Course Type	Course Code	Name of Course	L	T	P	Credit
DP	NMEC535	**Finite Element Analyses Lab**	0	0	3	1.5

Course Objective

The primary objective of the course is to expose the students to:

- Develop algorithm based on classical Finite Element Analyses
- Develop MATLAB codes for Finite Element Analyses with different linear/Non-linear 1D, 2D Finite Elements for structural analysis
- Decide optimum mesh size during FEA & perform Error Analyses

Learning Outcomes

On successful completion of this course, students will be able to:

- Develop the algorithm based on classical Finite Element Analyses.
- Develop MATLAB codes for Finite Element Analyses with different linear/Non-linear 1D, 2D, and 3D Finite Elements for structural analysis
- Decide the optimum mesh size during a Finite Element Analyses through Mesh convergence and perform error analyses (through comparison of Analytical and Finite Element Analysis based results) for different structural problem domains.

Unit	Topics to be Covered	Lecture Hours	Learning Outcome
1	Introduction to MATLAB, Matrix algebra & Gaussian Elimination Technique	3	Students will be introduced to the basic commands of MATLAB (useful for Finite Element Analyses), basic matrix algebra, and Gaussian Elimination Techniques
2	Structural Finite Element Analyses of abar subjected to point load and axially distributed loading for nodal deformations, stresses, and strains using lower order 1D Bar elements (**2-noded Linear Bar Element)**	3	Understanding the algorithm and develop MATLAB programing for **2-noded Linear Bar Element** based structural FEA of 1D bars.
3	Thermo-mechanical Finite Element Analyses of 1D bar subjected to elevated thermal field for nodal deformations, stresses, and strains using lower order 1D elements (**2-noded Linear Bar Element)**	3	Understanding the algorithm and develop MATLAB programing for **2-noded Linear Bar Element** based thermo-mechanical FEA of 1D bars.
4	Finite Element Analyses of a bar under body forces for nodal deformations, stresses, and strains using higher order 1D bar elements (**3-noded Quadratic Bar Element)**	3	Understanding the algorithm and develop MATLAB programing for**3-noded Quadratic Bar Element** based FEA of 1D bars.
5	Finite Element Analyses of **2DPlane Trusses** for nodal deformations, stresses and strains	3	Understanding the algorithm and develop MATLAB programing for **Plane Truss Element** based FEA of 2D Truss structures.
6	Finite Element Analyses of **2D Plane Frames** for nodal deformations, stresses, and strains	3	Understanding the algorithm and develop MATLAB programing for **Plane Frame Element** based FEA of 2D Frame structures.

7	Finite Element Analyses of an 1D beam subjected to UDL for determining nodal reactions, stresses, and strains using **Euler-Bernoulli Beam Element**	3	Understanding the algorithm and develop MATLAB programing for**Euler-Bernoulli Beam Element** based FEA of 1D Beam structures.
8	Finite Element Analyses of a Simply Supported Beam under point load for static deflection.	3	Understanding the algorithm and develop MATLAB programing for**static deflection of beam**
9	Finite Element Analysis of a cantilever Beam under dynamic loadingfor determining the mode shapes.	3	Understanding the algorithm and develop MATLAB programing for **Finite Element Analysis using Beam elements under dynamic forces**
10	Finite Element Analysis of a Simply Supported Beam subjected to a dynamic loading (Sinusoidal loading) to obtain the Time Response.	3	Understanding the algorithm and develop MATLAB programing for **Finite Element Analysis for Beam elements subjected to dynamic forces**for Time Response study
11	2D Finite Element Analyses structures using **3-nodedConstant Strain Triangle (CST) Elements.**	3	Understanding the algorithm and develop MATLAB programing for **2D FEA using 3-nodedCST Elements.**
12	2D Finite Element Analyses structures using **4-nodedQuadrilateral Elements.**	3	Understanding the algorithm and develop MATLAB programing for **2D FEA using 4-nodedQuadrilateral Elements.**
13	Mini Project	6	Students will understand to carry out structural analyses of real life structures through FEA.
	Total	**42**	

Test Books:

1. MATLAB codes for Finite Element Analyses; A, J, M. Ferrieira: Springer Publications
2. Finite Element Analyses: Theory and Application using ANSYS. SaeedMoaveni, PEARSON Publications.

References:

1. The Finite Element Method and Applications in Engineering using ANSYS. ErdoganMadenci, Ibrahim Guven, Springer Publications
2. Finite Element Analyses using ANSYS 11.0: P. Srinivas, K.C. Sambana, R.K. Datti. PHI Publishing House.