DR. A P J ABDUL KALAM UNIVERSITY, INDORE

SYLLABUS

of

MASTER OF TECHNOLOGY (STRUCTURAL ENGINEERING)

Department of Civil Engineering

(First Year)

(Session July- December 2016)

College of Engineering

Dr. A P J Abdul Kalam University, Indore

DR. A P J ABDUL KALAM UNIVERSITY, INDORE

Syllabus for Master of Technology (Structural Engineering)

Department of Civil Engineering

List of Subject (First Year)

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Unit 1: Numerical solution of Partial Differential Equation (PDE)

Numerical solution of PDE of hyperbolic, parabolic and elliptic types by finite difference method

Unit 2: Integral transforms

General definition, introduction to Mellin, Hankel and Fourier transforms and fast Fourier transforms, application of transforms to boundary value problems in engineering

Unit 3: Integral equations

Conversion of Linear Differential equation (LDE) to an integral equation (IE), conversion of boundary value problems to integral equations using Greens function, solution of Integral equation, IE of convolution type, Abels IE, Integral differential equations, IE with separable variable, solution of Fredholm Equation with separable kernels, solution of Fredholm and Volterra equations by method of successive approximations.

Unit 4: Calculus of Variation

Functionals and their Variational, Eulers equation for function of one and two independent variables, application to engineering problems.

Unit 5: FEM

Variational functionals, Euler Lagranges equation, Variational forms, Ritz methods, Galerkins method, descretization, finite elements method for one dimensional problems.

References:

[1] C. F. Froberg, Introduction to numerical analysis.

[2] S. S. Sastry, Introductory methods of numerical analysis.

[3] Krasnove, Kiselevanded Makarenho, Integral equations.

[4] Buchanan, Finite element Analysis (schaum Outline S), TMH.

[5] Krishnamurthy, Finite element analysis, TMH.

[6] Higher Engineering Mathematics by B.V. Ramana, Tata Mc Hill.

[7] Advance Engineering Mathematics by Ervin Kreszig, Wiley Easten Edd.

Unit 1: Two Dimensional Problems of Stress & Strain in Rectangular Co-ordinates

Solutions by Polynomials, Saint-Venant's Principle, Determination of displacements, bending of beams, solution of two dimensional problems in Fourier series. Plane Stress, Plane Strain, Stress and Strain at a points, Differential equations of equilibrium, constitutive relation : ansisotropic materials Linear elasticity; Stress, strain, constitutive relations; Boundary conditions, Compatibility equation, stress function.

Unit 2: Two Dimensional Problems in Polar Coordinates

General equations in Polar coordinates, Pure bending of curved bars, displacements for symmetrical stress distributions, bending of curved bar, stress distribution in plates with circular holes, stresses in a circular disc general solution.

Unit 3: Three Dimensional Problems of Stress and Strain

Principal stress and strain, shearing stress and strains, elementary equation of equilibrium , compatibility conditions, problems of elasticity involving pure bending of prismatic bars.

Unit 4: Torsion of Prismatic Bars

Torsion of prismatic bars, membrane analogy, torsion of rectangular bars, solution of torsional problem, torsion of rolled section, torsion of hollow shafts and thin tubes, torsion buckling torsional flexural buckling.

Unit 5: Introduction to Plasticity

Definitions and relation between nominal stress, true stress, engineering strain, natural strain, conclusion from experiments of loading unloading and reloading in plastic range, loading unloading and reverse loading, Bauschinger's effect, definition of yield criteria and types, Tresca and von mises yield criteria.

References:

[1] Timoshenko, S.P. , Theory of Elasticity
[2] Timoshenko, S.P., Theory of Elastic Stability
[3] Iyenger N.G.R., Structural Stability of Columns & Plates.

Unit 1: Matrix Flexibility Method

Force methods, Basic Concepts, evaluation of flexibility, transformation, analysis of a single member of different types, transformation of single member.

