COURSE STRUTURE AND SYLLABUS FOR FIRST YEAR PG PROGRAMME

I SEMESTER

S. No.	Course Code	Title of the Course	Hours Per Week			Internal Marks	External Marks	Total Marks	Credits
			L	P	Total				
1	**18CESE101**	Advanced concrete technology	4	--	4	40	60	100	3
2	**18CESE102**	Theory of Elasticity	4	--	4	40	60	100	3
3	**18CESE103**	Matrix Analysis of Structures	4	--	4	40	60	100	3
4	**18CESE104**	Structural Dynamics	4	--	4	40	60	100	3
5	**18CESE105A** **18CESE105B** **18CESE105C**	**Elective-1** 1. Experimental Stress Analysis 2. Sub-Structure Design 3.Structural Optimization	4	--	4	40	60	100	3
6	**18CESE106A** **18CESE106B** **18CESE106C**	**Elective – II** 1. Repair and Rehabilitation of Structures 2. Analysis and Design of Tall Buildings 3. Plastic Analysis and Design	4	--	4	40	60	100	3
7	**18CESE161**	Advanced Structural Engineering Laboratory	--	3	3	40	60	100	2
Total			**24**	**3**	**27**	**280**	**420**	**700**	**20**

L: Lecture **P**: Practical

II SEMESTER

S. No.	Course Code	Title of the Course	Hours Per Week			Internal Marks	External Marks	Total Marks	Credits
			L	P	Total				
1	**18CESE201**	Finite Element Method	4	--	4	40	60	100	3
2	**18CESE202**	Earthquake Resistant Design	4	--	4	40	60	100	3
3	**18CESE203**	Stability of Structures	4	--	4	40	60	100	3
4	**18CESE204**	Theory of Plates & Shells	4	--	4	40	60	100	3
5	**18CESE205A** **18CESE205B** **18CESE205C**	**Elective-1** 1. Pre-Stressed Concrete 2. Mechanics of Composite Material 3. Fracture Mechanics	4	--	4	40	60	100	3
6	**18CESE206A** **18CESE206B** **18CESE206C**	**Elective – II** 1. Industrial Structures 2.Bridge Engineering 3. Earth Retaining Structures	4	--	4	40	60	100	3
7	**18CESE261**	CAD Laboratory	--	3	3	40	60	100	2
Total			**24**	**3**	**27**	**280**	**420**	**700**	**20**

L: Lecture **P**: Practical

I Year I Semester **L P C**

18CESE 101 ADVANCED CONCRETE TECHNOLOGY 4 0 3

UNIT – I

Concrete Making Materials: Cement – Bogus Compounds – Hydration Process – Types of Cement – Aggregates – Gradation Charts – Combined Aggregate – Alkali Silica Reaction – Admixtures – Chemical and Mineral Admixtures. Bureau of Indian Standards (BIS) Provisions.

Form work: Materials – structural requests – form work systems – connections – Specifications – design of form work – shores – removal for forms - shores – reshoring – Failure of form work.

UNIT – II

Fresh And Hardened Concrete: Fresh Concrete – workability tests on Concrete – Setting Times of Fresh Concrete – Segregation and bleeding.

Hardened Concrete: Abrams Law, Gel space ratios, Maturity concept – Stress strain Behaviour – Creep and Shrinkage – Durability Tests on Concrete – Non Destructive Testing of Concrete. BIS Provisions.

UNIT – III

High Strength Concrete – Microstructure – Manufacturing and Properties – Design of HSC

Using Erintroy Shaklok method – Ultra High Strength Concrete.

High Performance Concrete – Requirements and Properties of High Performance Concrete

– Design Considerations. BIS Provisions.

UNIT – IV

Special Concretes: Self Compacting concrete, Polymer Concrete, Fibre Reinforced Concrete – Reactive Powder Concrete – Requirements and Guidelines – Advantages and Applications.

UNIT – V

Concrete Mix Design: Quality Control – Quality Assurance – Quality Audit - Mix Design Method – BIS Method – DOE Method – Light Weight Concrete, Self Compacting Concrete.

REFERENCES:

1. Properties of Concrete by A.M.Neville, ELBS publications Oct 1996.
2. Concrete: Micro Structure, Properties and Materials by P.K.Mehta and P.J.Monteiro,. Mc.
Graw-Hill Publishing Company Ltd. New Delhi
3. Concrete Technology by M.S.Shetty, S.Chand & Co 2009.
4. Concrete Technology by A.R. Santhakumar, Oxford University Press Oct 2006.
5. Design of Concrete Mixes by N.Krishna Raju, CBS Publications, 2000.
6. Special Structural concretes by Rafat Siddique, Galgotia Publications 2000.
7. Relevant BIS Codes

I Year I Semester **L P C**

18CESE102 THEORY OF ELASTICITY 4 0 3

UNIT-I Elasticity – Notation for forces and stresses – components of stresses and strains – Hooke's Law - Plane Stress – Plane strain – Differential Equations of equilibrium – Boundary conditions – Compatibility equations - Stress function – Boundary Conditions.

