DEPARTMENT OF CIVIL ENGINEERING
UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (AUTONOMOUS)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA - 533 003, ANDHRA PRADESH, INDIA

Course Structure and Syllabus

M. Tech (Structural Engineering) (DT) Programme

Revised on
28th January, 2014

DEPARTMENT OF CIVIL ENGINEERING

COLLEGE OF ENGINEERING: KAKINADA. (Autonomous)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

DEPARTMENT OF CIVIL ENGINEERING

Revised Course structure (R13) for

M. Tech. (Structural Engineering) (DT) Programme

S.No.	Name of the Subjects	Hrs/Week			Credits	Evaluation (Marks)			
		Lecture	Tutorial	Practical		Internal	External		Total
							Theory	Practical	
	I SEMESTER								
1	Advanced Mathematics	4	--	--	3	40	60	--	100
2	Theory of Elasticity	4	--	--	3	40	60	--	100
3	Matrix Analysis of Structures	4	--	--	3	40	60	--	100
4	Structural Dynamics	4	--	--	3	40	60	--	100
5	Elective –I	4	--	--	3	40	60	--	100
	a) Experimental Stress Analysis								
	b) Sub-Structure Design								
	c) Structural Optimization								
6	Elective – II	4	--	--	3	40	60	--	100
	a) Repair and Rehabilitation of Structures								
	b) Analysis and Design of Tall Buildings								
	c) Plastic Analysis and Design								
7	Advanced Structural Engineering Laboratory	--	--	3	2	40	--	60	100
	II SEMESTER								
1	Finite Element Method	4	--	--	3	40	60	--	100

2	Earthquake Resistant Design	4	--	--	3	40	60	--	100
3	Stability of Structures		--	--	3	40	60	--	100
4	Theory of Plates & Shells	4	--	--	3	40	60	--	100
5	Elective - III	4	--	--	3	40	60	--	100
	a) Pre-stressed Concrete								
	b) Mechanics of Composite Materials								
	c) Fracture Mechanics								
6	Elective – IV	4	--	--	3	40	60	--	100
	a) Industrial Structures								
	b) Bridge Engineering								
	c) Earth Retaining Structures								
7	CAD Laboratory	--	--	3	2	40	--	60	100
	III SEMESTER								
1	Seminar	--	--	--	2	50	--	--	50
2	Dissertation / Thesis	--	--	--	18	--	--	--	--
	IV SEMESTER								
1	Seminar	--	--	--	2	50	--	--	50
	Dissertation / Thesis	--	--	--	18	--	--	--	--

I-I	ADVANCED MATHEMATICS	L	P	Credits
		4	--	3

JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA
Applied Mathematics

Course Objectives

a. This course will provide concepts on One-dimensional Heat equation in Cartesian, cylindrical and spherical coordinates. (1)

b. Numerical solutions to Heat and Laplace Equations in Cartesian coordinates using finite – differences will be developed.(3)

c. The concepts of applied Statistics like Regression and correlation analysis, Non-linear curves Correlation of grouped bi-variate data, coefficient of determination Multiple Regression and partial Regression coefficients will be addressed.(4)

d. Analysis of variance for regression, Multiple correlation coefficients and linear regression with two independent variables will be provided. (5)

e. Introduction to Linear Programming Problem Formation, Graphical Method, Simplex method, and Non Linear Programming Problem Gradient method, Steepest Ascent Descent Methods will be addressed.(6)

Course Outcomes:

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

1. Understand One-dimensional Heat equation Cartesian, cylindrical and spherical coordinates.
2. Understand Two-dimensional Laplace Equation in Cartesian, cylindrical and spherical coordinates and Analytical solution by separation of variables technique.
3. Carryout Numerical solutions to Heat and Laplace Equations in Cartesian coordinates using finite – differences.
4. Carryout Regression and correlation analysis – Method of Least squares, Curve fitting, Curvilinear Regression, Non-linear curves
5. Carryout Correlation of grouped bi-variate data, coefficient of determination Multiple Regression and partial Regression coefficients
6. Understand formulation of Linear Programming Problems, Graphical Method, Simplex method, and Non Linear Programming Problem Gradient method, Steepest Ascent Descent Methods.

Syllabus

UNIT-1

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-2

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

UNIT-3

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-4

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

UNIT-5

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.

