B.E Semester: 8 Automobile Engineering
Subject Name: Finite Element Method (MA803-N-B)
[Dept. Elect.-5]

Course Objective:

- To present a problem oriented in depth knowledge of Finite Element Method(FEM).
- To address the underlying concepts and analysis in FEM.
- To learn investigation techniques with FEA & FEM

B. Teaching / Examination Scheme:

Teaching Scheme				Total Credit	Evaluation Scheme					
L	T	P	Total		Theory		Mid Sem Exam	CIA	Pract.	Total
Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	Marks
3	0	2	5	4	3	70	30	20	30	150

C. Detailed Syllabus:

Unit No.	Details
1	**Fundamentals of Continuum Mechanics:** Equilibrium of continuum-Differential formulation, Energy ApproachIntegral formulation. Overview of approximate methods for the solution of the mathematical models: Rayleigh-Ritz methods, Methods of Weighted Residuals (Galerkin, Least-squares & Collocation methods).
2	**Line Elements and Applications:** Concepts of Modelling and discretization, Shape functions, elements and Degrees-of-Freedom, Strain – displacement relation, Local and Global equations; Iso-Sub-Super parametric formulation.
3	**Structural Problems:** Linear and Quadratic elements, Elimination and Penalty Approach, Properties of global stiffness matrix; Structural and Thermal strains; Treatment for various boundary conditions. Formulation of Truss element, Plane truss: Stiffness and Force matrix. Beam: Euler – Bernoulli Element formulation, plane frames, various loading and boundary conditions
4	**Thermal and Fluid Problems:** Steady state heat transfer: Element formulations, treatment to boundary conditions with application to 1-D heat conduction, heat transfer through thin fins; Potential flow problems.
5	**2D Elements:** Triangular (CST, LST): Shape function, Jacobian matrix, straindisplacement matrix, stress-strain relationship matrix, force vector. Quadrilateral Elements (Q4, Q8): Shape function, Jacobian matrix, strain displacement matrix, stress-strain relationship matrix, force vector.
6	**Dynamic Problems:** Formulation of dynamic problems, consistent and lumped mass matrices for 1-D and 2-D element, Solution of eigenvalue 1-D problems: Transformation methods, Jacobi method, Vector Iteration methods, subspace iteration method.

7	**Soft computing Case studies:** Introduction of FEA using various software (ANSYS), MATLAB,etc..., free ware software :Scilab , python ,etc..

Total hours (Theory):48
Total hours (Practical):32
Total hours:80

D. Lesson Planning:

Sr. No.	Date/Week	Unit	Weight age	Topic No
1	1^{st} ,2^{nd} ,3^{rd}	Unit 1	20%	1,2
2	4^{th} .5^{th} ,6^{th}	Unit 2	15%	3
3	7^{th} , 8^{th} ,9^{th}	Unit 3	20%	4
4	10^{th} .11^{th}. 12^{th}	Unit 4	20%	5
5	13^{th} , 14^{th} ,$15^{th,}$,16^{th}	Unit 5	25%	6,7

E. Instructional Method & Pedagogy

1	At the start of course, the course delivery pattern , prerequisite of the subject will be discussed
2	Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal Weight age should be given to all topics while teaching and conduction of all examinations.
3	Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
4	One/Two internal exams may be conducted and total/average/best of the same may be converted toequivalent of 30 marks as a part of internal theory evaluation.
5	Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
6	Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overallinternal evaluation.
7	The course includes a laboratory, where students have an opportunity to build an appreciation for theconcept being taught in lectures. Suggested list of experiment is given below

F. List of Practical:

1	Application of Numerical method for FEM
2	Solve 1D – Structural, thermal and fluid problems using FEA software and manually
3	Solve Plane truss problems, using FEA software and manually. Include problems with symmetry.
4	Solve Beam problems with different boundary and loading conditions using FEA software and manually.
5	Solve planar problem.
6	Solve axi-symmetric problem.
7	Solve Dynamic problem.

G. Students Learning Outcomes:

1	The student can identify different areas of FEM
2	Can find the applications of all the areas in day to day life.

H. Text Books & Reference Books:

1	Introduction to Finite Elements in Engineering, **Author** : Chandrupatla T. R. and Belegunda A. D,**Publisher** : PHI.
2	An Introduction to Finite Element Method , Author : J N Reddy ,Publisher : McGraw - Hill.
3	A First Course in the Finite Element Method, Author : D Logan, Publisher : Thompson Learning
4	Concepts and Applications of Finite Element Analysis, Author : R D Cook,Publisher : Wiley India.
5	The finite element method : theory, implementation, and practice, Larson Mats G., Bengzon Fredrik, New-York: Springer : 2012 : 385 p. : ISBN: 9783642332869
6	The finite element method : theory, implementation, and applications, Larson, Mats G. (Author) ; Bengzon, Fredrik ; cop. 2013