UNIT -II Two dimensional problems in rectangular co-ordinates – Solution by polynomials – Saint Venant's principle – Determination of displacements – Bending of simple beams – Application of Fourier series for two dimensional problems for gravity loading

UNIT-III Two dimensional problems in polar co-ordinates - General equations in polar co-ordinates – Stress distribution for problems having symmetrical about an axis - Strain components in polar co-ordinates – Displacements for symmetrical stress distributions - Stresses for plates with circular holes subjected to far field tension – stress concentration factor.

UNIT-IV Analysis of stress and strain in three dimension - Principal stresses – Stress ellipsoid and stress director surface – Determination of principal stresses - Maximum shear stress – Homogeneous Deformation – General Theorems - Differential equations of equilibrium – Conditions of compatibility – Equations of equilibrium in terms of displacements – Principle of superposition – Uniqueness of solution –Reciprocal theorem.

UNIT-V Torsion of prismatical bars – Bars with elliptical cross section – Other elementary solution – Membrane analogy – Torsion of rectangular bars – Solution of torsional problems by energy method.

REFERENCES:

1. Theory of Elasticity- Timoshenko & Goodier

2.Elasticity: Theory, Applications and Numeric- Martin H. Sadd

I Year I Semester **L P C**

18CESE103 MATRIX ANALYSIS OF STRUCTURES 4 0 3

UNIT-I Introduction of matrix methods of analysis – Static and kinematic indeterminacy – Degree of freedom – Structure idealization-stiffness and flexibility methods – Suitability: Element stiffness matrix for truss element, beam element and Torsional element- Element force - displacement equations

UNIT-II Stiffness method – Element and global stiffness equation – coordinate transformation and global assembly – structure stiffness matrix equation – analysis of simple pin jointed trusses – continuous beams – rigid jointed plane frames

UNIT-III Stiffness method for Grid elements – development of stiffness matrix – coordinate transformation. Examples of grid problems – tapered and curved beams

UNIT-IV Additional topics in stiffness methods – discussion of band width – semi band width – static condensation – sub structuring –Loads between joints-Support displacements- inertial and thermal stresses-Beams on elastic foundation by stiffness method.

UNIT-V Space trusses and frames - Member stiffness for space truss and space frame– Transformation matrix from Local to Global – Analysis of simple trusses, beams and frames

REFERENCES:

1. Matrix analysis of structures- Robert E Sennet- Prentice Hall-Englewood cliffs-New Jercy

2. Advanced structural analysis-Dr. P. Dayaratnam- Tata McGraw hill publishing company limited.

3. Indeterminate Structural analysis- C K Wang

4. Analysis of tall buildings by force – displacement – Method M. Smolira – Mc. Graw Hill.

5. Foundation Analysis and design – J.E. Bowls.

I Year I Semester **L P C**

18CESE104 STRUCTURAL DYNAMICS 4 0 3

UNIT-I Introduction to Structural Dynamics: Fundamental objective of Dynamic analysis – Types of prescribed loadings – methods of Discretization – Formulation of the Equations of Motion.

UNIT-II Theory of Vibrations: Introduction – Elements of a Vibratory system – Degrees of Freedom of continuous systems - Oscillatory motion – Simple Harmonic Motion – Free Vibrations of Single Degree of Freedom (SDOF) systems – Undamped and Damped – Critical damping – Logarithmic decrement – Forced vibrations of SDOF systems – Harmonic excitation – Dynamic magnification factor – Band width.

UNIT-III Single Degree of Freedom System: Formulation and Solution of the equation of Motion – Free vibration response – Response to Harmonic, Periodic, Impulsive and general dynamic loadings – Duhamel integral.

UNIT-IV Multi Degree of Freedom System: Selection of the Degrees of Freedom – Evaluation of Structural Property Matrices – Formulation of the MDOF equations of motion - Undamped free vibrations – Solution of Eigen value problem for natural frequencies and mode shapes – Analysis of dynamic response - Normal coordinates.

UNIT-V Continuous Systems: Introduction – Flexural vibrations of beams – Elementary case – Equation of motion – Analysis of undamped free vibration of beams in flexure – Natural frequencies and mode shapes of simple beams with different end conditions.

REFERENCES:

1. Dynamics of Structures by Clough & Penzien.

2. Structural Dynamics A K Chopra

I Year I Semester **L P C**

18CESE105A EXPERIMENTAL STRESS ANALYSIS 4 0 3

UNIT-I Introduction and Strain measurement methods – Model & Prototype – Dimensional analysis-Factors influencing model design – Scale factors and Model material properties – Methods of model design. Definition of strain and its relation to experimental determinations - properties of strain gauge systems – Mechanical, Optical, Acoustic and Pneumatic types.