REFERENCES

1. Solutions of Partial Differential Equations" – Duffy, D.G. CBS Publishers, 1988
2. Introductory Methods of Numerical Analysis – Sastry, S.S. Prentice-Hall, 2nd Edition, 1992
3. Basic Statistics – Agarval, B.L., Wiley 1991, 2nd edition.
4. Operations Research – Hamdy A, Taha.
5. Optimization Techniques.- S.S.Rao

JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA

Theory of Elasticity

Course Objectives

a. The course will provide a basic treatment of the formulation of linear elasticity theory and its application to problems of stress and displacement analysis.(1)
b. The fundamental field equations will be developed including strain energy concepts. Applications will involve the solution to problems of engineering interest including two-dimensional problems of plane strain and plane stress, torsion, bending and stress concentration, and an introduction to three-dimensional solutions. (2,3,4)
c. Implement a reasonable choice of parameters of the model (geometry, material properties, boundary conditions) (5)
d. Analyze the result of solution by standard computational programs.(6,7,8)

Course Outcomes:

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

1. Know the definition of stress and deformation and how to determine the components of the stress and strain tensors.
2. Apply the conditions of compatibility and equations of equilibrium.
3. Understand how to express the mechanical characteristics of materials, constitutive equations and generalized Hook law.
4. Use the equilibrium equations stated by the displacements and compatibility conditions stated by stresses
5. Understand index notation of equations, tensor and matrix notation and define state of plane stress, state of plane strain.
6. Be able to analyze real problem and to formulate the conditions of theory of elasticity applications.
7. Determine the boundary restrictions in calculations.
8. Solve the basic problems of the theory of elasticity by using Airy function expressed as biharmonic function.

Syllabus

UNIT-1

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-2

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-3

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-4

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-5

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

JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA
Matrix Analysis of Structures

Course Objectives

a. The objective of the course is to learn the fundamental concepts of modern matrix structural mechanics, such as the stiffness method.(1)

b. Learning concepts of classical structural analysis such as, energy methods, method of consistent displacement methods, displacement and force methods. (1)

c. The concepts of structural analysis learnt in mechanics of solids and structures course.(2)

d. Understanding the analysis of statically determinate and indeterminate structures such as trusses, beams, frames and plane stress problems.(3)

e. Learn the concepts of the stiffness method and apply it to a variety of structural problems involving trusses, beams, frames (two and three dimensional), and plane stress. (3)

f. Understand the introductory concepts of the finite element methods applied to structural mechanics problems. (4)

Course Outcomes:

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

1. Perform the structural analysis of determinate and indeterminate structures using classical compatibility methods, such as method of consistent displacements, force and equilibrium methods
2. Perform structural analysis using the stiffness method.
3. Solve multiple degree of freedom two and three dimensional problems involving trusses, beams, frames and plane stress
4. Understand basic finite element analysis

Syllabus

UNIT-1

Introduction of matrix methods of analysis – Static indeterminacy 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-2

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-3

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

UNIT-4

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-5

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.

JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA
Structural Dynamics

Course Objectives:

a. Provide a general grounding in the basic principles of dynamics applied to structures and their interaction.(1)

b. To show how problems of structural dynamics can be expressed as equivalent problems of statics.(1)

c. Understanding of the response of structural systems to time-varying dynamic loads and displacements.

d. Study the behavior of structures subjected to dynamic loads such as free vibration, harmonic excitation and earthquake load.(2)

e. Learn behavior and response of Single degree of freedom structures with various dynamic loading, analysis with and without viscous dampers. (2)

f. Study the behavior and response of MDOF structures with various dynamic loading. (3)

g. Study the different Dynamic analysis procedures for calculating the response of structures. (4,5)

Course Outcomes:

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

1. Understand the response of structural systems to dynamic loads.
2. Realize the behavior and response of linear and nonlinear SDOF and MDOF structures with various dynamic loading.
3. Understand the behavior and response of MDOF structures with various dynamic loading.
4. Possess the ability to find out suitable solution for continuous system.
5. Understand the behavior of structures subjected to dynamic loads such as free vibration, Harmonic excitation and earthquake load

Syllabus

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

JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA
Experimental Stress Analysis

Course Objectives

a. This course provides an introductory experience to experimental stress analysis theory and methods as utilized in the field of engineering. (1)

b. The course material and hands-on laboratory exercises provide the student with an important introduction to experimental stress analysis methods that will serve them throughout their careers. (1,2,3,4,5,6)

c. To provide an introduction to the basic principles and methods of experimental stress analysis. (1)

d. Hands-on laboratory exercises are provided to illustrate and strengthen the student's knowledge of experimental stress analysis methods
(2,3,4,5,6)

Course Outcomes:

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

1. Understand the fundamentals of the theory of elasticity
2. Implement the principles and techniques of photoelastic measurement
3. Obtain the principles and techniques of strain gage measurement
4. Adopt the principles and techniques of moiré analysis
5. Apply the principles and techniques of holographic interferometry
6. Apply the principles and techniques of brittle coating analysis

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.

