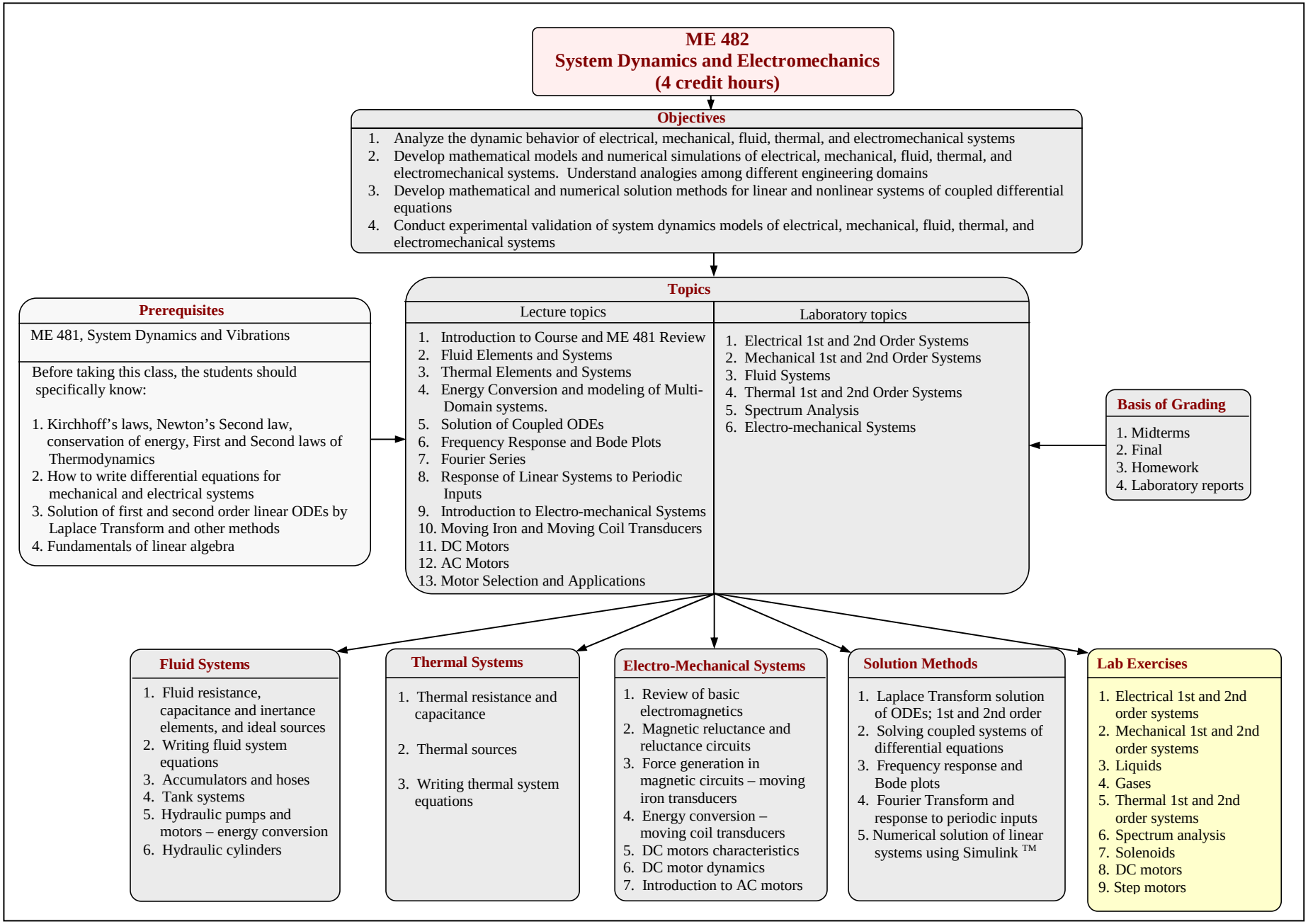
ME 482
System Dynamics and Electromechanics
(4 credit hours)
Objectives
1. Analyze the dynamic behavior of electrical, mechanical, fluid, thermal, and electromechanical systems
2. Develop mathematical models and numerical simulations of electrical, mechanical, fluid, thermal, and electromechanical systems. Understand analogies among different engineering domains
3. Develop mathematical and numerical solution methods for linear and nonlinear systems of coupled differential equations
4. Conduct experimental validation of system dynamics models of electrical, mechanical, fluid, thermal, and electromechanical systems
Prerequisites
ME 481, System Dynamics and Vibrations
Before taking this class, the students should specifically know:
1. Kirchhoff's laws, Newton's Second law, conservation of energy, First and Second laws of Thermodynamics
2. How to write differential equations for mechanical and electrical systems
3. Solution of first and second order linear ODEs by Laplace Transform and other methods
4. Fundamentals of linear algebra
Topics
Lecture topics
1. Introduction to Course and ME 481 Review
2. Fluid Elements and Systems
3. Thermal Elements and Systems
4. Energy Conversion and modeling of Multi-Domain systems.
5. Solution of Coupled ODEs
6. Frequency Response and Bode Plots
7. Fourier Series
8. Response of Linear Systems to Periodic Inputs
9. Introduction to Electro-mechanical Systems
10. Moving Iron and Moving Coil Transducers
11. DC Motors
12. AC Motors
13. Motor Selection and Applications
Laboratory topics
1. Electrical 1st and 2nd Order Systems
2. Mechanical 1st and 2nd Order Systems
3. Fluid Systems
4. Thermal 1st and 2nd Order Systems
5. Spectrum Analysis
6. Electro-mechanical Systems
Basis of Grading
1. Midterms
2. Final
3. Homework
4. Laboratory reports
Fluid Systems
1. Fluid resistance, capacitance and inertance elements, and ideal sources
2. Writing fluid system equations
3. Accumulators and hoses
4. Tank systems
5. Hydraulic pumps and motors – energy conversion
6. Hydraulic cylinders
Thermal Systems
1. Thermal resistance and capacitance
2. Thermal sources
3. Writing thermal system equations
Electro-Mechanical Systems
1. Review of basic electromagnetics
2. Magnetic reluctance and reluctance circuits
3. Force generation in magnetic circuits – moving iron transducers
4. Energy conversion – moving coil transducers
5. DC motors characteristics
6. DC motor dynamics
7. Introduction to AC motors
Solution Methods
1. Laplace Transform solution of ODEs; 1st and 2nd order
2. Solving coupled systems of differential equations
3. Frequency response and Bode plots
4. Fourier Transform and response to periodic inputs
5. Numerical solution of linear systems using Simulink TM
Lab Exercises
1. Electrical 1st and 2nd order systems
2. Mechanical 1st and 2nd order systems
3. Liquids
4. Gases
5. Thermal 1st and 2nd order systems
6. Spectrum analysis
7. Solenoids
8. DC motors
9. Step motors