SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE (AUTONOMOUS)
(Affiliated to JNTUK, Kakinada), (Recognised by AICTE, New Delhi)
Accredited by NAAC with 'A' Grade
Recognised as Scientific and Industrial Research Organisation
CHINNA AMIRAM (P.O):: BHIMAVARAM :: W.G.Dt., A.P., INDIA :: PIN: 534 204

SCHEME OF INSTRUCTION & EXAMINATION
(Regulation R17)

M.TECH (STRUCTURAL ENGINEERING)
DEPARTMENT OF CIVIL ENGINEERING

(With effect from **2017-2018** Admitted Batch onwards**)**
Under Choice Based Credit System

I-SEMESTER

Code No.	Name of the Subject	Credits	Lec-ture Hrs	Tutorial Hrs	Lab Hrs	Contact Hrs/ Week	Internal Marks	External Marks	Total Marks
M17 ST 1101	Advanced Mathematics	3	3	1	--	4	30	70	100
M17 ST 1102	Theory of Elasticity	3	3	1	--	4	30	70	100
M17 ST 1103	Matrix methods of Structural Analysis	3	3	1	--	4	30	70	100
M17 ST 1104	Structural Dynamics	3	3	1	--	4	30	70	100
#ELE-1	Elective-I	3	3	1	--	4	30	70	100
#ELE-2	Elective-II	3	3	1	--	4	30	70	100
M17 ST 1111	Advanced Structural Engineering Laboratory	2	--	--	3	3	50	50	100
Total		**20**	**18**	**6**	**3**	**27**	**230**	**470**	**700**

	Course Code	Course
#ELE-1	M17 ST 1105	Sub-Structure Design
	M17 ST 1106	Experimental Stress Analysis
	M17 ST 1107	Advanced Reinforced concrete Design
#ELE-2	M17 ST 1108	Plastic Analysis and Design
	M17 ST 1109	Analysis and Design of Tall Buildings
	M17 ST 1110	Repair and Rehabilitation of Structures

Code: M17 ST 1101

ADVANCED MATHEMATICS

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. Second order partial differentiation that arise in applications such as one-dimensional heat equation and two-dimensional laplace equation and their solution by both analytical as well as numerical methods.
2. In detail about correlation and regression. Also learn certain tests of significance.
3. About linear programming, methods of solutions such as simplex method. Certain aspects of non-linear programming.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to

1. Obtain analytical solution of the two-dimensional partial differentials they come across in simple applications.
2. Get numerical solutions for One – dimensional heat and two-dimensional laplace equations by different methods.
3. Perform correlation and regression analysis for different types of data they come across.
4. Formulate a linear programming problem and solve it by an appropriate method. Analyse non-linear programming problems by some specific methods.

SYLLABUS

UNIT-I

Applied partial Differential Equations: One-dimensional Heat equation Cartesian, cylindrical and spherical coordinates (problems having axi-symmetry). Two-dimensional Laplace Equation in Cartesian, cylindrical and spherical coordinates (problems having axi-symmetry) – Analytical solution by separation of variables technique.

UNIT-II

Numerical solutions to Heat and Laplace Equations in Cartesian coordinates using finite–differences.Implicit methods, Crank Nicholsen Method, Jacobi Method, GuassSeidal method.

UNIT-III

Applied Statistics: Regression and correlation analysis – Method of Least squares – Curve fitting – Curvilinear Regression – Non-linear curves – correlation coefficient – Correlation of grouped bi-variate data – coefficient of determination Multiple Regression – partial Regression coefficients.

UNIT-IV

Tests of significance – Analysis of variance for regression – Multiple correlation coefficients – Multiple linear regression with two independent variables.

UNIT-V

Linear Programming Problem Formation, Graphical Method, Simplex method, artificial variable method-Big-M method-Two Phase Method.

