# ME 400 COURSE PROFILE

**DEGREE PROGRAM:** Mechanical Engineering

<table>
<thead>
<tr>
<th>COURSE NUMBER: ME 400</th>
<th>COURSE TITLE: Mechanical Engineering Analysis</th>
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<tr>
<td><strong>REQUIRED COURSE OR ELECTIVE COURSE:</strong> Elective</td>
<td><strong>TERMS OFFERED:</strong> Fall or Winter</td>
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<td><strong>TEXTBOOK / REQUIRED MATERIAL:</strong> Murray Spiegel: Schaum's Outline of Advanced Mathematics for Engineers and Scientists and CANVAS notes</td>
<td><strong>PRE / CO-REQUISITES:</strong> MECHENG 211, MECHENG 240, Math 216. I (3 credits)</td>
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<td><strong>COGNIZANT FACULTY:</strong> W. Schultz</td>
<td><strong>COURSE TOPICS:</strong></td>
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| **BULLETIN DESCRIPTION:** Exact and approximate techniques for the analysis of problems in Mechanical Engineering including structures, vibrations, control systems, fluids, and design. Emphasis is on application. | 1. Linear Algebra  
2. Matrix Factorization  
3. Eigenvalue Problems  
4. Iteration methods for eigenvalue problems  
5. Ordinary differential equations  
6. Analytic Solutions  
7. Numerical Solutions  
8. Finite difference methods  
9. Maxima and Minima  
10. Structural Optimization  
11. Eigenvector Orthogonality  
12. Modal Analysis  
13. Laplace transforms  
14. Linear Independence; completeness |
| **COURSE STRUCTURE/SCHEDULE:** Lecture: 3 hours per week |
### COURSE OBJECTIVES:
For each course objective, links to the Program Outcomes are identified in brackets.

1. Review and develop specific mathematics techniques as applied to mechanical engineering problems [1, 2, 6, 7]
2. Develop mathematics in a physical and engineering context [1, 4]
3. Show that engineering problems can be grouped into (a) steady state (b) eigenvalue, and (c) propagation problems [1, 7]
4. Show how engineering problems can be described by differential equations and difference methods [1, 2, 6, 7]
5. Show how engineering problems can be described by energy methods and the calculus of variations [1, 2, 6, 7]

### COURSE OUTCOMES:
For each course outcome, links to the Course Objectives are identified in brackets.

2. Apply continuous compound interest, buckling, Mohr's circle for stress and strain and mass moments of inertia [2,3]
3. Apply Newton's Law of cooling, compound interest, stress in thick disks [2, 3, 4]
4. Apply Laplace transforms and ordinary differential equations [2, 3]
5. Apply Newton-Raphson and binary chop techniques for roots of algebraic and transcendental relations: buckling loads, natural frequencies of continuous systems [1, 2]
6. Compute approximate derivatives and integrals using finite difference techniques [1]
7. Apply finite difference technique to problems: steady state temperature distribution, heat flow in a rod, problems with Sturm-Liouville boundary conditions, natural frequencies [2, 3, 4]
8. Use techniques of curve fitting: a) hyperbolic b) exponential c) powers [1].
10. Solve minimum/maximum problems: geometric problems with and without constraints [1]
11. Solve the simple problem of the calculus of variations [1]
13. Formulate continuous systems with lumped end conditions [2, 5]

### ASSESSMENT TOOLS:
For each assessment tool, links to the course outcomes are identified

1. Regular homework problems
2. In-class exercises
3. Exam(s) and/or project(s)

PREPARED BY: W. Schultz
LAST UPDATED: 06/05/2017