Unit 2: Application of Flexibility Method

Applications to plane and space structures with pin joints and rigid joints, energy approach in flexibility method, effect of support displacement and transformation, temperature stresses.

Unit 3: Matrix Stiffness Method

Displacement methods, Basic concepts, Evaluation of stiffness coefficients, Direct stiffness method, energy approach in stiffness method. Code No. approach for global stiffness matrix, effect of support displacement and temperature.

Unit 4: Application of Stiffness Method

Applications to plane and space structures with pin joints and rigid joints, energy approach in stiffness method, effect of support displacement and transformation, temperature stresses.

Unit 5: Analysis of Space Trusses and Grids

3D concepts, tension coefficient method, Grid analysis using flexibility and stiffness matrix method.

References:

[1] C. S. Reddy , Basic Structural Analysis ,TMH, Publishers.
[2] W. Wearer Jr. & James M. Gere, Matrix Analysis of Framed Structures, CBS Pub.
[3] Rajsekeran, Sankarsubramanian, Computational structural Mechanics, PHI.
[4] Pandit, Structural Analysis: a matrix approach, TMH.

Unit 1: Effect of Earthquake and Wind

Earthquake and wind effects on structures, loads on structures, reinforced concrete Design of flat slabs, grid floors, deep beams, design of buildings load bearing and framed structures, design of foundations, seismic analysis.

Unit 2: Water Tank & Bridge

Design of underground and elevated water tanks, Continuity analysis of circular and intze tanks, design of bridge decks.

Unit 3: Pre-stressed concrete

analysis and design of sections under flexure using limit state approach, anchorage zone and end block design, composite construction, introduction to statistically indeterminate pre-stressed concrete structures.

Unit 4: Silos and bunker

Janseen's and Airy's theory, rectangular bunkers with sloping bottoms and with high side walls, battery of bunkers.

Unit 5: Design of Grids and Flat Slabs

Types of grid floors and their designs, types of flat slabs and their design.

References:

[1] Jaikrishna, Chandrasekaran, Elements of earthquake engineering.
[2] Shah and Karve, Text book of reinforced concrete.
[3] Punamia, RCC designs.
[4] Krishna Raju, Prestressed concrete.
[5] Varghese, Advanced RC Designs, PHI.
[6] Everard, Theory and problems of RC design (Shaums Outline S), TMH.

Unit 1: C++ Programming Language

Basics of programming, loops, decisions, structures, functions, objects classes, arrays.

Unit 2: Object Oriented Programming

Overloading, inheritance, virtual functions and pointers, object oriented programming, Turbo C++ features and programming, structure engineering problems programming.

Unit 3: Computer Aided Drafting 2-D

Computer Aided drafting, 2-D and 3-D drawings, Introduction to CAD software, drawing of buildings..

Unit 4: Computer Aided Drafting 3-D

Computer Aided drafting, 3-D drawings, Introduction to CAD software, drawing of buildings..

Unit 5: Modeling Software

Introduction to computer graphics, 3-D modeling software and analysis software.

References:

[1] Robert Lafore, Object oriented programming in C++.
[2] E. Balaguruswamy, Programming in C.
[3] Syal and Gupta, Computer programming and engineering analysis.
[4] AutoCAD, SolidEdge, Cadlab software and Manuals.

Sub Code: MTSE 106	Sub Name: Lab-I Concrete	6 Credits

List of Experiments:

1. Tests on Cement
2. Determination of compressive strength of concrete with different cement grades.
3. Determination of workability by compacting factor apparatus.
4. Determination of workability by Vee Bee consistometer.
5. Nondestructive testing of concrete by Rebound hammer test
6. Nondestructive testing of concrete by ultrasonic Method.
7. Test for the effect of admixtures on the concrete compressive strength
8. Testing of microconcrete

List of Experiments:

1. Write a programme to print "HELLO WORD" on the screen.
2. WAP of Arithmetic Expression
3. Write a program to interchange value of two variables without using third variable.
4. To Study general commands of Auto cad.
5. To Study modified commands of Auto cad.
6. Planning of a residential building plan on auto cad.
7. Planning of a commercial building plan on auto cad.