Non Linear Programming Problem Gradient method, Steepest Ascent Descent Methods

TEXT BOOKS

1. Solutions of Partial Differential Equations" – Duffy, D.G. CBS Publishers, 1988
2. Introductory Methods of Numerical Analysis – Sastry, S.S.

REFERENCE BOOKS

1. Basic Statistics – Agarval, B.L., Wiley 1991, 2nd edition.
2. Operations Research – Hamdy A, Taha.Optimization Techniques.-S.S Rao

Code: M17 ST 1102

THEORY OF ELASTICITY

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSEOBJECTIVE:

1. This subject is taught to impart knowledge on theory of elasticity.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to

1. Analyze the stresses and strains for two dimensional and three dimensional elements.
2. Understand the equilibrium and compatibility conditions.
3. Solve the problems on Torsion for different shaped bars.

SYLLABUS

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.

TEXT BOOK:

1. "Theory of Elasticity" by Timoshenko and Goodier, McGraw Hill Company.

REFERENCE BOOKS:

1. "Theory of Elasticity" by Sadhu Singh, Khanna publisher
2. "Applied Elasticity" by C.T. Wang., McGraw Hill Company
3. "Advanced Strength of Materials" by Denhortog, Dover publications

Code: M17 ST 1103

MATRIX METHODS OF STRUCTURAL ANALYSIS

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

The main objectives 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 analyze the beams by matrix methods.
3. To prepare the students to analyze the Plane truss problems by matrix methods.
4. To prepare the students to analyze the Plane Frames by matrix methods.

COURSE OUTCOMES:

After completion of course students should be able to

1. Analyze various beams by the matrix methods at different loading conditions.
2. Analyze various Plane truss problems by the matrix methods.
3. Analyze Plane Frames by the matrix methods at different loading conditions.

SYLLABUS

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

TEXT BOOKS:

1. Analysis of Inderminate structures – C.K Wang, McGraw Hill Co.
2. Matrix Analysis of framed Structures-W Weaver& Gere,Van Nostrand Reinhold Company
3. G.S.Pandit, S.P.Gupta, "Matrix methods of Structural Analysis", TataMcGraw Hill Co..
4. William Weaver, James M. Gere, "Matrix Analysis and Framed Structures", D. Van Nostrand Co., 1980.

REFERENCE BOOKS:

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.

Code: M17 ST 1104

STRUCTURAL DYNAMICS

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

The main objectives of this Course is

1. To find the behavior of structures subjected to dynamic loads such as wind, earthquake and blast loads.
2. To study the different Dynamic analysis procedures for calculating the response of structures.

COURSE OUTCOMES:

After completion of course students should be able to

1. Solve the problems on Single degree of freedom.
2. Understand the difference between harmonic loading and impulse loading and the related analysis procedures.
3. Evaluate the structural properties, mode shapes for different structures.

SYLLABUS

UNIT-I

Introduction to Structural Dynamics:Fundamental objective of Dynamic analysis – Typesof 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

ContinuousSystems: 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.

TEXT BOOK:

1. "Structural Dynamics" by John M. Biggs, McGraw Hill Co.

REFERENCE BOOKS:

1. "Structural Analysis" by A. Ghali& A.M. Neville, CRC Press
2. Dynamics of Structures by Anil Kumar Chopra,Pearson Prentice Hall
3. Dynamics of Structures by Clough &Penzien.

Code: M17 ST 1105

SUB-STRUCTURE DESIGN
(ELECTIVE-I)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

The main objectives of this Course is

1. To emphasize the importance of soil sampling and site investigations.
2. To explain the safe bearing capacity and proportioning of Shallow Foundations.
3. To explain in what circumstances pile is needed and how to do analysis of pile and pile group under various soil conditions.

COURSE OUTCOMES:

After completion of course students should be able to

1. Plan a detailed soil exploration programme.
2. Apply various methods for estimating bearing capacity of different types of foundations.
3. Estimate load capacity of single piles and groups of piles

SYLLABUS

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 groups in clays and sands – settlement of pile groups in clays and sands – Computation of load on each pile in a group.

