BMEE306L	Computer Aided Design and Finite Element Analysis	L	T	P	C
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Pre-requisite	**BMEE202L, BMEE202P**	**Syllabus version**			
		1.0			

Course Objectives

1. To impart knowledge on the design of engineering products and processes at continuum scale.
2. To give insight to convert the physical problem into an engineering problem through geometrical and numerical modelling capabilities.
3. To familiarize the application of finite element methods on structural, thermal and dynamic problems.
4. To develop the knowledge and skills needed to evaluate design solutions.

Course Outcome

At the end of the course, the student will be able to

1. Develop concept model into CAD model using geometric modelling techniques.
2. Apply suitable product data exchange techniques to convert geometric model into numerical model.
3. Generate mathematical representation of curves, surfaces and solids using interpolation and approximation concepts.
4. Formulate 1D and 2D finite element equations at element and assembly level for static structural, thermal and dynamic applications.
5. Apply finite element formulations using linear and quadratic shape functions to compute desired results.
6. Solve complex engineering problem using the first principles and commercial CAD/FEM tools.

Module:1	**Introduction to CAD**	**4 hours**

Raster-scan graphics-Coordinate systems-Database structures for graphic modelling-Engineering Data Management system- Transformation of geometry-3D Transformations-Clipping-Hidden line/surface removal-Colour-Shading

Module:2	**Geometric modelling – Analytical and Synthetic curves**	**4 hours**

Requirements of geometric modelling-Wireframe modelling-analytical curves-Cubic spline-Bezier spline-B-spline-NURBS- Solving analytical and synthetic curve problems

Module:3	**Geometric modelling – Surface and solid modelling-CAD Standards**	**5 hours**

Surface representation-Analytical and Synthetic surfaces-Solid representation methods-constrained based modelling-parametric modelling- Standardisation in graphics-Exchange of modelling data-software modules-software development-Efficient use of CAD software

Module:4	**Introduction to approximation methods**	**4 hours**

Introduction to Finite Element Method - Direct formulation - Minimum total potential energy formulation - Variational approach - Weighted Residual formulation – Weak Formulation

Module:5	**Interpolation Functions**	**8 hours**

Polynomial form of interpolation functions - Simplex, Complex, Multiplex elements, Selection of order of interpolation functions, Convergence requirements, Global local and natural coordinates system.
Derivation of shape function equation for various elements: One dimensional element (linear, quadratic and cubic), Two dimensional elements – linear, bilinear and quadratic - Beam element.

Module:6	**Analysis of One Dimensional and Two-dimensional problems**	**14 hours**

Generic form of 1D finite element equations –Bar, Truss, Beam -1D thermal – Isoparametric elements-Numerical Integration-Problem solving
Generic form of 2D finite element equations - Triangular element - Rectangular elements- - Applications in solid mechanics (plane stress, plane strain and axisymmetric) and heat transfer

Module:7	**Dynamic Problems**	**4 hours**

Dynamic analysis using finite element method -Eigen value and Eigen vectors- 1D Bar and Beam-vibration problems –Problem solving

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Books

1	Ibrahim Zeid, “Mastering CAD/CAM”, 2013, McGraw Hill Education (India) P Ltd., SIE.

2	Rao S. S., Finite Element Method in Engineering, 2010, 5th edition, Butterworth-Heinemann.		
Reference Books			
1.	Saeed Moaveni, Finite Element Analysis, Theory and Application with ANSYS, 2021, Pearson Fifth Edition.		
2.	Tirupathi R. Chandrupatla and Ashok D. Belugundu, Introduction to Finite Elements in Engineering, 2011, 4th Edition, Prentice Hall.		
3.	Seshu. P, Finite Element Analysis, 2013, Prentice Hall of India.		
4.	J.N.Reddy, Introduction to Finite Element Method, 2019, McGraw -Hill International Edition.		
Mode of Evaluation: CAT, Written assignment, Quiz, FAT			
Recommended by Board of Studies	09-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022