GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (PRODUCTION ENGINEERING) (28)

FINITE ELEMENT ANALYSIS
SUBJECT CODE: 2732808
M.E. SEM-III

Type of course: MAJOR ELECTIVE - IV

Prerequisite: NIL

Rationale: This course provides the knowledge of different Mechanical Elements Stiffness and strength equation and their specific Boundary Condition for Beam, Bar and Structure Component in manufacturing & Designing. This course gives hands on practice regarding development of CM system & FMS systems from the Computer Software models Analysis. This course gives knowledge about different major industrial application related to modernize Production.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks		Practical Marks				
L	T	P	C	ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	CM System Concurent engineering and design methodology, collaborative product development, Product data management for manufacturing and design data reuse product life cycle management, arid collaborative product, commerce, Advance manufacturing, Cellular, Synchronous Agile, Lear, Manufacturing system, concept of rapid prototyping, reverse engineering, re-engineering, case studies.	**06**	**18**
2	FMS Definition of FMS, types and configuration, concept, types of flexibility and performance measures, Function ofFMS host computer, FMS host and area controller, function distribution. Development and implementation: Planning phase integration, system configuration, FMS layouts, simulation, FMS project development steps.	**06**	**18**
3	Basics of FEM - Initial value and boundary value problems - weighted residual, Galerkin and Raleigh Ritz methods - Review of Variational calculus - Integration by parts – Basics of Variational formulation.	**04**	**10**
4	Steps In FEA - Descretization, interpolation, derivation of element characteristic matrix function, assembly and imposition of boundary conditions - Solution and post processing, One-dimensional analysis in solid mechanics and heat transfer.	**06**	**18**

5	Global and Natural co-ordinates - Shape functions for one and two dimensional elements – Three nodded triangular and four noded quadrilateral element - non linear analysis – Isoparametric elements - Jacobian matrices and transformations - Basics of two dimensional axi symmetric analysis.	**06**	**18**
6	FE analysis of metal casting - Special considerations, latent heat incorporation. Gap element - Time stepping procedures - crank - Nicholson ,algorithm - Prediction of grain structure – Basic concepts of plasticity - Solid and flow formulation - Small incremental deformation formulation - FE analysis of metal cutting. chip separation criteria, incorporation of strain rate dependency	**06**	**18**

Reference Books:

1. Vajpayee, Principles of CIM, PHI
2. Seshu, Text book of Finite Element Analysis, PHI
3. Introduction to finite elements in engineering by Tirupathi K. Chandrupatla and Ashok D.Belegundu.
4. CAD / Cam and Automation by Farazdak Haidery, Nirali Prakashan.
5. Practical Finite Element Analysis by Nitin S. Gokhale, Sanjay S.Deshpande, Sanjeev V. Bedekar and Anand N. Thite, Finite to infinite, Pune.
6. Finite Element Procedures in Engineering analysis by K.J Bathe.
7. An Introduction to Nonlinear Finite Element Analysis by J.N.Reddy, Oxford University Press. 6. The finite element methods in Engineering – S.S. Rao - Pergamon, New York.
8. An Introduction to Finite Element Methods – J. N. Reddy – Mc Graw Hill.
9. The Finite Element Method in Engineering science – O.C. Zienkowicz, Mc Graw Hill.Concepts and applications of finite element analysis – Robert Cook

Course Outcome:

After learning the course the students should be able to find out the boundary conditions of the structural and the machine part. And understand the stress concentration better.

List of Experiments:

1. 1D & 2D structural analysis.
2.1D and 2D heat transfer problems.
3.Analysis of plane trusses.
4.Computation of shape function.
5.Computer programmes for 3D structural analysis.
6.Formulation and solution of dynamic problems using computer programmes.

Design based Problems (DP)/Open Ended Problem:

1. Write a generic program for solving 1D and 2D structural problems.
2. Determine Stress Intensification Factor using FEA

Major Equipments/Software/learning website:

1) **Ansys Latest Version**
2) **http://www.dmoz.org/Science/Technology/Software_for_Engineering/Finite_Element_Analysis/**

3) **http://imechanica.org/**
4) **http://www.codedevelopment.net/**

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.