TEXT BOOKS:

1. Principles of Foundation Engineering by Braja M. Das.
2. Soil Mechanics in Engineering Practice by Terzagi and Peck
3. Foundation Analysis and Design by J.E. Bowles McGraw Hill Publishing Co.,
4. Analysis and Design of sub structures by Swami Saran

REFERENCE BOOKS:

1. Design Aids in Soil Mechanics and Foundation Engineering by Shanbaga R. Kaniraj,Tata Mc. Graw Hill.
2. Foundation Design and Construction by MJ Tomlinson – Longman Scientific
3. A short course in Foundation Engineering by Simmons and Menzes – ELBS.
4. Foundation Design by Wayne C. Teng, John Wiley & Co.,

Code: M17 ST 1106

EXPERIMENTAL STRESS ANALYSIS
(ELECTIVE-I)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVE:

1. The main objectives of this Course is to impart knowledge about the instruments and its applications.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to

1. Know the working principle of strain gauges.
2. Do the model analysis using different theorems.
3. Know the concepts of photo elasticity and its applications.

SYLLABUS

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 Emission-application 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 – isoclinic fringe patterns – compensation techniques – calibration methods – separation methods – materials for photo- elasticity – properties of photo-elastic materials.

TEXT BOOKS:

1. "Experimental Stress Analysis", Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., , Tata McGraw-Hill, New Delhi, 1984.
2. Experimental Stress Analysis- Sadhu Singh

REFERENCE BOOKS:

1. Dally, J.W., and Riley, W.F., "Experimental Stress Analysis", McGraw-Hill Inc

Code: M17 ST 1107

ADVANCED REINFORCED CONCRETE DESIGN
(ELECTIVE-I)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

The main objectives of this Course is

1. To Estimate the crack width and deflection with regard to theserviceability.
2. To analyze and design a grid floor system.
3. To analyze and design a flat slab system.
4. To analyze and design of concrete structures against fire resistance, according to ISO 834 standards

COURSE OUTCOMES:

After completion of course the students should be ability to

1. Estimate the crack width and deflection with regard to theserviceability.
2. Analyze and design a grid floor system.
3. Analyze and design a flat slab system.
4. Analyze and design of concrete structures against fire resistance, according to ISO 834 standards.

SYLLABUS

UNIT-I

Deflection of Reinforced Concrete Beams and Slabs: Introduction, 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.

UNIT-II

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-III

Redistribution of Moments in Reinforced Concrete Beams: Introduction, Redistribution of moments in fixed beam, Positions of points of contraflexures, Conditions for moment redistribution, Final shape of redistributed bending moment diagram, Moment redistribution for a two-span continuous beam, Advantages and disadvantages of moment redistribution, Modification of clear distance between bars in beams (for limiting crack width) with redistribution, Moment-curvature (M - ψ), Relation of reinforced concrete sections.

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-IV

Design of Flat Slabs:Introduction, Proportioning of Flat Slabs, Determination of Bending moment and Shear Force, Direct Design method, Equivalent Frame method, Slab Reinforcement.

UNIT-V

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.

TEXT BOOK:

1. "Advanced Reinforced Concrete Design" by P.C. Varghese, Prentice Hall India Learning Private Limited.

REFERENCE BOOKS:

1. "Reinforced Concrete" by Park &Paulay, Wiley publications.
2. "Reinforced Concrete Limit state Design" - P. Dayaratnam, Oxford & IBH publications.

Code: M17 ST 1108

PLASTIC ANALYSIS AND DESIGN
(ELECTIVE-II)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

The main objectives of this Course is

1. To familiarize the student on various design principles of plastic analysis and design.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to

1. Analyze the S.S.B and fixed beams by limit design.
2. Design the continuous beams and simple frames.
3. To compute the deflections for S.S.B,fixed portal frames.