UNIT-II Electrical resistance strain gages: Introduction – gauge construction – strain gauge adhesives - mounting methods – gauge sensitivities and gage factor – performance characteristics of wire and foil strain gauges – environmental effects. Analysis of strain gauge data – the three element rectangular rosette – the delta rosette – correction for transverse sensitivity.

UNIT-III Non – destructive testing: Introduction – objectives of non destructive testing. Ultrasonic pulse velocity method – Rebound Hammer method (Concrete hammer) – Acoustic Emissionapplication to assessment of concrete quality.

UNIT-IV Theory of photo elasticity: Introduction – temporary double refraction – Index ellipsoid and stress ellipsoid – the stress optic law – effects of stressed model in a polariscope for various arrangements - fringe sharpening.

UNIT-V Two dimensional photo elasticity: Introduction – iso-chromatic fringe patterns – isoclinicfringe patterns – compensation techniques – calibration methods – separation methods – materials for photo- elasticity – properties of photo-elastic materials .

REFERENCES:

1. Experimental Stress Analysis- Riley and Dally

2. Experimental Stress Analysis - L.S. Srinath

3. Experimental Stress Analysis – Lee

4. Experimental Stress Analysis- Sadhu Singh

I Year I Semester **L P C**

18CESE105C STRUCTURAL OPTMIZATION 4 0 3

UNIT-I Introduction: Need and scope for optimization – statements of optimization problemsObjective function and its surface design variables- constraints and constraint surfaceClassification of optimization problems (various functions continuous, discontinuous and discrete) and function behavior (monotonic and unimodal)

UNIT-II Classical optimization techniques: Differential calculus method, multi variable optimization by method of constrained variation and Lagrange multipliers (generalized problem) Khun-Tucker conditions of optimality -Fully stressed design and optimality criterion based algorithmsintroduction, characteristics of fully stressed design theoretical basis-examples

UNIT-III Non-Liner programming: Unconstrained minimization- Fibonacci, golden search, 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- Zoutendjik's method- 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 ntroduction to quadratic programming: Geometric programming- and dynamic programmingDesign of beams and frames using dynamic programming technique

REFERENCES

1. Optimization Theory and Applications – S.S. Rao, Wiley Eastern Limited, New Delh Optimization Concepts and Application in Engineering- Belegundu A.D. and Chandrupatla T.R

I Year I Semester **L P C**

18CESE105B **SUB-STRUCTURE DESIGN** **4 0 3**

UNIT-I Soil Exploration – Importance, Terminology, planning - Geophysical methods. Borings, location, spacing and depth, methods of boring including drilling, stabilization of boreholes, boring records.

UNIT-II Soil sampling – Methods of sampling -Types of samples and samplers-cleaning of bore holes, preservation, labeling and shipment of samples - Design considerations of open drive samplers.

UNIT-III Shallow Foundations –Bearing capacity – General bearing capacity equation, Meyerhof's, Hansen's and Vesic's bearing capacity factors - Bearing capacity of stratified soils - Bearing capacity based on penetration resistance- safe bearing capacity and allowable bearing pressure. (Ref: IS -2131 & IS 6403)

UNIT-IV Types and choice of type. Design considerations including location and depth, Proportioning of shallow foundations- isolated and combined footings and mats - Design procedure for mats. Floating foundation- Fundamentals of beams on Elastic foundations. .(Ref: IS -456 & N.B.C. relevant volume).

UNIT-V Pile foundations-Classification of piles-factors influencing choice-Load - carrying capacity of single piles in clays and sands using static pile formulae- á - â - and λ - methods –Dynamic pile formulae-limitations-Monotonic and cyclic pile load tests – Under reamed piles. Pile groups -Efficiency of pile groups- Different formulae-load carrying capacity of pile groupsin clays and sands – settlement of pile groups in clays and sands – Computation of load on each pile in a group.

REFERENCES:

1. Principles of Foundation Engineering by Braja M. Das.

2. Soil Mechanics in Engineering Practice by Terzagi and Peck

3. Foundation Design by Wayne C. Teng, John Wiley & Co.,

4. Foundation Analysis and Design by J.E. Bowles McGraw Hill Publishing Co.,

5. Analysis and Design of sub structures by Swami Saran

6. Design Aids in Soil Mechanics and Foundation Engineering by Shanbaga R. Kaniraj,Tata Mc. Graw Hill.

7. Foundation Design and Construction by MJ Tomlinson – Longman Scientific 8. A short course in Foundation Engineering by Simmons and Menzes – ELBS.