Unit 1 Single Degree of Freedom System

Free and forced vibrations, Linear Viscous Damper, Coulomb Damper: Response to harmonic excitation, rotating unbalance and support excitations, Vibration isolation and transmissibility, single degree of freedom system as vibro-meter and accelerometer, response to periodic and arbitrary excitation.

Unit 2: Laplace Transform Fourier Transform

Duhamels integral, Impulse response function, Laplace transform Fourier transform methods. Frequency response function. Phase-Plane Techniques. Critical Speed of rotors. Energy methods, Rayleigh□s method, Equivalent viscous damping.

Unit 3: Damped and Un-damped

Two Degree of Freedom System. Matrix Formulation, Free Vibration, Beat phenomenon. Principle of damped and un-damped vibration absorbers.

Unit 4: **Multi Degree of Freedom System**

Matrix formulation, stiffness and flexibility influence coefficients, eigenvalue problem, normal modes and their properties. Matrix iterationtechnique for eigenvalue, and eigen vectors, Free and forced vibration by modal analysis.

Unit 5: Continuous System

Axial vibration of bar, torsion of shafts, transverse vibration of strings and bending vibration beams. Forced vibration. Normal mode method.Lagrangles equation. Approximate methods of Rayleigh-Ritz, Galerkin etc.

References:

1. R. W. Clough, J Penzien, Dynamics of structures.
2. D. G. Fertia, Dynamics and vibration of Structures.
3. J. M. Biggs, Introduction to structural dynamic.
4. Mario Paz, Structural dynamics: Theory and computation.
5. Anil K. Chopra, Dynamics of Structures.

Unit 1: Introduction to Finite Element Method

General Applicability and Description of Finite Element Method Comparison with other methods.

Unit 2: Solution of Finite Element Method

Solution of Equilibrium Problems, Eigen value problems, propagation problems, computer implementation of Gaussian eliminations, Choleskis decomposition, Jocobis and Ranga Kutta Method.

Unit 3: General Procedure of Finite Element Method

Descretization of the domain, Selection of Shapes, Types and Number of elements, node numbering technique, Interpolation Polynomials, their selection and derivation in terms of global and local coordinates, Convergence requirements. Formulation of Element Characteristic matrices and vectors, Variational approach. Assembly of Element matricesand Vectors and Derivation system equations, computation of element resultants.

Unit 4: Iso-parametric Formulation

Lagrange and Hermite interpolation functions, Isoparametric Elements, Numerical Integration.

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Unit 5: Static Analysis

Formulation of equilibrium equation, Analysis of truss, Frames, Plane Stress and Plane Strain Problems Plates and Shells.

References:

1. Weaver, Johnson, Finite element and structural analysis.
2. HC Martin, Matrix structural analysis.
3. CF Abel, CS Desai, Finite element methods.
4. Buchanan, Finite element Analysis (schaum Outline S), TMH.
5. Krishnamurthy, Finite element analysis, TMH.
6. S. S. Rao, Finite element method in Engineering.

Unit 1 Cement & Its Properties
Cement & its properties, properties of fresh concrete compaction of concrete, curing of concrete.

Unit 2 Properties of **Concrete**

Properties of hardened concrete, strength characteristic, shrinkage, creep, durability, fattier.

Unit 3 Special Concrete

Permeability & durability of concrete is detail. Special concrete and their properties

Unit 4 Concrete (Effect of Temp.)

Concrete at low & high temp. Air entrained concrete, high performance concrete.

Unit 5 Mix Design

Mix Design, Non destructive Testing of Concrete.

