19ME313 COMPUTER AIDED ENGINEERING

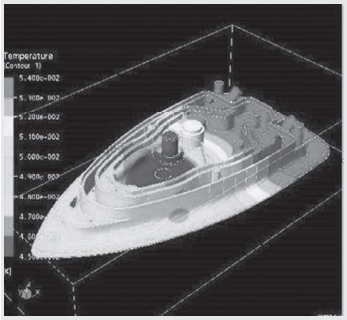
Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
5	40	-	8	5	-



Source:
https://www.google.com/search?q=design+and+computer+aided+engineering

PRE-REQUISITE COURSES: Solid Mechanics, Engineering Thermodynamics

COURSE DESCRIPTION AND OBJECTIVES:

This course explores the fundamental concepts of finite element methods(FEM) & basics of analysis package. It is a numerical method used to find the approximate solutions of various real time field problems. The objective of this course is to provide solutions using FEM for static structural and steady state heat transfer problems.

COURSE OUTCOMES:

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

COs	Course Outcomes	POs
1	Identify appropriate elements for structural & heat transfer problems.	1,5
2	Derive element equations for various elements.	1
3	Evaluate nodal solution for structural & heat transfer problems.	2,3
4	Analyze and solve structural/thermal field problems using analysis package.	5

SKILLS:

- ✓ Apply FE method to solve different boundary value problems.
- ✓ Implement energy method concepts to solve bar/stepped problems.
- ✓ Obtain the solution of various 1D structural and thermal field problems.
- ✓ Analyze machine structures using ANSYS and MATLAB packages.

UNIT- I **L-9**

ENERGY METHODS: Introduction, 3D Stresses and strains, Plane stress, Plane strain condition, Energy methods, Minimum Potential energy method, Rayleigh-Ritz and Weighted residual methods, Galerkin method, Problems on energy methods (restricted to Bar problems only), Introduction to Finite Element Software - ANSYS.

UNIT- II **L-9**

ONE DIMENSIONAL PROBLEMS: Finite element modeling, Coordinates and shape functions, FEM procedure, Problems on 1D stepped bar/ simple bars, One dimensional analysis of plane walls, composite walls, Fins (with 2 noded bar elements only).

UNIT- III **L-9**

ANALYSIS OF TRUSSES: Introduction, FEM procedure, Stress in truss elements, Problems on simple trusses (limited to three members only).

ANALYSIS OF BEAMS: Introduction, Finite element formulation, Nodal solution, Shear force and bending moment.

UNIT- IV **L-9**

TWO-DIMENSIONAL PROBLEMSUSING CONSTANT STRAINT RIANGLES: Introduction, Finite element modeling, Constant strain triangle, Element equations, Element stiffness matrix, Element body load vector, Element traction load vector, Two-dimensional analysis of plane walls.

UNIT - V **L-9**

SHAPE FUNCTIONS OF HIGHER ORDERELEMENTS: Shape functions of three noded bar element, Shape functions of four-node quadrilateral elements and six noded triangular element, Iso-parametric, sub-parametric and super-parametric elements.

NUMERICAL INTEGRATION: Gauss one point and two-point quadrature, Derivations of Gauss points and weights (limited to two points only), Problems on 1D bar elements and 2D quadrilateral elements.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS **TOTAL HOURS: 30**

1. To perform static structural analysis of 1D problems.
2. To perform 1D steady state thermal analysis of fins/plane wall/ composite wall.
3. To perform structural analysis of trusses.
4. To determine Nodal solution and Von-mises stress distribution for plane stress and plane strain structuralproblems using manual meshing procedure.
5. To determine Nodal solution and Von-mises stress distribution for plane stress and plane strain structural problems using automatic meshing procedure.
6. To perform 2D steady state thermal analysis of fins/plane wall/ composite wall.
7. To analyze the different types of beams subjected to UDL, UVL, Bending moment, and point load.
8. To study the buckling behavior of connecting rod.
9. To find natural frequencies and mode shapes of single rotor system.
10. To determine the contact stresses during indentation.
11. To simulate the thermal behavior of I.C engine block in Ansys workbench.
12. To carry out coupled field analysis of boiler/pressure vessel Ansys workbench.

TEXT BOOKS:

1. Chandrupatla T R and Ashok D Belegundu, “Introduction to Finite Elements in Engineering”, 4th edition, Pearson, 2012.
2. S.S. Rao, “The Finite Element Methods in Engineering”, 5th edition, Butterworth - Heinemann, 2010.

REFERENCE BOOKS :

1. J.N. Reddy, “An Introduction to Finite Element Method”, 3rd edition, Tata McGraw-Hill, 2005.
2. Alavala, “Finite Element Methods”, 2nd edition, PHI, 2008.
3. Kenneth H. Huebner and Donald L. Dewhirst, “The Finite Element Method for Engineers”,4th edition, John Wiley and Sons (ASIA), 2007.
4. C.S. Krishna Murthy, “Finite Element Analysis”, 2nd edition, Tata McGraw-Hill, 2005.