I Year I Semester **L P C**

18CESE106A REPAIR AND REHABILITATION OF STRUCTURES 4 0 3

UNIT I Materials for repair and rehabilitation -Admixtures- types of admixtures- purposes of using admixtures- chemical composition- Natural admixtures- Fibres- wraps- Glass and Carbon fibre wraps- Steel Plates-Non destructive evaluation: Importance- Concrete behavior under corrosion, disintegrated mechanisms- moisture effects and thermal effects – Visual investigation- Acoustical emission methods- Corrosion activity measurement- chloride content – Depth of carbonation- Impact echo methods- Ultrasound pulse velocity methods- Pull out tests.

UNIT II Strengthening and stabilization- Techniques- design considerations-Beam shear capacity strengthening- Shear Transfer strengthening-stress reduction techniques- Column strengthening-flexural strengthening- Connection stabilization and strengthening, Crack stabilization.

UNIT III Bonded installation techniques- Externally bonded FRP- Wet layup sheet, bolted plate, near surface mounted FRP, fundamental debonding mechanisms- intermediate crack debondingCDC debonding- plate end debonding- strengthening of floor of structures.

UNIT IV Fibre reinforced concrete- Properties of constituent materials- Mix proportions, mixing and casting methods-Mechanical properties of fiber reinforced concrete- applications of fibre reinforced concretes-Light weight concrete- properties of light weight concrete- No fines concrete- design of light weight concrete- Flyash concrete-Introduction- classification of flyash- properties and reaction mechanism of flyash- Properties of flyash concrete in fresh state and hardened state- Durability of flyash concretes.

UNIT V High performance concretes- Introduction- Development of high performance concretesMaterials of high performance concretesProperties of high performance concretes- Self Consolidating concrete-propertiesqualifications.

REFERENCE: 1. Concrete technology- Neville & Brooks

2. Special Structural concrete- Rafat Siddique

3. Concrete repair and maintenance illustrated- Peter H Emmons

4. Concrete technology-M S Shetty

I Year I Semester **L P C**

18CESE106B ANALYSIS AND DESIGN OF TALL BUILDINGS 4 0 3

UNIT I. Design Criteria Philosophy, Materials – Modern concepts – High Performance Concrete, Fibre Reinforced Concrete, Light weight concrete, Self Compacting Concrete

UNIT II. Gravity Loading – Dead load, Live load, Impact load, Construction load, Sequential loading. Wind Loading – Static and Dynamic Approach, Analytical method, Wind Tunnel Experimental methods. Earthquake Loading – Equivalent lateral Load analysis, Response Spectrum Method, Combination of Loads.

UNIT III Behavior of Structural Systems- Factors affecting the growth, height and structural form, Behaviour of Braced frames, Rigid Frames, In-filled frames, Shear walls, Coupled Shear walls, Wall–Frames, Tubular, Outrigger braced, Hybrid systems.

UNIT IV Analysis and Design- Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of structures as an integral unit, Analysis for member forces, drift and twist. Computerized 3D analysis. Design for differential movement, Creep and Shrinkage effects, Temperature Effects and Fire Resistance.

UNIT V Stability Analysis- Overall buckling analysis of frames, wall–frames, Approximate methods, Second order effect of gravity loading, P–Delta Effects, Simultaneous first order and P-Delta analysis, Translational instability, Torsional Instability, Out of plumb effects, Effect of stiffness of members and foundation rotation in stability of structures.

TEXT BOOKS:

1. Bryan Stafford Smith and Alex Coull, “Tall Building Structures - Analysis and Design”, John Wiley and Sons, Inc., 1991.

2. Taranath B.S, “Structural Analysis and Design of Tall Buildings”, McGraw-Hill, 1988.

I Year I Semester **L P C**

18CESE106C PLASTIC ANALYSIS AND DESIGN 4 0 3

UNIT I Introduction and basic hypothesis: Concepts of stress and strain – relation of steel Moment curvature relation- basic difference between elastic and plastic analysis with examples- Yield condition, idealizations, collapse criteria- Virtual work in the elastic-plastic state-Evaluation of fully plastic moment and shape factors for the various practical sections.

UNIT II Method of Limit Analysis: Introduction to limit analysis of simply supported fixed beams and continuous beams, Effect of partial fixity and end, invariance of collapse loads, basic theorems of limit analysis, rectangular portal frames, gable frames, grids, superposition of mechanisms, drawing statistical bending moment diagrams for checks.

UNIT III Limit design Principles: Basic principles, limit design theorems, application of limit design theorems, trial and error method, method of combining mechanisms, plastic moment distribution method, load replacement method, continuous beams and simple frames designs using above principles.

UNIT IV Deflection in Plastic beams and frames: Load deflection relations for simply supported beams, deflection of simple pin based and fixed based portal frames, method of computing deflections.

