A. **TITLE:** Applied Finite Element Method

B. **COURSE NUMBER:** MECH 417

C. **CREDIT HOURS:** 3

D. **WRITING INTENSIVE COURSE:** No

E. **COURSE LENGTH:** 15 weeks

F. **SEMESTER(S) OFFERED:** Fall or Spring

G. **HOURS OF LECTURE, LABORATORY, RECITATION, TUTORIAL, ACTIVITY:**
   Two 1-hour lectures and one two-hour lab

H. **CATALOG DESCRIPTION:**
   This course introduces the student to modeling and analysis of mechanical systems via the finite element method. Topics include the theory and procedures to design computer models to simulate various applied mechanical problems, validation of computer models, and interpretation of numerical results, mesh and accuracy analysis, and discussion of conclusions. Students will use FEM software to solve various mechanical and heat transfer problems.

I. **PRE-REQUISITES/CO-REQUISITES:**
   b. Co-requisite(s): none

J. **GOALS (STUDENT LEARNING OUTCOMES):**
   By the end of this course, the student will be able to:

<table>
<thead>
<tr>
<th>Course Objective</th>
<th>Institutional SLO</th>
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<tbody>
<tr>
<td>1. Demonstrate the fundamental theory of the</td>
<td>1. Communication</td>
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<tr>
<td>Finite Element Method</td>
<td>2. Critical Thinking</td>
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<td>2. Build computer models for a mechanical system</td>
<td>2. Critical Thinking</td>
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<td>3. Create 1D, 2D and 3D meshes</td>
<td>2. Critical Thinking</td>
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<td>4. Define material properties</td>
<td>2. Critical Thinking</td>
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<td>5. Define boundary conditions and load analysis</td>
<td>2. Critical Thinking</td>
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<td>6. Select appropriate mechanical models</td>
<td>2. Critical Thinking</td>
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<td>7. Analyze model convergence, stability, and accuracy</td>
<td>2. Critical Thinking</td>
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<tr>
<td>8. Perform model validation</td>
<td>2. Critical Thinking</td>
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K. **TEXTS:**

L. **REFERENCES:**

M. **EQUIPMENT:** Computer Lab

N. **GRADING METHOD:** A-F
O. **MEASUREMENT CRITERIA/METHODS:**
   - Exams
   - Quizzes
   - Labs
   - Participation
   - Projects

P. **DETAILED COURSE OUTLINE:**
   I. Introduction to Finite Element Method (FEM)
      A. What is FEM
      B. Background of FEM
      C. Applications of FEM
   
   II. FEM Solution Procedures
      A. Introduction
      B. Problem Setup
      C. Discrete Mesh Generation
      D. Material and Section Properties
      E. Boundary Conditions and Load Analysis
      F. Mechanical Model Assembling
      G. Creating and Submitting FEM Jobs
      H. Results and Visualization
   
   III. Governing Equations for FEM
      A. Introduction
      B. BEAM Analysis
      C. Plate/Shell/Composite and Solid Analysis
      D. Linear/Non-Linear Structural Analysis
      E. Vibration Analysis
      F. Fatigue Analysis

IV. FEM Techniques
   A. Introduction
   B. Model Discretization
   C. Weight Function
   D. Model Validation

V. FEM Solution Analysis
   A. Introduction
   B. Consistency Analysis
   B. Stability Analysis
   C. Convergence Analysis
   D. Accuracy Analysis
   E. Computing Efficiency

Q. **LABORATORY OUTLINE:**
   I. Introduction to FEM Software
   
   II. Beam Analysis
   
   III. Truss Analysis
   
   IV. Buckling of centrally loaded structure
V. Plate/Shell analysis

VI. Dynamic Load analysis – Wind Turbine