SYLLABUS

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 functions-Foulkes theorems and its geometrical analogue and absolute minimum weight design.

TEXT BOOKS:

1. "Comprehensive Design of Steel Structures", B.C.Punmia,Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications (P) Ltd.
2. Plastic Analysis and Design –C E Messennet, M A Seve
3. Design of Steel Structures by Duggal S.K, Tata McGrawHill Education2000

REFERENCE BOOKS:

1. "Plastic Analysis of Structures" by Beedle, Wiley Publications.
2. "Design of Steel Structures" by Arya&Ajmani, Nemchand Publishers.
3. "Design of Steel Structures" Vol2 by Dr.Rama Chandra, Scientific Publications
4 Plastic Methods of Structural analysis- B G Neal, Chapman and Rall publications

Code: M17 ST 1109

ANALYSIS AND DESIGN OF TALL BUILDINGS
(ELECTIVE-II)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

The main objectives of this Course is

1. This course is intended to teach the concept of tall structures.
2. Various methods to analyze the tall structure will be explained in the classes.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to

1. Know the types of tall buildings.
2. Analyze the plane frame systems by different methods.

SYLLABUS

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.
3. "Reinforced Concrete Structures" by Park, R. &Paulay, T, Wiley publications

REFERENCE BOOKS:

1. "Limit State Design of Reinforced Concrete" by Ashok Kumar Jain & B.C.Punmia,Laxmi Publications.
2. "Tall Chimneys" by Manohar, S.N., Tata McGraw-Hill Pub. Co.
3. "Design of Steel Structures"byN.Subramanian, Oxford Publications.

Code: M17 ST 1110

REPAIR AND REHABILITATION OF STRUCTURES
(ELECTIVE-II)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To familiarize the students with various types of deteriorations and need for rehabilitation.
2. To familiarize the student with Non – destructive testing and repairs.

COURSE OUTCOMES:

Students will be able to

1. Assess the damage intensity.
2. Select proper rehabilitation and repair measures for different types of deteriorations.
3. Apply the Seismic Retrofitting techniques on reinforced concrete building.

SYLLABUS

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 debonding-CDC 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 concretes- Materials of high performance concretes-Properties of high performance concretes- Self Consolidating concrete-properties-qualifications.

TEXT BOOKS:

1. "Renovation of Structures" by Perkins, E & FN Spon.
2. "Repairs of Fire Damaged Structures" by Jagadish, R, McGraw Hill Co.
3. "Deterioration, Maintenance and Repair of Structures" by Johnson, McGraw Hill Co.

REFERENCE BOOKS:

1. Concrete technology- Neville & Brooks
2. Special Structural concrete- RafatSiddique
3. Concrete repair and maintenance illustrated- Peter H Emmons
4. Concrete technology-M S Shetty

Code: M17 ST 1111

ADVANCED STRUCTURAL ENGINEERING LABORATORY

Lab	**: 3 Periods**	**Int.Marks**	**: 50**
Exam	**: 3 Hrs**	**Ext. Marks**	**: 50**
		Credits	**: 2**

COURSE OBJECTIVES:

1. To Apply the knowledge in strain measurement, SCC, Chemical analysis of water and aggregate.
2. To familiarize the student with Non – destructive tests on hardened concrete.

COURSE OUTCOMES:

Students will be able to

1. Measure strains in concrete elements by Electrical resistance strain gauges.
2. Conduct qualifying tests for Self compaction concrete.
3. Conduct Chemical Analysis of water and Aggregate for Suitabilityin concreting with and without Reinforcement.

SYLLABUS

1. Strain measurement - Electrical resistance strain gauges
2. Non destructive testing- Impact Hammer test, UPV test
3. Qualifications tests on Self compaction concrete-LBox 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.