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

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Sub Structure Design

Course Objectives:

a. To assess the soil condition at a given location in order to suggest suitable foundation, based upon bearing capacity. (1)

b. Study the design of different type of shallow foundations like isolated, raft and combined footing. (2)

c. Familiarize with the design of pile foundation and pile caps. (3)

d. Design well and caissons foundations. (4)

Course Outcomes:

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

1. Attain the perception of site investigation to select suitable type of foundation based on soil category.
2. Capable of ensuring design concepts of shallow foundation.
3. Can be efficient in selecting suitable type of pile for different soil stratum and in evaluation of group capacity by formulation
4. Design different types of well foundation.

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- α - β - 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.

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.

JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA
Optimization Techniques

Course Objectives

a. Study the types of techniques that can be applied to discrete optimization problems. (1)

b. Application of techniques to practical problems in machine learning, logical problem-solving and operational planning, and how the key features of these problems govern the choice of algorithm.(2,3)

c. Introduce methods of optimization to engineering students, including linear programming, network flow algorithms, integer programming, interior point methods, quadratic programming, nonlinear programming, and heuristic methods. (4,5)

Course Outcomes

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

1. Basic theoretical principles in optimization
2. Formulation of optimization models
3. Solution methods in optimization
4. Methods of sensitivity analysis and post processing of results
5. Applications to a wide range of engineering problems

Syllabus

UNIT-1

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-2

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-3

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-4

Linear programming: Definitions and theorems- Simplex method- Duality in Linear programming- Plastic analysis and Minimum weight design and rigid frame

UNIT-5

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

REFERENCES

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

JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA
Repair and Rehabilitation of Structures

Course Objective

a. Study the assessment, maintenance and repair techniques of concrete structures. (1,2)

b. Different case studies are analyzed to define the best strategy to maintain and repair the structure.(2,3)

c. Identify scope of rehabilitation work for dilapidated / obsolete buildings. (2)

d. Identify and apply appropriate structural and construction technologies to rectify maintenance problems. (4,5)

e. Prepare short and long term maintenance plans. (4)

f. Identify / apply appropriate standards and statutory controls for maintenance and rehabilitation work. Understand the use of Building Information Modelling (BIM) for maintenance planning
(6,7,8)

Course Outcomes

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

1. Recognize the mechanisms of degradation of concrete structures and to design durable concrete structures.
2. Conduct field monitoring and non-destructive evaluation of concrete structures.
3. Design and suggest repair strategies for deteriorated concrete structures including repairing with composites.
4. Understand the methods of strengthening methods for concrete structures
5. Assessment of the serviceability and residual life span of concrete structures by Visual inspection and in situ tests
6. Evaluation of causes and mechanism of damage
7. Evaluation of actual capacity of the concrete structure Maintenance strategies
8. Repair / Rehabilitate / Strengthening techniques by using traditional and advanced materials and techniques.

Syllabus

UNIT-1

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-2

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-3

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-4

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-5

High performance concretes- Introduction- Development of high performance concretes-Materials of high performance concretes- Properties of high performance concretes- Self Consolidating concrete- properties- qualifications.

REFERENCES:

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

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JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA
Analysis and Design of Tall Buildings

Course Objectives

a. Discuss various structural systems and the methods of analysis and design (1)

b. The behavior of building for wind and earthquake loading and how it effects the design of structural systems and building services. (2)

c. Introduce various aspects of planning of Tall Buildings and know about different types of loads (2)

d. Introduce various structural systems for high rise buildings with their behaviour and analysis. (3)

e. Impart knowledge about analysis involved in Tall structures. (4)

f. Know about sectional shapes and design for differential movement, creep and shrinkage effects.(5)

g. Impart knowledge about stability analysis of various systems and to know about advanced topics. (3)

Course Outcomes:

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

1. Know design principles and different types of loading
2. Understand various structural systems used for Tall structures.
3. Capable of analyzing the tall structures and design of structural elements for secondary effects
4. Execute stability analysis, overall buckling analysis of frames, Analysis for various secondary effects –such as Creep, Shrinkage and Temperature.

