COURSE NUMBER	**ME 425**
COURSE TITLE	**Finite Element Method in Mechanical Engineering**
COURSE STRUCTURE	(3-0-3) (lecture hr/wk - lab hr/wk – course credits)
COURSE COORDINATOR	S. Chester
COURSE DESCRIPTION	Introduction to central ideas underlying the finite element method in mechanical engineering and its computer implementation. Fundamental concepts such as interpolation functions for one- and two –dimensional elements, bar element method, Galerkin's method, discretization of a model, methods of assembling global matrices, and the final solution techniques for obtaining nodal values. Specific applications to mechanical engineering problems in trusses, beams, torsion, heat transfer, fluid flow, plane stress, and plane strain.
PREREQUISITE(S)	CIS 101 – Computer Programming and Problem Solving Math 222 – Differential Equations MECH 237 Strength of Materials
REQUIRED ELECTIVE, ELECTIVE **COREQUISITE(S)**	Elective None
REQUIRED MATERIALS	Introduction to Finite Element Analysis and Design By Nam-Ho Kim and Bhavani V. Sankar Publisher: John Wiley & Sons, Inc. 2009
Other supplemental materials	Hand out lecture note with examples
COMPUTER USAGE	ANSYS software is used to solve projects.
COURSE LEARNING OUTCOMES	By the end of the course students should be able to: 1. derive 1-D element matrix equation for bar under tension and heat transfer type problem. (1,2,5,6) 2. apply the steps required for FEM solution to variety of physical systems and obtain engineering design quantities. (1,2,5,7) 3. use existing software (available from ME CAD room) such as ANSYS to work on projects. (1,2,3,6,7) 4. select engineering design quantities (force, stress or heat flux) for truss, beam, plane stress or heat transfer problems. (1,2,6)
CLASS TOPICS	1. Introduction, spring and bar elements, element and global matrix equations, solution. 2. Interpolation functions, potential energy, residual integral. 3. Matrix algebra. 4. Truss element formulation, element stiffness, assembled and condensed matrices. 5. ANSYS – truss structure. 6. Heat transfer in a fin, axial deformation of a bar using 3-node element. 7. Beam and Frame elements, Hermite Interp. Functions. 8. ANSYS – frame structure.

	9. Gaussian quadrature. 10. 2-D elements, triangular and rectangular elements, isoparametric transformation. 11. ANSYS – 2-D heat transfer. 12. Potential flow and torsion of a solid bar. 13. Plane elastic problems. 14. 1-D time dependent problems. 15. ANSYS – plane stress analysis.
RELATED STUDENT OUTCOMES	The **Course Learning Outcomes (CLOs)** support the achievement of the following ME Student Outcomes of ABET Criterion 3 requirements **Student Outcome 1** - an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. **Related CLO** – 1- 4 **Student Outcome 2 -** an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. **Related CLO** – 3-4 **Student Outcome 3 –** an ability to communicate effectively with a range of audiences **Related CLO** – 3 **Student Outcome 5 -** an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives **Student Outcome 6** - an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions **Related CLO –** 1,2,3,4 **Related CLO** – 3 **Student Outcome 7 –** an ability to acquire and apply new knowledge as needed, using appropriate learning strategies **Related CLO** – 3