REFERENCE BOOKS:

1. "Theory of Elasticity" by Sadhu Singh, Khanna publisher
2. Concrete technology- Neville & Brooks
3. Concrete technology-M S Shetty

SCHEME OF INSTRUCTION & EXAMINATION
(Regulation R17)

M.TECH (STRUCTURAL ENGINEERING)
DEPARTMENT OF CIVIL ENGINEERING

(With effect from **2017-2018** Admitted Batch onwards**)**
Under Choice Based Credit System

II-SEMESTER

Code No.	Name of the Subject	Credits	Lec-ture Hrs	Tutorial Hrs	Lab Hrs	Contact Hrs/ Week	Internal Marks	External Marks	Total Marks
M17ST 1201	Theory of Plates and Shells	3	3	1	--	4	30	70	100
M17ST 1202	Finite Element Methods of Analysis	3	3	1	--	4	30	70	100
M17ST 1203	Earthquake Resistant Design of Structures	3	3	1	--	4	30	70	100
M17ST 1204	Structural Stability	3	3	1	--	4	30	70	100
#ELE-3	Elective-III	3	3	1	--	4	30	70	100
#ELE-4	Elective-IV	3	3	1	--	4	30	70	100
M17 ST 1211	Computer applications in structural Engineering Lab	2	--	--	3	3	50	50	100
Total		**20**	**18**	**6**	**3**	**27**	**230**	**470**	**700**

	Course Code	Course
#ELE-3	M17 ST 1205	Reliability Analysis and Design
	M17 ST 1206	Prestressed Concrete
	M17 ST 1207	Optimization Techniques
#ELE-4	M17 ST 1208	Industrial Structures
	M17 ST 1209	Bridge Engineering
	M17 ST 1210	Earth Retaining Structures

Code: M17 ST 1201

THEORY OF PLATES AND SHELLS

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To familiarize with the concepts of plates and shells and designing of shells.

COURSE OUTCOMES:

Students will be able to

1. Analyze and design for plates for different loadings.
2. Analyze and design of shells.
3. Explain the concept oftheory of cylindrical shells.

SYLLABUS

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.

TEXT BOOK:

1. Theory of Plates and Shells" by Timoshenko, S. and Wernewsky-Kriegar, McGraw Hill Co

REFERENCE BOOKS:

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, McGraw – Hill, New York.

Code: M17 ST 1202

FINITE ELEMENT METHODS OF ANALYSIS

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To apply the concepts of Finite element method for solving structural Engineering problems.

COURSE OUTCOMES:

Students will be able to

1. Understand the fundamentals of Finite element method.
2. Derive the solution of the problems of 1D and 2D by FEM.
3. Apply the concept of iso-parametric formulation for solving problems.
4. Derive the shape functions for higher order elements.

SYLLABUS

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 problems- Derivation 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.

TEXT BOOKS :

1. Introduction to Finite element Method by TirupathichandraPatla and Belugundu, PHI
2. C.S.Krishnamoorthy, (2002), Finite Element Analysis, Tata McGraw Hill Publishing Co. Ltd.

REFERENCE BOOKS:

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, PHI publications.
4. The Finite Element Method in Engineering Science" by Zienkiewicz, P., McGraw Hill, 1971.
5. Introduction to Finite Element Method by Desai,C.S.and Abel, J.F.,VanNostrand, 1972.

Code: M17 ST 1203

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To impart the knowledge of designing earthquake resistant structures and familiarize the codeprovisions.

COURSE OUTCOMES:

Students will be able to

1. Describe various terms of engineering seismology.
2. Design earthquake-resistant structures.
3. Gain the knowledge on seismic code provisions and detailing.
4. Acquire the knowledge in structural irregularities in seismic planning and shear wall concept.

SYLLABUS

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 – Non-structural 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 concepts- Base 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.

