Company,2012.

OPEN ELECTIVE: (a) BUSINESS ANALYTICS

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. Gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. Become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Course Outcomes:

At the end of the course the student should be able to

CO1. Demonstrate knowledge of data analytics.

CO2. Demonstrate the ability of think critically in making decisions based on data and deep analytics.

CO3. Demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.

CO4. Demonstrate the ability to translate data into clear, actionable insights.

SYLLABUS:

UNIT-I:

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics.

Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT-II:

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression.

Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT-III:

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.

Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT-IV:

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.
Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT-V:

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

TEXT BOOKS:

1. R. Evans James “Business Analytics”, Second edition, Pearson Education (27 January 2017).

REFERENCES:

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey “ Business Analytics Principles, Concepts, and Applications” . Pearson FT Press; 1st edition (7 October 2014)

OPEN ELECTIVE: (b) INDUSTRIAL SAFETY

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

SYLLABUS:

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, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

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, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

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: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TEXT BOOKS:

1. Higgins & Morrow, “Maintenance Engineering Handbook”, 4th Revised edition, DA Information Services; (1 September 1987)
2. H. P. Garg “Maintenance Engineering”, S. S.Chand (G/L) & Company Ltd; 3rd edition (1 May 1987)

REFERENCES:

1. Audels, Theo, “Pump-hydraulic Compressors”, Audel & Company Publishers (January 1, 1949)
2. Winterkorn and Fang “Foundation Engineering Handbook”. Galgotia Booksource (1 January 2010)

OPEN ELECTIVE: (c) OPERATIONS RESEARCH

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Outcomes

At the end of the course the student should be able to

CO1. Apply the dynamic programming to solve problems of discreet and continuous variables.
CO2. Apply the concept of non-linear programming
CO3. Carry out sensitivity analysis
CO4. Model the real world problem and simulate it.

SYLLABUS:

UNIT–I: **Introduction**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT–II:

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

UNIT–III:

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

UNIT–IV:

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT–V:

Competitive Models, Single and Multi-Channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

TEXT BOOKS:

1. H.A. Taha, "Operations Research, An Introduction" 10th Edition, Pearson , 2017
2. H.M. Wagner, "Principles of Operations Research" 2nd edition ,Prentice Hall India Learning Private Limited; (1 January 1980)

REFERENCES:

1. J.C. Pant, “Introduction to Optimisation: Operations Research”, Jain Brothers (1 January 2008)
2. Hitler Libermann “Operations Research” Tenth edition, McGraw Hill Education; (5 July 2017)
3. Pannerselvam, “Operations Research”: 2nd Edition, PHI Publication (1 June 2016)
4. Harvey M Wagner, “Principles of Operations Research”: 2nd Revised edition, Prentice Hall; (1 June 1975)

OPEN ELECTIVE: (d) COST MANAGEMENT OF ENGINEERING PROJECTS

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

SYLLABUS:

UNIT–I: **Introduction**
Introduction and Overview of the Strategic Cost Management Process

UNIT–II:
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.

UNIT–III:
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non- technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

UNIT–IV:
Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT–V:
Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

TEXT BOOKS:

1. Srikant Datar and Madhav Rajan, "Cost Accounting a Managerial Emphasis", Pearson; 16th edition (19 January 2017)
2. "Cost Accounting: A managerial Emphasis" (Charles T HornGren Series in Accounting), Pearson: 9th Edition (31 July 1996)

REFERENCES:

1. Colin Drury, "Management & Cost Accounting", Cengage Learning India Private Limited; 8th edition (1 January 2014).
3. Ashish K. Bhattacharya, "Principles & Practices of Cost Accounting" Prentice Hall India Learning Private Limited; 3rd edition (1 January 2004)
4. N.D. Vohra, "Quantitative Techniques in Management", McGraw Hill Education; Fifth edition (5 July 2017)

OPEN ELECTIVE: (e) COMPOSITE MATERIALS

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to

1. Introduce different composite materials, manufacturing process and strength criterias.

Course Outcomes

At the end of the course the student should be able to

CO1. Explain characteristics of Composite materials.
CO2. Illustrate different types of reinforcements.
CO3. Explain the manufacturing of metal matrix composites.
CO4. Describe the manufacturing of polymer matrix composites.
CO5. Define the different strength criterias.

SYLLABUS:

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 isostatic pressing. 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 prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT–V: Strength

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Wiley VCH; "Material Science and Technology- A Comprehensive Treatment Volume 10B" Edition (25 May 1994)
2. WD Callister, Jr., Adapted by R. Balasubramaniam, "Materials Science and Engineering, An introduction". John Wiley & Sons, NY, Indian Edition, 2007.

REFERENCES:

1. George Lubin, "Hand Book of Composite Materials", 1st Edition, Springer US 1982
2. Deborah D.L. Chung "Composite Materials Science and Applications" 2nd edition, Springer-Verlag London, 2010
3. Danial Gay, Suong V. Hoa, and Stephen W. Tasi. "Composite Materials Design and Applications" 3rd edition, CRC Press; (3 September 2014)

OPEN ELECTIVE: (f) WASTE TO ENERGY

Subject code:	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

SYLLABUS:

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.

TEXT BOOKS:

1. G D Rai, “Non-Conventional Energy Sources”, Khanna (1 January 1988)
2. Khandelwal, K. C. and Mahdi, S. S. “Biogas Technology - A Practical Hand Book -, Vol. I & II”, Tata McGraw Hill Publishing Co. Ltd., 1983

REFERENCES:

1. Challal, D. S., “Food, Feed and Fuel from Biomass”, IBH Publishing Co. Pvt. Ltd., 1991.
2. C. Y. WereKo-Brobby and E. B. Hagan “Biomass Conversion and Technology,”, John Wiley & Sons, 1996.

OPEN ELECTIVE: (g) DISASTER MANAGEMENT

Subject code:	**Credits : 0**
Instruction : 2 Lectures/week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Course Objective:

The objective of this course is to

1. Create awareness on disasters, disaster prone areas and hazards.
2. Create exposure on disaster mitigation and management.

Course Outcomes:

At the end of this course, students will be able to

CO 1. Define and differentiate between hazard and disaster.
CO 2. Understand repercussions of Disasters and Hazards.
CO 3. Identify different disaster Prone Areas in India.
CO 4. Illustrate disaster preparedness and management.
CO 5. Estimate risk and understand concept of disaster Mitigation.

SYLLABUS:

UNIT-I: Introduction

Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT-II: Repercussions of Disasters and Hazards

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.
Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches,
Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT-III: Disaster Prone Areas in India

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT-IV: Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT-V: Risk Assessment and Disaster Mitigation

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival. Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Text Book:

1. R.Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" 'New Royal book Company.
2. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep &Deep Publication Pvt. Ltd., New Delhi.

References Books:

1. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.

DISSERTATION I:

Subject code:	**Credits : 10**
Instruction : 0	Sessional Marks : 50
End Exam : Viva Voice	End Exam Marks : 50

SEMESTER IV

DISSERTATION II:

Subject code:	**Credits : 16**
Instruction : 0	Sessional Marks : 50
End Exam : Viva Voice	End Exam Marks : 50