ME 400 COURSE PROFILE

DEGREE PROGRAM: Mechanical Engineering

COURSE NUMBER: ME 400	**COURSE TITLE:** Mechanical Engineering Analysis
REQUIRED COURSE OR ELECTIVE COURSE: Elective	**TERMS OFFERED:** Fall or Winter
TEXTBOOK / REQUIRED MATERIAL: Murray Spiegel: Schaum's Outline of Advanced Mathematics for Engineers and Scientists and CANVAS notes	**PRE / CO-REQUISITES:** MECHENG 211, MECHENG 240, Math 216. I (3 credits)
COGNIZANT FACULTY: W. Schultz **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.	**COURSE TOPICS:** 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.**	1. Apply linear algebraic equations, matrices, Cramers Rule, inverse matrices, orthogonal transformations, determinant and trace functions, eigenvalue and general eigenvalue problems, Cayley-Hamilton theorem [1] 2. Apply continuous compound interest, buckling, Mohrs circle for stress and strain and mass moments of inertia [2,3] 3. Apply Newtons 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]. 9. Apply curve fitting: student grades, isothermal and adiabatic processes, overdamped systems, hyperfocal distance in optics [2] 10. Solve minimum/maximum problems: geometric problems with and without constrains [1] 11. Solve the simple problem of the calculus of variations [1] 12. Apply essential and natural boundary conditions, isoperimetric problems, Lagrange multipliers, Euler equations, canonical formulation of Hamilton [1] 13. Formulate continuous systems with lumped end conditions [2, 5] 14. Write Lagrange equations of dynamics [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
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