Syllabus

UNIT-1

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

UNIT-2

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-3

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-4

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-5

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.

REFERENCES:

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.

JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA

Plastic Analysis and Design

Course Objectives

a. Introduce Concepts of stress and strain , Virtual work in the elastic-plastic state and Evaluation of fully plastic moment and shape factors for the various practical sections.(1)

b. Introduction to limit analysis of 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. (2)

c. Enable the students to understand Limit design Principles to solve continuous beams and simple frames designs using above principles. (3,4)

d. Understand Load deflection relations for simply supported beams, deflection of simple pin based and fixed based portal frames, method of computing deflections. (5)

e. Understand Minimum weight Design, Foulkes theorems and its geometrical analogue and absolute minimum weight design. (6)

Course Outcomes

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

1. Understand Concepts of stress and strain – relation of steel Moment curvature relation.
2. Carryout limit analysis of simply supported fixed beams and continuous beams, Effect of partial fixity and end, invariance of collapse loads.
3. Study basic theorems of limit analysis, rectangular portal frames, gable frames, grids, superposition of mechanisms.
4. Understand Limit design Principles to solve continuous beams and simple frames designs using above principles.
5. Develop Load deflection relations for simply supported beams, deflection of simple pin based and fixed based portal frames, method of computing deflections.
6. Carryout Minimum weight Design using Foulkes theorems and its geometrical analogue and absolute minimum weight design.

Syllabus

UNIT-1

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-2

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-3

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-4

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-5

Minimum weight Design: Introduction to minimum Weight and linear Weight functions-Foulkes 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

ADVANCED STRUCTURAL ENGINEERING LABORATORY

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. Identification of Dynamic Mode shapes and frequencies
6. Repair and rehabilitation of concrete beams

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JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA
Finite Element Method

Course Objectives

a. Equip the students with the Finite Element Analysis fundamentals. (1)
b. Enable the students to formulate the design problems into FEA. (2)
c. Enable the students to perform engineering simulations using Finite Element Analysis software (3)
d. Enable the students to understand the ethical issues related to the utilization of FEA in the industry. (2)
e. Enable the students to understand the CAD interfaces, joints and connections (4)

Course Outcomes

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

1. Develop finite element formulations of 1 degree of freedom problems and solve them
2. Understand any Finite Element software to perform stress, thermal and modal analysis
3. Compute the stiffness matrices of different elements and system.
4. Interpret displacements, strains and stress resultants

Syllabus

UNIT-1

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-2

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-3

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-4

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-5

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, PHI publications.

JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA
Earthquake Resistant Design

Course Objectives

a. During the course students will learn the fundamental aspects of earthquake engineering.(1,2)
b. Understand fundamentals of engineering seismology, fundamentals of structural dynamics, definition of the seismic actions.(2,3,4)
c. Behavior of structures under earthquake actions -with reference to both the elastic and the inelastic (4,5,6)
d. Behavior- structural design approaches according to the most important codes and regulations. (7,8)

Course Outcomes

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

1. To learn the fundamentals of seismology and basic earthquake mechanisms, tectonics, types of ground motion, and propagation of ground motion.
2. Understand qualitative and quantitative representations of earthquake magnitude
3. Determine the natural frequency of a single degree of freedom dynamic system for given mass, stiffness and damping properties.
4. Determine the maximum dynamic response of an elastic vibrating structure to a given forcing function
5. Learn the fundamentals of building code based structural design.
6. Determine the static design base shear based on the type of structural system, irregularity, location and occupancy.
7. Distribute the static base shear to the structure based on vertical distribution of mass, horizontal distribution of mass, and centers of rigidity.
8. Recognize special conditions such as irregular buildings, building separation, P-delta effects and base isolation.

Syllabus

UNIT-1

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-2

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-3

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-4

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

UNIT-5

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.