UNIT V Minimum weight Design: Introduction to minimum Weight and linear Weight functionsFoulkes theorems and its geometrical analogue and absolute minimum weight design. –

REFERENCES: 1. Plastic Methods of Structural analysis- B G Neal, Chapman and Rall publications 2. Plastic analysis and Design – C E Messennet, M A Seve

I Year I Semester **L P C**

18CESE106C DVANCED STRUCTURAL ENGINEERING LABORATORY 0 3 2

1. Strain measurement - Electrical resistance strain gauges
2. Non destructive testing- Impact Hammer test, UPV test
3. Qualifications tests on Self compaction concrete- L Box test, J Box test, U box test, Slump test
4. Tests on Buckling of columns – Southwell plot
5. Repair and rehabilitation of concrete beams
6. Chemical Analysis of water for suitability in concreting with and without Reinforcement.
7. Chemical Analysis of sand and Aggregate for Suitability in Construction.

NOTE: A minimum of five experiments from the above set have to be conducted.

II SEMESTER

S. No.	Course Code	Title of the Course	Hours Per Week			Internal Marks	External Marks	Total Marks	Credits
			L	**P**	**Total**				
1	**18CESE201**	Finite Element Method	4	--	4	40	60	100	3
2	**18CESE202**	Earthquake Resistant Design	4	--	4	40	60	100	3
3	**18CESE203**	Stability of Structures	4	--	4	40	60	100	3
4	**18CESE204**	Theory of Plates & Shells	4	--	4	40	60	100	3
5	**18CESE205A** **18CESE205B** **18CESE205C**	**Elective-1** 1. Pre-Stressed Concrete 2. Mechanics of Composite Material 3. Fracture Mechanics	4	--	4	40	60	100	3
6	**18CESE206A** **18CESE206B** **18CESE206C**	**Elective – II** 1. Industrial Structures 2.Bridge Engineering 3. Earth Retaining Structures	4	--	4	40	60	100	3
7	**18CESE261**	CAD Laboratory	--	3	3	40	60	100	2
Total			**24**	**3**	**27**	**280**	**420**	**700**	**20**

L: Lecture **P**: Practical

FINITE ELEMENT METHOD
(18D1287401)

UNIT I Introduction: Review of stiffness method- Principle of Stationary potential energy-Potential energy of an elastic body- Rayleigh-Ritz method of functional approximation - variational approaches -weighted residual methods

UNIT II Finite Element formulation of truss element: Stiffness matrix- properties of stiffness matrix – Selection of approximate displacement functions-solution of a plane truss- transformation matrix and stiffness matrix for a 3-D truss- Inclined and skewed supports- Galerkin's method for 1-D truss – Computation of stress in a truss element.

UNIT III Finite element formulation of Beam elements: Beam stiffness-assemblage of beam stiffness matrix- Examples of beam analysis for concentrated and distributed loading- Galerkin's method - 2-D Arbitrarily oriented beam element – inclined and skewed supports – rigid plane frame examples

UNIT IV Finite element formulation for plane stress, plane strain and axisymmetric problemsDerivation of CST and LST stiffness matrix and equations-treatment of body and surface forces-Finite Element solution for plane stress and axisymmetric problems- comparison of CST and LST elements –convergence of solution-interpretation of stresses

UNIT V Iso-parametric Formulation: An isoparametric bar element- plane bilinear isoparametric element – quadratic plane element - shape functions, evaluation of stiffness matrix, consistent nodal load vector - Gauss quadrature- appropriate order of quadrature – element and mesh instabilities – spurious zero energy modes, stress computation- patch test.

REFERENCES:

1. Concepts and applications of Finite Element Analysis – Robert D. Cook, Michael E Plesha, John Wiley & sons Publications
2. A first course in the Finite Element Method – Daryl L. Logan, Thomson Publications
3. Introduction to Finite Elements in Engineering- Tirupati R. Chandrupatla, Ashok D. Belgunda,

EARTHQUAKE RESISTANT DESIGN

(18D1287402)

UNIT I Engineering seismology – rebound theory – plate tectonics – seismic waves - earthquake size and various scales – local site effects – Indian seismicity – seismic zones of India – theory of vibrations – near ground and far ground rotation and their effects.

UNIT II Seismic design concepts – EQ load on simple building – load path – floor and roof diaphragms – seismic resistant building architecture – plan configuration – vertical configuration – pounding effects – mass and stiffness irregularities – torsion in structural system- Provision of seismic code (IS 1893 & 13920) – Building system – frames – shear wall – braced frames – layout design of Moment Resisting Frames(MRF) – ductility of MRF – Infill wall – Nonstructural elements.

UNIT III Calculation of EQ load – 3D modeling of building systems and analysis (theory only) Design and ductile detailing of Beams and columns of frames Concept of strong column weak beams, Design and ductile detailing of shear walls

UNIT IV Cyclic loading behavior of RC, steel and pre- stressed concrete elements - modern conceptsBase isolation – Adaptive systems – case studies.