TEXT BOOKS:

1. "Elements of Earthquake Engineering" by Jaikrishna and Chandrasekharan, SarithaPrakasham, Meerut.
2. "Dynamics of Structures, Theory and Applications to Earthquake Engineering" by Anil K. Chopra, Prentice Hall of India.
3. "Earthquake resistant design of structures" by S.K.Duggal, Oxford University Pres

REFERENCE BOOKS

1. PankajAgarwal 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.

Code: M17 ST 1204

STRUCTURAL STABILITY

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To impart the knowledge on linear and nonlinear behaviour of structures.
2. To familiarize the student with stability of plates under combined loads.

COURSE OUTCOMES:

Students will be able to

1. Analyze structures with linear and nonlinear behaviour.
2. Gain the knowledge on Stability of Continuous systems.
3. Distinguish elastic buckling and in elastic buckling.

SYLLABUS

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.

TEXT BOOKS:

1. "Principles of Structural Stability Theory" by Alexander Chajes, Prentice Hall
2. "Theory of Elasticity Stability" by Timoshenko and Gere, McGraw Hill pub.
3. "Structural Stability of Columns and Plates"NGRIyengar,EWP affiliated EastWest Press.

REFERENCE BOOKS:

1. An introduction to elastic stability of structures,ByG.J.Simitses,1976 Prentice Hall NJ.
2. Stability of Structures By ZP Bazant and L Cedolin,1990,Oxford University Press.

Code: M17 ST 1205

RELIABILITY ANALYSIS AND DESIGN
(ELECTIVE–III)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To learn the importance of reliability in Civil engineering and concepts ofcomputing structural reliability.

COURSE OUTCOMES:

Students will be able to

1. Understand the importance of reliability in Civil engineering.
2. Apply the concepts of computation of structural reliability for solving engineering problems.
3. Gain the knowledge of reliability based structural design.

SYLLABUS

UNIT-I

Concepts of Structural Safety: General, Design methods.Basic Statistics: Introduction, Data reduction, Histograms, Sample correlation.Probability Theory: Introduction, Random events, Random variables, Functions of random variables, Moments and expectation, Common probability distribution, Extremal distribution.

UNIT-II

Resistance Distributions and Parameters: Introduction, Statistics of properties of concrete, Statistics of properties of steel, Statistics of strength of bricks and mortar, Dimensional variations, Characterization of variables, Allowable stresses based on specified reliability.

UNIT-III

Probabilistic Analysis of Loads: Gravity loads, Wind load. Basic Structural Reliability: Introduction, Computation of structural reliability. Monte Carlo Study of Structural Safety: General, Monte Carlo method, Applications.

UNIT-IV

Level 2 Reliability Methods: Introduction, Basic variables and failure surface, First-order second-moment methods (FOSM).

UNIT-V

Reliability Based Design: Introduction, 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. Reliability of Structural Systems: Preliminary concepts as applied to simple structures.

TEXT BOOK:

1. "Structural Reliability Analysis and Design" by Ranganatham, R., Jaico Publishing house.

REFERENCE BOOK:

1. "Structural Reliability" by Melchers, R.E., Wiley publications.

Code: M17 ST 1206

PRESTRESSED CONCRETE
(ELECTIVE–III)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To impart the knowledge on pre-stressing techniques and materials requiredfor pre-stressing.
2. To familiarize the student with the losses of pre-stress and design of beams and slabs.

COURSE OUTCOMES:

Students will be able to

1. Analyze and design pre-stressed concrete members.
2. Gain the knowledge on materials, prestressing Systems, end anchorages.
3. Gain the knowledge on losses of pre-stress.
4. Analyze and design of sections for flexure.

SYLLABUS

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 tendons- Deflections 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 stresses- Approximate method of design- anchorage zone reinforcement- transfer of pre stresses- pre tensioned members-Composite sections: Introduction-Analysis for stresses- differential shrinkage- general design considerations

TEXT BOOKS:

1. Prestressed Concrete by N.KrishnaRaju, TataMcGrawhill, NewDelhi
2. Design of Prestressed Concrete Structures by T.Y. Lin and Ned. H. Burns, JohnWilley& sons.