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JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA

Stability of Structures

Course Objectives

a. Understand behavior of structural components and systems that suffer from failure due to geometric, rather than material, nonlinearity (1)

b. Understand fundamental mechanics that is designed to give the theoretical background to the more practical design-based modules.(2)

c. Study the stability of columns using theoretical and numerical methods. (3)

d. Understand the approximate methods and numerical methods of inelastic buckling.

e. Get accustomed to beam column behavior and that of frames. (2)

f. Study concepts of lateral buckling, lateral torsional buckling and flexural torsional buckling of beams. (4)

g. Study various numerical techniques and energy methods for buckling of thin plates.(2)

Course Outcomes

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

1. Analyze different types of structural instabilities
2. Execute and work out the inelastic buckling using various methodologies.
3. Examine the behaviour of beam columns and frames with and without side sway using classical and stiffness methods.
4. To be well versed in the lateral buckling, torsional buckling, Flexural torsional buckling of various beams and non-circular sections.

Syllabus

UNIT-1

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-2

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-3

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-4

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-5

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.

JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA

Theory of Plates and Shells

Course Objectives:

a. To study various plate theories, governing equations for bending of plates with various boundary conditions. (1)

b. Study Concepts using Navier's solution and Levy's solution and to analyze rectangular and square plates. (2)

c. Study the behavior of bending of circular plates. (3)

d. Use energy methods to analyze the solution of rectangular plates for the given boundary conditions. (3,4,5)

e. Classify and analyze the different type of shell structures. (6)

f. Design circular domes, conical roofs and circular cylindrical shells. (6)

g. Study the behaviour of pyramidal roof (6)

h. Study behavior and design of shells and folded plates

Course Outcomes:

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

1. Have a knowledge about various plate theories due to bending
2. Gain the knowledge of Navier's solution, Levy's solution and solve for the rectangular and square plates.
3. Analyze circular plates with various boundary conditions.
4. Focus on the finite difference method of solving plate problems.
5. Ability to realize the potential energy principle and find the solution of rectangular plates for various loadings
6. Understand the behavior of folded plates and shells.

Syllabus

UNIT-1

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-2

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

UNIT-3

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

UNIT-4

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-5

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. Theory of Plates 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.

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JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA
Prestressed Concrete

Course Objectives:

a. Study systems of pre-stressing using the principles of pre-stressing. (1)

b. Analysis of deflection for the types and losses in pre-stressing.(2)

c. Design of flexural members with shear, bond and torsion and design of the end blocks. (2)

d. Analysis and design of beams using the concept of linear transformation and cable profile using IS Code. (3)

e. Design the tension and compression members and their application in design of pipes, water tanks, piles and flag mast. (4)

f. Analysis and design of composite section and their application in design of prestressed concrete bridges. (5)

Course Outcomes:

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

1. Explain the principle, types and systems of prestressing and analyze the deflections.
2. Determine the flexural strength and design the flexural members, end blocks.
3. Analyze the statically indeterminate structures and design the continuous beam.
4. Design the tension and compression members and apply it for design of piles.
5. Analyze the stress, deflections, flexural and shear strength and apply it for the design of bridges.

Syllabus

UNIT-1

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-2

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-3

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-4

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-5

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

REFERENCES:

1. Prestressed Concrete- N. Krishna Raju
2. Prestressed Concrete- S. Ramamrutham
3. Prestressed Concrete- P. Dayaratnam
4. Prestressed Concrete- T. Y. Lin

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JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA
Mechanics of Composite Materials

Course Objectives:

a. Concepts of composite materials and properties of composite fiber and matrix constituents. (1)
b. Formulate Stress strain relation of orthotropic and anisotropic materials (2)
c. The static, dynamic and stability analysis for simpler cases of composite plates. (3)
d. The failure criterion and fracture mechanism of composites. (4)
e. The metal and ceramic composite & design with composites (5)

Course Outcomes:

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

1. Identify the fibre types and classify the composite material.
2. Relate the stress –strain properties, longitudinal and transverse properties of composites lamina.
3. Analyze the laminated composites and compute the lamina strength.
4. Find the failure criterion and fracture mechanics of composites.
5. Apply the load deformation relation, residual stresses for the design of composites.

Syllabus

UNIT-1

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 application-Reinforcements: 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-2

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-3

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-4

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-5

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

REFERENCES:

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, Wiley- Interscience, New York, 1980.

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

JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA

Fracture Mechanics

Course Objectives:

a. The course will treat linear and nonlinear fracture mechanics principles and their applications to structural design. (1,2)

b. Fracture phenomena in metals and nonmetals will be discussed and testing methods will be highlighted. (2,3)

c. In the end computer assisted techniques for fracture study will be discussed (2,3,4)

Outcomes:

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

1. Predict material failure for any combination of applied stresses.
2. Estimate failure conditions of a structures
3. Determine the stress intensity factor for simple components of simple geometry
4. Predict the likelihood of failure of a structure containing a defect

Syllabus

UNIT-1

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 fracture- history of fracture mechanics-Griffiths criteria for crack propagation cracks- Energy release rate , G_I G_{II} and G_{III} - Critical energy release rate G_{Ic} , G_{IIc} and G_{IIIc} – surface energy - R curves – compliance.

