**ME 3017 System Dynamics (Required)**

**Catalog Description:** ME 3017 System Dynamics (3-0-3)

Prerequisites: MATH 2403 Differential Equations, ME 2202 Dynamics of Rigid Bodies, and ECE 3710 Circuits and Electronics.

Dynamic modeling and simulation of systems with mechanical, hydraulic, thermal and/or electrical elements. Frequency response analysis, stability, and feedback control design of dynamic systems.

**Textbooks:** Palm, William J., III, System Dynamics, 2nd Edition, McGraw-Hill College, 2009.

**Reference:** Ogata, K., System Dynamics, 4th Edition, Prentice-Hall, 2004.

**Topics Covered:**

1. Laplace Transform
2. Modeling of Mechanical Systems
3. Transfer Function Models
4. Modeling of Electrical & Electromechanical Systems
5. Modeling of Fluid & Thermal Systems
6. Time Response Analysis of Linear Dynamic Systems
7. Computer Simulation of Dynamic Systems
8. Frequency Response of Linear Dynamic Systems
9. Free Vibration of Multi-Degree of Freedom Systems
10. Input-Output Stability and Transient Response Analysis
11. Introduction to Feedback Control Systems

**Course Outcomes:**

Outcome 1: To introduce students to mathematical modeling of dynamic systems in various engineering disciplines.

1.1 Students will demonstrate understanding of various mathematical models such as differential equation and transfer function models for dynamic systems.

1.2 The students will demonstrate the ability to formulate mathematical models for mechanical, electrical, fluid, and thermal systems.

1.3 The students will demonstrate the ability to model mixed systems such as electromechanical and hydro-mechanical systems.

Outcome 2: To develop students’ skills in analyzing, simulating, and identifying dynamic systems based upon their input-output responses.

2.1 Students will demonstrate that they can derive and analyze time response (transient & steady-state) of linear dynamic systems.

2.2 Students will demonstrate the ability to formulate the frequency response of linear dynamic systems.

2.3 Students will demonstrate understanding of free vibrations of multi degree of freedom systems.

2.4 Students will demonstrate the ability to perform computer simulation of various dynamic system responses.

2.5 Students will demonstrate that they can apply time and frequency response analyses to system identification and design modification.

Outcome 3: To introduce students to design and analysis of basic feedback control systems.

3.1 Students will demonstrate understanding of dynamic system stability and transient response specifications.

3.2 Students will demonstrate understanding of block diagrams and how to reduce them.

3.3 Students will be able to design and analyze basic automatic controllers using algebraic techniques in the transfer domain

3.4 Students will demonstrate the ability to apply feedback control to real-world engineering systems.

**Correlation between Course Outcomes and Program Educational Outcomes**

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| ME 3017 | | | | | | | | | | | | |
|  | Mechanical Engineering Program Educational Outcomes | | | | | | | | | | | |
| Course Outcomes | a | b | c | d | e | f | g | h | i | j | k | l |
| Course Outcome 1.1 | x |  |  |  | x |  |  |  |  |  | x | x |
| Course Outcome 1.2 | x |  |  |  |  |  |  |  |  |  | x | x |
| Course Outcome 1.3 | x |  |  |  | x |  |  |  |  | x | x | x |
| Course Outcome 2.1 | x |  |  |  |  |  |  |  |  |  | x | x |
| Course Outcome 2.2 | x |  |  |  | x |  |  |  |  |  | x | x |
| Course Outcome 2.3 | x |  |  |  |  |  |  |  |  |  | x | x |
| Course Outcome 2.4 | x |  |  |  |  |  |  |  |  |  | x | x |
| Course Outcome 2.5 | x | x | x |  | x |  |  |  |  |  | x | x |
| Course Outcome 3.1 | x |  |  |  |  |  |  |  |  |  | x | x |
| Course Outcome 3.2 | x |  |  |  |  |  |  |  |  |  | x | x |
| Course Outcome 3.3 | x | x | x |  | x |  |  |  |  |  | x | x |
| Course Outcome 3.4 | x | x | x |  | x |  |  |  | x | x | x | x |

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