REFERENCE BOOKS:

1. Prestressed Concrete by N.Rajagopalan, Alpha Science publications.
2. Prestressed Concrete by P. Dayaratnam, Delhi publications.

Code: M17 ST 1207

OPTIMIZATION TECHNIQUES
(ELECTIVE–III)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

Students will be able to

1. Derive optimized structure using classical and modern methods of optimization.
2. Gain the knowledge on Formulation of Structural Optimization problems.
3. Gain the knowledge on the concept of classical methods of optimization for multivariable
4. With equality or inequality constraints: solution by method of Lagrange Multiplier – Applications in structural engineering, Kuhn-Tucker conditions.

SYLLABUS

UNIT-I

Introduction: Need and scope for optimization – statements of 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 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 algorithms-introduction, 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

Introduction to quadratic programming: Geometric programming- and dynamic programming- Design of beams and frames using dynamic programming technique

TEXT BOOKS:

1. "Optimization Theory and Applications" by Rao, S.S., Wiley Eastern Ltd., New Delhi, 1978.
2. "Optimum Design of Structures" by Majid, K.I., Newnes-Butter Worths, London, 1974.
3. Optimization Concepts and Application in Engineering- Belegundu A.D. and Chandrupatla

REFERENCE BOOKS:

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

Code: M17 ST 1208

INDUSTRIAL STRUCTURES
(ELECTIVE–IV)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVE:

1. This subject imparts a broad knowledge in the area of industrial structures.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to

1. Know the requirements of various industries.
2. Design the roofs and Gantry girder for Industrial buildings .
3. Design the Folded plates and Bunkers and silos.
4. Design the Chimneys, cooling towers and Transmission of towers.

SYLLABUS

UNIT-I

Planning and functional requirements- classification of industries and industrial structures- planning 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-

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.

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

UNIT-V

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.

TEXT BOOKS:

1. "Comprehensive Design of Steel Structures", B.C.Punmia,Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications (P) Ltd.
2. Design of Steel Structures by Duggal S.K, Tata McGrawHill Education2000

REFERENCE BOOKS:

1. Advanced reinforced concrete design- N. KrishnamRaju
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

Code: M17 ST 1209

BRIDGE ENGINEERING
(ELECTIVE–IV)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To learn relevant code of practice for the design of steel Bridges.
2. To analyze and design of Plate girder Bridges.

COURSE OUTCOMES:

After completion of course students should be able to

1. Apply the IS code of practice for the design of steel bridges.
2. Analyze and design of Plate girder Bridges.

SYLLABUS

UNIT-I

Masonry arch Bridge design details- Rise, radius, and thickness of arch- Arch ring-Dimensioning 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 method-Courbon'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)

TEXT BOOKS:

1. Design of Steel structures by N. Subramanian, Oxford University Press.
2. Design of concrete bridges- Aswini, Vazirani, Ratwani
3. Essentials of bridge engineering- Jhonson Victor D

REFERENCE BOOKS:

1. Comprehensive design of steel structures-B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi Publications (P) Ltd.
2. Design of Steel Structures by Duggal S.K, Tata McGrawHill Education2000

Code: M17 ST 1210

EARTH RETAINING STRUCTURES
(ELECTIVE–IV)

Lecture	**: 3 Periods**	**Int.Marks**	**: 30**
Tutorial	**: 1 Period.**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

COURSE OBJECTIVES:

1. To impart the knowledge on different types of earth pressure theories and know to design different types of Retaining walls.
2. To impart the knowledge on different types of sheet pile structures and Reinforced earth structures.

COURSE OUTCOMES:

After completion of course students should be able to

1. Design the different types of Retaining walls and sheet piles using earth pressure theories.
2. Design the reinforced earth structures ,Braced cuts and cofferdams.