UNIT V Retrofitting and restoration of buildings subjected to damage due to earthquakes- effects of earthquakes – factors related to building damages due to earthquake- methods of seismic retrofitting- restoration of buildings

REFERENCES

1. Pankaj Agarwal and Manish ShriKhande, Earthquake Resistant Design of Structures, Prentice – Hall of India, 2007, New Delhi.

2. Bullen K.E., Introduction to the Theory of Seismology, Great Britain at the University Printing houses, Cambridge University Press 1996.

3. Relevant code of practices.

STABILITY OF STRUCTURES

(18D1287403)

UNIT I Beam columns: Differential equation for beam columns – Beams column with concentrated loads – continuous lateral load – couples – Beam column with built in ends – continuous beams with axial load – application of Trigonometric series – Determination of allowable stresses.

UNIT II Elastic buckling of bars : Elastic buckling of straight columns – Effect of shear stress on buckling – Eccentrically and laterally loaded columns –Sway & Non Sway mode - Energy methods – Buckling of a bar on elastic foundation – Buckling of bar with intermediate compressive forces and distributed axial loads – Buckling of bars with change in cross section – Effect of shear force on critical load – Built up columns – Effect of Initial curvature on bars – Buckling of frames – Sway & Non Sway mode.

UNIT III In-elastic buckling: Buckling of straight bars – Double modulus theory Tangent modulus theory. Experiments and design formulae: Experiments on columns – Critical stress diagram – Empirical formulae of design – various end conditions – Design of columns based on buckling. Mathematical Treatment of stability problems: Buckling problem orthogonality relation – Ritz method –Stiffness method and formulation of Geometric stiffness matrix- Applications to simple frames

UNIT IV Torsional Buckling: Pure torsion of thin walled bars of open cross section – Non uniform torsion of thin walled bars of open cross section - Torsional buckling – Buckling of Torsion and Flexure.

UNIT V Lateral Buckling of simply supported Beams: Beams of rectangular cross section subjected for pure bending, Buckling of I Section subjected to pure bending.

REFERENCES:

1. Theory of Elastic stability by Timshenko & Gere-Mc Graw Hill

2. Theory of Stability of Structures by Alexander ChaJes.

THEORY OF PLATES AND SHELLS

(18D1287404)

UNIT I Derivation of governing differential equation for plate– in plane bending and transverse bending effects- Rectangular plates: Plates under various loading conditions like concentrated, uniformly distributed load and hydrostatic pressure. Navier and Levy's type of solutions for various boundary condition.

UNIT II Circular plates: Symmetrically loaded, circular plates under various loading conditions, Annular plates.

UNIT III Introduction to Shells- Single and double curvature- Equations of Equilibrium of Shells: Derivation of stress resultants, Principles of membrane theory and bending theory.

UNIT IV Cylindrical Shells: Derivation of the governing DKJ equation for bending theory, details of Schorer's theory. Application to the analysis and design of short and long shells. Use of ASCE Manual coefficients for the design.

UNIT V Beam theory of cylindrical shells: Beam and arch action. Design of diaphragms - Geometry analysis and design of elliptic Paraboloid, Conoidal and Hyperbolic Paraboloid shapes by membrane theory.

REFERENCES:

1. Theory of Plates and Shells – Timoshenko and Krieger, McGraw-Hill book company, INC, New york.

2. K. Chandra Sekhara

3. A Text Book of Plate Analysis – Bairagi, K, Khanna Publisher, New Delhi.

4. Design and Construction of Concrete Shell Roofs – Ramaswamy, G.S, Mc Graw – Hill, New York.

PRESTRESSED CONCRETE

(18D1287511)

UNIT I General principles of Pre-stressing- Pre-tensioning and Post tensioning - Pre tensioning and Post tensioning methods- Different systems of Pre-stressing- Analysis of prestress and Bending stresses– Resultant – stress at a section – pressure line – concept of load balancing – stresses in tendons.

UNIT II Losses of Pre-stressing- Loss of Pre-stress in pre-tensioned and post tensioned members due to various causes -Elastic shortening of concrete, shrinkage of concrete, creep of concrete, Relaxation of steel, slip in anchorage, differential shrinkage-bending of members and frictional losses- Long term losses

UNIT III Flexural, shear; torsional resistance and design of Prestressed concrete section. Types of flexural failure – code procedures-shear and principal stresses – Prestressed concrete members in torsion – Design of sections for flexure, Axial Tension, Compression and bending, shear, Bond

UNIT IV Analysis of continuous beams –Elastic theory- Linear transformation and Concordant tendonsDeflections of pre-stressed concrete beams: Importance of control of deflections- factors influencing deflections-short term deflections of un-cracked member – prediction of long term deflections

UNIT V Analysis of end blocks: By Guyon's method and Magnel's method, Anchorage zone stressesApproximate method of design- anchorage zone reinforcement- transfer of pre stresses- pre tensioned members-Composite sections: Introduction-Analysis for stresses- differential shrinkage- general design considerations

REFERENCES:

