BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE PILANI, HYDERABAD CAMPUS
INSTRUCTION DIVISION
FIRST SEMESTER, 2016-2017
COURSE HANDOUT PART-II (ON-CAMPUS)

Date: 01/08/2016

In addition to Part-I (General handout for all courses appended to the Time Table), this portion gives further specific details regarding the course.

Course No : **ME G512**
Course Title : **FINITE ELEMENT METHODS**
Instructor-In-Charge : **SRINIVASA PRAKASH REGALLA**

Course Description: Fundamental concepts, matrix algebra and Gauss elimination, one-dimensional problems, trusses, two-dimensional problems using constant strain triangles, axisymmetric solids subjected to axisymmetric loading, two-dimensional isoparametric elements and numerical integration, beams and frames, three-dimensional problems in stress analysis, scalar field problems, dynamic considerations, pre-processing and post processing.

Scope and Objective: The course covers intermediate to advanced topics of finite element methods including scalar field problems,

Text Book:

T1. T. R. Chandrupatla, A. D. Belegundu, Introduction to Finite Elements in Engineering, 3rd Edition, Prentice Hall of India, New Delhi.

Reference Books:
R1. Reddy J. N., *An Introduction to Finite Element Method*, 3rd Edition, Tata-McGraw Hill Edition, 2006, New Delhi.
R2. Rao S. S., *The finite element method in engineering*, fourth edition, Elsevier, 2005, MA, USA.

Course Plan:

Module	Modularized Learning Items	Reference:	No. of Lectures
M1: Fundamental Concepts	RL1.1: Historical background, stresses and equilibrium, boundary conditions, strain-displacement relations, stress-strain relations RL1.2: Temperature effects, potential energy and equilibrium, Rayleigh-Ritz method, Galerkin method, von-Mises stress	T1: Chapter 1	2
M2: Matrix algebra in FEM	RL2.1: Important concepts of matrix implementation of FEM calculations, eigenvalues and eigenvectors, positive definite matrix, cholesky decomposition, Gaussian elimination, conjugate gradient method	T1: Chapter 2	1
M3: Finite element modeling of one-dimensional vector-field problems	RL3.1: Finite element modeling, linear and quadratic shape functions RL3.2: Rayleigh-Ritz & Galerkin approaches, assembly of equations and application of essential and natural boundary conditions by different methods, temperature effects RL3.3: Finite element modeling of planar trusses, allusion to three-dimensional trusses, assembly of global stiffness matrix	T1: Chapter 3 & 4	3
M4: Finite element modeling of two-dimensional vector-field problems	RL4.1: Finite element modeling using CST element, isoparametric representation RL4.2: Modeling of orthotropic material system RL4.3: Finite element modeling of axisymmetric solids subjected to axisymmetric loading RL4.4: Application of boundary conditions in axisymmetric problems	T1: Chapter 5, 6 and 7	5

Module	Modularized Learning Items	Reference:	No. of Lectures
	with different examples RL4.4: Two dimensional isoparametric modeling with four node quadrilateral element RL4.4: Numerical integration RL4.5: Higher order elements and modeling of axisymmetric problems, conjugate gradient implementation of the quadrilateral elements		
M5: Modeling of fourth order problems	SM5.1: Beams and Frames RL5.1.1: Modeling using Euler-Bernoulli Beam elements using Rayleigh-Ritz and Galerkin approaches, Load vector and boundary conditions, shear force and bending moment, beams on elastic supports RL5.1.2: Plane frames, three-dimensional frames RL5.1.3: Modeling using Timoshenko beam elements SM5.2: Plate bending RL5.2.1: Analysis of plates using membrane elements with in-plane loads RL5.2.2: Modeling of bending of plates under transverse loads	T1: Chapter 5 R1: Chapter 7 R2: Chapter 10	5
M6. Modeling of 3-dimensional problems	M6.1: Formulation of 3D problems, stress calculations, hexahedral elements, solution procedures	T1: Chapter 9	1
M7: Modeling of eigenvalue and dynamic problems	RL7.1.1: Formulation of Eigen value problems, mass matrices and stiffness matrices RL7.1.2: Formulation of time dependent problems, parabolic equations RL7.1.3: Formulation of time dependent problems, hyperbolic equations	T1: Chapter 11 R1: Chapter 6 R2: Chapter 12	3
M8: Finite element modeling of single variable scalar field problems	RL6.1: Boundary value problems RL6.2: mesh generation and boundary conditions RL6.3: applications to heat transfer RL6.4: applications to potential flow, seepage fluid mechanics RL6.5: application to solid mechanics RL6.6: application to torsion	T1: Chapter 10 R1: Chapter 8 R2: Chapters 13 to 16	8
M9: Finite element analysis fluid flow as vector field problems	RL9.1: Equations of fluid mechanics, modeling procedure RL9.2: analysis of inviscid and incompressible fluid flows RL9.3: analysis of viscous and non-Newtonian flows	R2: Chapter 17-19 T1: Chapter 10	8
M10: Introduction to Advanced Topics	RL10.1: Solution of quasi-harmonic equations RL10.2: Solution of Helmholtz equation RL10.3: Solution of Reynolds equation	R2: Chapter 20 to 22	6
Total Lecture Classes: 42			

Evaluation Scheme:

EC No.	Evaluation Component	Duration	%Wgt	Date & Time	Nature of Component
1	Test-I	1 hr	15%	13/9, 4.00--5.00 PM	Closed Book
2	Test-II	1 hr	15%	21/10, 4.00--5.00 PM	Closed Book
3	Weekly Practicals	2 hours each week	20%	Central CAD Lab (D208) 3 PM to 5 PM every Friday	Open Book: Comprehensive Practicals Examination at the end of the Semester
4	Project	-	20%		Open Book
5	Comprehensive Examination	3 hrs	30%	06/12 FN	Closed Book Quiz (15%) + Open Book (15%)

Chamber Consultation Hour: will be announced in the class.
Make up policy: Only genuine cases will be granted make up.
Notices: All in The CMS and if very important also on the Department Notice Board.

NOTE: The border cases in final grading will be decided based on mainly class room attendance and attentiveness in the classroom.

Instructor-In-charge ME G512