References:

1. A.M. Nobille, Concrete Technology , ELBS, London.
2. M.L. Gambir, Concrete Technology, Tata Mc Graw Hill Book Co.
3. Peurifoy R.L., Construction Planning Equipment & Methods, TMH.
4. Verma Mahesh, Construction Equipments and its Planning & Application, Metropoliton Book Company New Delhi.

Unit 1 Introduction to Stress Analysis

Introduction to stress analysis by strain measurement, mechanical strain gages, Moire fringe method, Brittle coatings for stress indication, circuitry for resistance strain gages, calibrating strain gages, temperature compensation of circuitry, indication and recording equipments, unbalance of bridge systems, balanced bridge systems, reference bridge systems, constant current strain indicators, multichannel recording systems.

Unit 2 Strain Gages

Introduction to stress analysis by photo elasticity, optical theory, stress optical relationship, equipment and models, static stress analysis (2-D, 3-D techniques), stress analysis by photo elastic strain gages. Polariscopes, fractional fringe order.

Unit 3 Principle in Crack Theory

Conditions for crack growth, fracture mechanics and strength of solids, stress and displacement fields in the vicinity of crack tip, the Griffith Orowan-Irwin concept, stable and unstable crack growth, the integral variation principle in crack theory, some more model representations, cracks in linearly elastic bodies, stress intensity factor.

Unit 4 Stress Intensity Factor

Basic numerical methods for calculating the stress intensity factor, calculation of stress intensity factor for double cantilever beam specimen by FEM, the method of section for an approximate calculation of stress intensity factor, some material characteristics used for evaluation of crack propagation resistance.

Unit 5 Plane and Three Dimensional

Solution of some plane and three dimensional problems, constructional crack arrest, system of cracks, stress intensity factors for some practical important cases, shell with a crack trajectory.

References:

1. Dove, Adams, Experimental stress analysis and motion.
2. Heteny, Experimental stress analysis.
3. Dally, Rilay, Experimental stress analysis.
4. VZ Panon, M Morozove, Elastic-plastic fracture mechanics.

Unit 1 Theory of Plates

Theory of Plates: Bearing of long rectangular plates to the cylindrical surface with different edge conditions. Pure bending of plates, Differential equations of equilibrium. Theory of small deflections of laterally loads plates. Boundary conditions, momentcurvature relationship.

Unit 2 Analysis of Rectangular Plates

Analysis of rectangular plates, Naviers and levy solutions, exact theory of plates, symmetrical bending of circular plates, continuous rectangular plates

Unit 3 Special & approximate methods of theory of plates

Special and approximate methods of theory of plates, singularities, use of influence surfaces, use of infinite integrals and transforms, strain energy methods, experimental methods.

Unit 4 Theory of Shells

Classification of shells, Gaussian curvature, General theory of cylindrical shells, membrane theory and bending theory for cylindrical shells, long and short shells, shells, shells with and without edge beams, Fourier loading.

Unit 5 Classification of Shells

Equation of equilibrium for shells of surface of revolution, Reduction to two differential equations of second order. Spherical shells, membrane theory for shells of double curvature synclastic and anti-clastic shells. Cylindrical shells, Hyperbolic-paraboloid, Elliptic paraboloid shells, funicular shells.

References:

1. S Timoshenko, S Woinowasky K, Theory of Plates and Shells.
2. Design and construction of concrete shells roofs by G. S. Ramaswamy.
3. Analysis of Thin Concrete Shells by K. Chandrasekhara.
4. Shell theory by Ramchandra.

List of Experiments:

1. To measure stress and strain using strain gauge mounted on a cantilever beam.
2. To study linear variable differential transformer and use it in a simple experimental setup to measure the of meter in a tank.
3. To study various temperature measuring instrument and to estimate their response time
4. To measure load using aload cellon a tube.
5. To measure the speed of a motor shaft with the help non contact type pick up.
6. Polariscopes stress calculation using fringes.

1. To Study the **staad pro** and SAP software analysis.