THEORY AND APPLICATION OF CONTROL SYSTEM LAB

(Core Subject)

Course Code:	10B1WEC575	Semester:	5^{th} Semester, B. Tech (ECE)
Credits:	1	Contact Hours:	L-0, T-0,P-2

Course Objectives

The objectives are to study

1. Use computational tools in the modelling, simulation and analysis of linear control systems.
2. To understand procedures for modelling of physical systems, and related analytical and numerical methods for predicting their behavior.

Course Outcomes

After studying this course the students would gain enough knowledge

1. Mathematical modelling of physical systems and performing their analysis.
2. The skill to analyze the response of any LTI system using software tools.
3. The ability to design any system with desired specifications both in time and frequency domain and analyze systems using different techniques.
4. Be able to design the suitable controller and improve the performance of the system.

List of Experiments

1. To define a transfer function and draw its pole-zero plot for a (a) mechanical system (b) electrical system.

   Tasks:

   - Define a polynomial using (*a*) its roots and (*b*) its coefficients.
   - To obtain the roots of a given polynomial.
   - Define a polynomial using syslin.
   - To obtain the location of poles and zeros for a given transfer function.
   - To draw the pole-zero plot.

2. To obtain the overall transmittance of a given complex system represented in either the block diagram representation or signal flow graph representation by using masons gain formula.

   Tasks:

   - To convert the given block diagram to signal flow graph.
   - Define gains between different nodes as symbolic variables.
   - To obtain overall transmittance between the input and output node by using masons gain formula.

3. To obtain the time response of a given system and obtain the steady state error for different inputs.

   Tasks:

   - Define symbolic variables.

- To express the given system in terms of its partial fractions.
- To determine the Laplace inverse.
- To obtain the value of steady state error for (a) different inputs and for (b) different types of the system.

4. To obtain the time response specifications of a given systems for various inputs.

   Tasks:
   - To obtain the transient response specifications for a given system with various inputs.
   - To design a system for given transient response specifications.

5. To determine the stability of a given LTI system using locations of poles.

   Tasks:
   - To obtain the characteristic equation for a given closed loop systems.
   - To identify the locations of poles for the given systems.
   - To draw the pole-zero plot for the given systems.
   - To analyze the relative stability of the systems.

6. To determine the range of the forward path gain for the system to be stable using root locus technique.

   Tasks:
   - To obtain the transfer function for a given system.
   - To plot the root locus of the system by varying the forward path gain from k=0 to k=infinity.
   - To analyze the effect of adding pole and zero.

7. To design, simulate and analyze the stability and frequency domain specifications of LTI systems using Bode plot and Nyquist criteria.

   Tasks:
   - To define the system using transfer function.
   - To obtain the bode plot of the system.
   - To determine the gain margin and phase margin.
   - To obtain the range of K for which the system is stable.
   - To analyze the effect of adding a pole and zero.
   - Repeat above steps for Nyquist Plot.

8. To design, compensated systems to achieve the desired time domain and frequency domain specifications using (a) root locus and (b) bode plots.

   Tasks:
   - To define the system using transfer function.
   - To obtain the bode plot of the uncompensated system.
   - To design the compensator using desired time domain specifications.
   - To obtain the bode plot of the compensated system.
   - Repeat above steps for desired frequency response specifications using Bode plots.

9. To design and analyze the state space model of given LTI systems.

   Tasks:
   - To obtain the state model of the given transfer function.
   - To obtain the time response of the state model.

- To determine the controllability and observability of the developed state model.

10. To simulate a state space model for given LTI systems and analyze their (a) Response (b) Controllability and (c) Observability.

11. To determine the transfer function of electrical systems of first order and second order and observe its magnitude response and time response on CRO for different excitations.

12. To analyze the effect of variation in forward and feedback path parameters on the frequency response of the system.

13. To obtain proportional, derivate and integral constants of an analog PID controller using simulated systems.

Evaluation Scheme

1.	Mid Sem Evaluation	20 Marks
2.	End Sem Evaluation	20 Marks
3.	Attendance	15 Marks
4.	Class response	30 Marks
5.	File	15 Marks
	Total Marks	**100 Marks**

Text Books

1. K. Ogata, "Modern Control Engineering", Prentice Hall of India.
2. Norman S. Mise, "Control System Engineering", Wiley Publishing Co.