Approval: 8th Senate Meeting

Course Name: Linear Dynamical Systems
Course code: EE509
Credits: 3-0-0-3
Prerequisites: EE 301 Control Systems
Intended for: UG/PG
Elective/Core: Elective
Semester: Odd/Even

Course Preamble: This is an introductory course on modern control systems. This course is designed to provide students a thorough knowledge on linear control systems. This course is suitable for final year UG and first year PG students who are interested to work in the field of control theory and its applications.

Course Outline:

- Review of mathematical modelling, state space representation and basics of linear vector space,
- Canonical realizations and similarity transformation,
- Time response, Stability analysis,
- Controllability and observability,
- State feedback and State estimation

Course Modules:

1**. Mathematical modelling and basics of linear spaces: [4 Lectures]**

Mathematical descriptions: transfer function and state-space, state space representation of electrical and mechanical systems, some basics of linear vector space: vector space, basis, linear dependent, matrix representation.

2. Canonical realizations and similarity transformation: [8 Lectures]

Controller canonical realization, observer canonical realization, diagonal realization, analog computer simulation, Non-uniqueness of state-space representation, transformation to diagonal form, Jordan form, controller canonical form and observer canonical form.

3. Time response and stability: [6 Lectures]

Time response of linear systems, modal analysis (associated with eigenvalues and eigenvectors), stability analysis: external and internal stability.

4. Controllability and observability: [7 Lectures]

Controllability and observability matrices, rank test, controllable and uncontrollable modes, matrix decomposition corresponding to controllable and uncontrollable modes.

5. State feedback and state estimation: [10 Lectures]

State feedback, pole assignment, state estimation, observer design, combined controller-observer design.

Textbook

1. T. Kailath, *Linear Systems*, Englewood Cliffs, Prentice-Hall, Englewood Cliffs, NJ, 1980.

References Books

2. P.J. Antsaklis and A.N. Michel*, Linear Systems*, McGraw-Hill, Englewood Cliffs, NJ, 1997,
3. K. Ogata, *Modern Control Engineering*, Prentice-Hall, NJ, 2010.