1. Prestressed Concrete- N. Krishna Raju

2. Prestressed Concrete- S. Ramamrutham

3. Prestressed Concrete- P. Dayaratnam

4. Prestressed Concrete- T.Y.Lin

MECHANICS OF COMPOSITE MATERIALS

UNIT I Introduction to Composite Materials: Introduction ,Classification: Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and nature-made composites, and applicationReinforcements: Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.-Manufacturing methods: Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

UNIT II Macromechanical Analysis of a Lamina: Introduction, Definitions: Stress, Strain ,Elastic Moduli, Strain Energy. Hooke's Law for Different Types of Materials, Hooke's Law for a Two-Dimensional Unidirectional Lamina, Plane Stress Assumption, Reduction of Hooke's Law in Three Dimensions to Two Dimensions, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina,

UNIT III Hooke's Law for a Two-Dimensional Angle Lamina, Engineering Constants of an Angle Lamina, Invariant Form of Stiffness and Compliance Matrices for an Angle Lamina Strength Failure Theories of an Angle Lamina : Maximum Stress Failure Theory Strength Ratio, Failure Envelopes, Maximum Strain Failure Theory ,Tsai–Hill Failure Theory, Tsai–Wu Failure Theory, Comparison of Experimental Results with Failure Theories. Hygrothermal Stresses and Strains in a Lamina: Hygrothermal Stress–Strain Relationships for a Unidirectional Lamina, Hygrothermal Stress–Strain Relationships for an Angle Lamina

UNIT IV Micromechanical Analysis of a Lamina :Introduction, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli, Strength of Materials Approach, Semi-Empirical Models, Elasticity Approach, Elastic Moduli of Lamina with Transversely Isotropic Fibers, Ultimate Strengths of a Unidirectional Lamina, Coefficients of Thermal Expansion, Coefficients of Moisture Expansion

UNIT V Macromechanical Analysis of Laminates: Introduction , Laminate Code , Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate , Hygrothermal Effects in a Laminate, Warpage of Laminates -Failure, Analysis, and Design of Laminates : Introduction , Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite

TEXT BOOKS:

1. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.
2. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, WileyInterscience, New York, 1980.

3. Mechanics of Composite Materials, Second Edition (Mechanical Engineering), By Autar K. Kaw ,Publisher: CRC

FRACTURE MECHANICS

(18CESE205C)

UNIT I Introduction: Fundamentals of elastic and plastic behaviour of materials-stresses in a plate with a hole – Stress Concentration factor-modes of failure- Brittle fracture and ductile fracturehistory of fracture mechanics-Griffiths criteria for crack propagation cracks- Energy release rate, GI GII and GIII - Critical energy release rate GIc , GIIc and GIIIc – surface energy - R curves – compliance.

UNIT II Principles of Linear Elastic Fracture Mechanics: SOM vs Fracture Mechanics - stressed based Criteria for fracture- Stress Intensity Factors- KI K II and K III – Critical stress Intensity Factors, KIc KIIc and KIIc – crack tip plastic zone – Erwin's plastic zone correction -Critical crack length-Load carrying capacity of a cracked component-Design of components based on fracture mechanics.

UNIT III Mixed mode crack propagation- Maximum tangential stress criterion – crack propagation angle -Material characterisation by Crack Tip Opening Displacements (CTOD)- Crack Mouth Opening Displacement (CMOD)- Critical crack tip opening displacement (CTODc) –critical Crack Mouth Opening Displacement (CMODc).

UNIT IV Fatigue Crack propagation- Fatigue load parameters Fatigue crack growth curve –Threshold stress intensity factor-Paris law- Retardation effects.

UNIT V Applications of fracture Mechanics to concrete- reasons –strain softening behaviour –Bazant's size effect law.

REFERENCES

1. Elementary engineering fracture mechanics – David Broek – Sijthoff & Noordhoff – Netherlands. 1. Elements of Fracture Mechanics – Prasanth Kumar, wiley Eastern Publications
2. Fracture Mechanics: Fundamentals and applications – T. L. Andrason, PhD, CRC publications
3. Fracture Mechanics of Concrete: Applications of fracture mechanics to concrete, Rock, and other quasi-brittle materials, Surendra P. Shah, Stuart E. Swartz, Chengsheng Ouyang, John Wiley & Son publication

INDUSTRIAL STRUCTURES

(18CESE206A)

UNIT I Planning and functional requirements- classification of industries and industrial structuresplanning for layout- requirements regarding lighting ventilation and fire safety- protection against noise and vibrations

UNIT II Industrial buildings- roofs for industrial buildings (Steel) - design of gantry girder- design of corbels and nibs- machine foundations

UNIT III Design of Folded plates- Design considerations- analysis of folded plates- analysis of multibay folded plates- design of diaphragm beam

UNIT IV Power plant structures- Bunkers and silos- chimney and cooling towers- Nuclear containment structures