UNIT-2

Principles of Linear Elastic Fracture Mechanics: SOM vs Fracture Mechanics -stressed based Criteria for fracture- Stress Intensity Factors- K_I K_{II} and K_{III} – Critical stress Intensity Factors, K_{Ic} K_{IIc} and K_{IIc} – 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-3

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 ($CTOD_c$) –critical Crack Mouth Opening Displacement ($CMOD_c$).

UNIT-4

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

UNIT-5

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.
2. Elements of Fracture Mechanics – Prasanth Kumar, wiley Eastern Publications
3. Fracture Mechanics: Fundamentals and applications – T. L. Andrason, PhD, CRC publications
4. 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 publications.

JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA
Industrial Structures

Course Objectives:

a. This subject imparts a broad knowledge in the area of Planning and functional requirements for industrial structures. (1)

b. Understand the basic idea about the materials and design of industry structural elements. (2)

c. Know the design concepts of Power plant structures, (3)

d. Realize the design concepts of Power transmission structures, (4)

e. Understand the basic design concepts of Chimneys, Bunkers and silos and the construction techniques (5)

Course Outcomes:

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

1. Plan the functional requirements of structural systems for various industries.
2. Get an idea about the materials used and design of industrial structural elements.
3. Realize the basic concepts and design of power plant structures.
4. Design power transmission structures.

Possess the ability to understand the design concepts of Chimneys, bunkers and silos

Syllabus

UNIT-1

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-2

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

UNIT-3

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

UNIT-4

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

UNIT-5

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

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JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA
Bridge Engineering

Course Objectives:

a. Study the various bridge forms and typical loadings on the bridges. (1)
b. Get familiarized with the design of short span bridges. (2)
c. Possess knowledge on the design concepts of long span bridges. (2,3)
d. Design the prestressed concrete bridges. (4)
e. Design the substructure for bridges, plate girder to IRS loadings, foundation for bridges and bearings (5)

Course Outcomes:

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

1. Design theories for super structure and substructure of bridges
2. Design Culvert, R.C.C T Beam Bridge.
3. Understand the behavior of continuous bridges, box girder bridges.
4. Possess the knowledge to design prestressed concrete bridges.
5. Design Railway bridges, Plate girder bridges, different types of bearings, abutments, piers and various types of foundations for Bridges

Syllabus

UNIT-1

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-2

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-3

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

UNIT-4

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-5

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

JAWAHARLAL NEHRU TECHNOLGICAL UNIVERSITY KAKINADA
Earth Retaining Structures

Course Objectives:

a. The overall objective of this course is to provide students the fundamentals needed for the design and analysis of earth retaining systems.(1)

b. Performance evaluation, selection, design of earth retaining structures used for the support of fills and excavations. (2,3)

c. Classical earth pressures theories and soil-reinforcement interaction. (5)

d. Case studies as well as demonstrating the selection, design and performance of various earth retaining structures.(6)

e. Distinguish among retaining walls, bulk heads, well caissons and coffer dams.(7)

Course Outcome

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

1. Quantify the lateral earth pressures associated with different earth systems.
2. Evaluate the mechanical properties of geosynthetics used for soil reinforcement.
3. Identify the merits and demerits of different earth retaining systems.
4. Select the most technically appropriate type of retaining wall for the application from a thorough knowledge of available systems.
5. Design of retaining structures using appropriate design methods, factors of safety, earth pressure diagrams and field verification methods.
6. Aware of current guidelines regarding the design of earth retaining structures.
7. Design retaining structures considering both external and internal stability aspects.

Syllabus

UNIT-1

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-2

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

UNIT-3

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-4

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

UNIT-5

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.

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MSEP-2 – CAD Laboratory

Pre-Requisites: None

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

CO1	Develop Computer Programs for Analysis and Design of various Structural Elements
CO2	Use different Structural Engineering software's to solve various civil Engineering programs

Mapping of Course Outcomes with Progrom Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	3	3	3	1	3	3
CO2	1	3	2	3	1	3	3

1. Slightly 2. Moderately 3. Substancially

Detailed 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:

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