SYLLABUS

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 Embankments 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.

TEXT BOOKS

1. Principles of Foundation Engineering by Braja M. Das.
2. Foundation analysis and design – Bowles, JE – McGraw Hill.

REFERENCE BOOKS

1. Soil Mechanics in Engineering Practice – Terzaghi, K and Rolph, B. peck 2nd Edn. – John Wiley & Co.
2. Analysis and Design of Foundations and Retaining Structures, Prakash, S – SarithaPrakashan, Mearut.

Code: M17 ST 1211

COMPUTER APPLICATIONS IN STRUCTURAL ENGINEERINGLAB

Lab	**: 3 Periods**	**Int.Marks**	**: 50**
Exam	**: 3 Hrs**	**Ext. Marks**	**: 50**
		Credits	**: 2**

COURSE OBJECTIVES:

1. To apply the civil engineering software to some of the structural engineering problems.

COURSE OUTCOMES:

Students will be able to
1. Analyze the structural elements using software designs.
2. Design the structures fir the dynamic loads using software's.
3. Solve the finite elements application problems of structural engineering by software's.

SYLLABUS

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 BOOKS:

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

SCHEME OF INSTRUCTION & EXAMINATION
(Regulation R17)

M.TECH (STRUCTURAL ENGINEERING)
DEPARTMENT OF CIVIL ENGINEERING

(With effect from **2017-2018** Admitted Batch onwards**)**
Under Choice Based Credit System

III-SEMESTER

Code No	Course Title	Scheme of Examination	C	Int.	Ext.	Total
M17 ST 2101	Comprehensive Viva-Voce	Viva-Voce	2	50	---	50
M17 ST 2102	Seminar-I	Oral Presentation	2	50	---	50
M17 ST 2103	Project Work Part-I	Review	16	50	---	50
		Total	**20**	**150**	**---**	**150**

1. The Viva-Voce for the Comprehensive Viva-Voce and Seminar-I shall be held with the Project Guide, PG coordinator, and Head of the Department. The marks shall be awarded in the ratio of 20, 10 and 20 Marks by the members respectively.
2. Candidates can do their Project Work Part-I&II work within the department or in any industry/research organization for two semesters (i.e. 3rd and 4th semesters). In case of thesis done in an industry/research organization, one advisor (Guide) should be from the department and one advisor (Co-Guide) should be from the industry/research organization.
3. The Project Work Part-I should be submitted at the end of 3rd Semester and it will be evaluated through Review by a committee consisting of Head of the Department, PG coordinator and Project guide. The marks shall be awarded in the ratio of 20, 10 and 20 Marks by the members respectively.

SCHEME OF INSTRUCTION & EXAMINATION
(Regulation R17)

M.TECH (STRUCTURAL ENGINEERING)
DEPARTMENT OF CIVIL ENGINEERING

(With effect from **2017-2018** Admitted Batch onwards**)**
Under Choice Based Credit System

IV-SEMESTER

Code No	Course Title	Scheme of Examination	C	Int.	Ext.	Total
M17 ST 2201	Seminar-II	Oral presentation	2	50	-	50
M17 ST 2202	Project Work Part-II	Viva-voce	18	-	100	100
		Total	20	50	100	150

1. The viva-voce for Seminar-II shall be held with the Project Guide, PG coordinator, and Head of the Department. The marks shall be awarded in the ratio of 20, 10 and 20 Marks by the members respectively.
2. A publication of a paper on the thesis work in a National/International Journal at the end of 4th semester is mandatory for the submission of thesis work.
3. The Project Work Part-II should be submitted at the end of 4th semester and it will be evaluated through Viva–Voce examination by a committee consisting of External Examiner, Head of the Department, Project guide and PG coordinator. The marks shall be awarded in the ratio of 40, 20, 20 and 20 Marks by the members respectively.