Course: ME 45400 – Intermediate Dynamics with Computer Applications

Type of Course: Elective (Group 1) for ME program

Catalog Description: Introduction to the advanced theories of dynamics and application of the digital computer as a tool in engineering design and analysis of structural members and machine components in motion. Simulation of kinematic and kinetic behavior.

Credits: 3

Contact Hours: 3

Prerequisite Courses: ME 33100

Corequisite Courses: None

Prerequisites by Topics: Dynamics, Differential Equations, Linear Algebra


Course Objectives: To provide students with the advanced theories of dynamics that often require digital computer implementations, and to provide students with computational techniques used to integrate the modern digital computer into the engineering analysis and design cycle

Course Outcomes: A student who successfully fulfills the course requirements will be able to:

1. Analyze three-dimensional kinematics and kinetics of a rigid body through understanding and practicing of (1, 7)
   - infinitesimal rotations and finite rotations
   - relative motion analysis using translating and rotating axes
   - inertia tensor and angular momentum
   - energy principles
   - equations of motion in three dimensions
   - gyroscopic motion

2. Link intermediate dynamics and mathematics concepts with engineering applications through understanding and practicing of (1, 7)
   - Lagrange equation of motion
- Fourier series and discrete spectral analysis
- state space formulation and analysis
3. Recognize and identify dynamic forces and their effects on machines and structural components in motion through understanding and practicing of (1, 7)
  - dynamic force analysis
  - periodic-forced response analysis
  - transient and shock response analysis
4. Solve relatively complex dynamics problems through understanding and practicing of (1, 7):
  - analysis and simulation of with applications of modern computing tools
5. Design a simple mechanical system or components involving dynamics issues (1, 2, 3, 7)
  - application of modern computing tools
  - open-end design project(s)
  - project report writing

**Lecture Topics**
1. 3D Multi-Body Dynamics and Dynamic Force Analysis (10 classes)
2. Fourier Series Analysis and Discrete Spectral Analysis (4 classes)
3. Lagrange Equation of Motion (3 classes)
4. Eigenvalue problems (4 classes)
5. Applications of State Space Analysis (5 classes)
6. Boundary Value Problems (4 classes)
7. Discretization and Approximation Techniques (4 classes)
8. Numerical Simulation and Animation of Dynamic Responses (8 classes)

**Computer Usage**
High

**Laboratory Experience**
None

**Design Experience**
Medium

**Coordinator**
Bongsu Kang, Ph.D.

**Date**
27 March 2018