**ME 4452 Control of Dynamic Systems (Elective)**

**Catalog Description:** ME 4452 Control of Dynamic Systems (3-0-3)

Prerequisites: ME 3017 System Dynamics

Modeling and simulation of dynamic systems in frequency and time domains. Feedback control analysis and design methods including root-locus, frequency response, and pole-placement. Introduction to digital control systems.

**Textbooks:** Nise, S. Norman, Control Systems Engineering, 6th Edition, Wiley, 2010.

**Reference:** Ogata, K., Modern Control Engineering, 5th Edition, Prentice Hall, 2009.

**Topics Covered:**

1. Modeling in Laplace Domain
2. Modeling in Time Domain
3. Time Response Analysis and Specifications
4. Stability Analysis
5. Steady-State Errors
6. Root-Locus Control Design
7. Frequency Response Control Design
8. State-Space Control Design
9. Introduction to Digital Control Systems
10. Control System Applications & Case Studies

**Course Outcomes:**

Outcome 1: To teach students mathematical of engineering dynamic systems in time and frequency domains.

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

1.2 Students will demonstrate the ability to formulate state-space models dynamic systems.

1.3 Students will demonstrate the ability to linearize the dynamic model of nonlinear systems.

Outcome 2: To develop students understanding of stability, transient, and steady-state behavior of linear dynamic systems

2.1 Students will demonstrate the ability to formulate the time response of a linear system based on its transfer function or state-space model.

2.2 Students will demonstrate the ability to derive the frequency response of a linear system and construct its bode diagrams.

2.3 Students will demonstrate the ability to identify a dynamic system from its time or frequency response.

2.4 Students will demonstrate how to evaluate stability of dynamic systems both in time and frequency domains.

2.5 Students will demonstrate understanding of transient and steady-state response specifications for dynamic systems.

Outcome 3: To develop students’ skills in analyzing and designing feedback controllers in time and frequency domains

3.1 Students will demonstrate the ability to reduce block diagrams of multiple subsystems.

3.2 Students will demonstrate that they can analyze and design controllers using the root-locus technique.

3.3 Students will demonstrate the ability to design control compensation using frequency domain techniques

3.4 Students will demonstrate an ability to design controllers in the time-domain using state-space methods.

3.5 Students will demonstrate when and how to apply various control design techniques to real-world engineering systems.

3.6 Students will demonstrate the ability to evaluate performance of control systems by simulation.

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

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| ME 4452 | | | | | | | | | | | | |
|  | 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 | x |
| Course Outcome 1.3 | x |  |  |  | x |  |  |  |  |  | x | x |
| Course Outcome 2.1 | x |  |  |  |  |  |  |  |  |  | x | x |
| Course Outcome 2.2 | x |  |  |  |  |  |  |  |  |  | x | x |
| Course Outcome 2.3 | x | x |  |  | x |  |  |  |  | x | x | x |
| Course Outcome 2.4 | x |  |  |  | x |  |  |  |  |  | x | x |
| Course Outcome 2.5 | x |  |  |  | x |  |  |  |  |  | x | x |
| Course Outcome 3.1 | x |  |  |  |  |  |  |  |  |  | x | x |
| Course Outcome 3.2 | x |  | x |  | x |  |  |  |  |  | x | x |
| Course Outcome 3.3 | x |  | x |  | x |  |  |  |  |  | x | x |
| Course Outcome 3.4 | x |  | x |  | x |  |  |  |  |  | x | x |
| Course Outcome 3.5 | x | x | x |  | x |  |  |  | x | x | x | x |
| Course Outcome 3.6 | x | x |  |  | x |  |  |  | x | x | x | x |

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