UNIT V Power transmission structures- transmission line towers- tower foundations- testing towers

REFERENCES:

1. Advanced reinforced concrete design- N. Krishnam Raju

2. Handbook on machine foundations- P. Srinivasulu and C.V. Vaidyanathan

3. Tall Chimneys- Design and construction – S.N. Manohar

4. Transmission Line Structures- A.R. Santakumar and S.S. Murthy

5. SP 32: 1986, Handbook on functional requirements of Industrial buildings 6. Design of shells- K. Chandrasekhara

BRIDGE ENGINEERING

(18D1287522)

UNIT I Masonry arch Bridge design details- Rise, radius, and thickness of arch- Arch ringDimensioning of sub structures- Abutments pier and end connections.(Ref: IRC-SP-13)

UNIT II Super Structure: Slab bridge- Wheel load on slab- effective width method-slabs supported on two edges- cantilever slabs- dispersion length- Design of interior panel of slab- Pigeaud's method- design of longitudinal girders- Guyon-Messonet method- Hendry Jaegar methodCourbon's theory. (Ref: IRC-21), voided slabs, T-Beam bridges.

UNIT III Plate girder bridges- Elements of plate girder and their design-web-flange-intermediate stiffener- vertical stiffeners- bearing stiffener-design problem

UNIT IV Prestressed Concrete and Composite bridges- Preliminary dimensions-flexural and torsional parameters- Courbon's Theory – Distribution coefficients by exact analysis- design of girder section- maximum and minimum prestressing forces-eccentricity- live load and dead load shear forces- cable zone in girder- check for stresses at various sections- check for diagonal tension- diaphragms and end block design- short term and long term deflections- Composite action of composite brides-shear connectors- composite or transformed section- design problem. (Ref: IRC: Section-VI)

UNIT V Sub structure- Abutments- Stability analysis of abutments- piers- loads on piers – Analysis of piers- Design problem(Ref: IRC-13, IRC-21, IRC-78)- Pipe culvert-Flow pattern in pipe culvers- culvert alignment-culvert entrance structure- Hydraulic design and structural design of pipe culverts- reinforcements in pipes .(Ref: IRC: SP-13)

REFERENCES:

1. Design of concrete bridges- Aswini, Vazirani, Ratwani

2. Essentials of bridge engineering- Jhonson Victor D

3. Design of bridges- Krishna Raju

EARTH RETAINING STRUCTURES

(18CESE206C)

UNIT I Earth pressures – Different types and their coefficients- Classical Theories of Earth pressure – Rankine's and Coulomb's Theories for Active and Passive earth pressure- Computation of Lateral Earth Pressure in Homogeneous and Layered soils- Graphical solutions for Coulomb's Theory in active and passive conditions.

UNIT II Retaining walls – different types - Type of Failures of Retaining Walls – Stability requirements – Drainage behind Retaining walls – Provision of Joints – Relief Shells.

UNIT III Sheet Pile Structures – Types of Sheet piles – Cantilever sheet piles in sands and clays – Anchored sheet piles – Free earth and Fixed earth support methods – Row's moment reduction method – Location of anchors, Forces in anchors.

UNIT IV Soil reinforcement – Reinforced earth - Different components – their functions – Mechanics of reinforced earth – Failure modes-Failure theories – Design of Embakments on problematic soils.

UNIT V Braced cuts and Cofferdams: Lateral Pressure in Braced cuts – Design of Various Components of a Braced cut – Stability of Braced cuts – Bottom Heave in cuts. – types of cofferdam, suitability, merits and demerits – Design of single – wall cofferdams and their stability aspects – TVA method and Cummins' methods.

REFERENCES

1. Principles of Foundation Engineering by Braja M. Das.
2. Foundation analysis and design – Bowles, JE – McGraw Hill
3. Soil Mechanics in Engineering Practice – Terzaghi, K and Rolph, B. peck 2nd Edn. – John Wiley & Co.,
4. Analysis and Design of Foundations and Retaining Structures, Prakash, S – Saritha Prakashan, Mearut.

CAD LABORATORY

(18CESE261)

Analysis and Design using STADD, STRAP, STRUDS, ANSYS

1. Programming for beams subject to different loading (mandatory).

2. Analysis of reinforced concrete multistoried building

3. Analysis of steel transmission line tower

4. Analysis of plane and space truss

5. Analysis of plane and space frame

6. Determination of mode shapes and frequencies of tall buildings using lumped mass (stick model) approximation

7. Wind analysis on tall structure

8. Analysis of pre stressed concrete bridge girder

9. Analysis of Cylindrical shell

10. Modal Analysis of a Cantilever Beam

NOTE: A minimum of eight (including item 1) from the above set have to be conducted.

REFERENCE: Computer aided design laboratory (Civil Engineering) by Shesha Prakash and Suresh.S