INTEGRAL UNIVERSITY, LUCKNOW
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

COURSE: SYSTEM AND AUTOMATIC CONTROL
COURSE CODE: EC217
COURSE CREDIT: 4

PREREQUISITES:

Subject	Description	Level of study
Mathematics	Differential equations, Laplace Transform, Partial Fractions.	B.Tech. I & II Year

COURSE OBJECTIVES:

- To understand the concepts of control system and their applications. To provide a systematic approach to interpret different physical systems, mechanical systems and electrical systems and construct the equivalent electrical model of mechanical system. To learn about the representation of a system by transfer function, block reduction method and signal flow graph.
- To understand the basic concepts of different types of controllers.
- To learn the analysis of a system in time domain and predict the transient performance parameters of a system for different standard inputs.
- To learn the analysis of a system in frequency domain by Polar Plots, Nyquist Plot and Bode Plot. To study the stability of the system with location of Poles and Zeros and study the stability by using Routh Hurwitz Criterion. To understand the concept of compensation and design the suitable compensator to make the system stable by Bode Plot
- To understand the concepts of Root Locus and to understand the concept of compensation and design the suitable compensator to make the system stable by Root Locus.

COURSE OUTCOMES (CO):

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Given a system, students shall be able to **represent** the system in mathematical form, **identify** type of the system**, apply** block reduction technique and Mason's Gain formula to obtain the transfer function of the given system, and **formulate** differential equation to represent the model of a mechanical system into equivalent electrical system and **solve** using Laplace transform.
CO2	For a given system, **student** shall be able to understand the concept of different types of controllers used.
CO3	For a given system, **student** shall be able to **analyze** and **evaluate** the system in time domain and **predict** the performance in time domain for different standard input signals. **Evaluate** the steady-state error. **Examine** and **analyze** the stability by Routh-Hurwitz Criterion.
CO4	For a given system, student shall be able to **analyze** the system in frequency domain and explain the nature of stability. **Examine** and **analyze** the stability by Nyquist criterion and Bode Plot. For a given unstable system, students shall be able to **identify** and **select** the suitable compensator. To make the system stable **select** and **design** the suitable compensator for implementation. To **develop** the compensator by using Bode Plot.
CO5	For a given system student shall be able to study and understand the concept Root Locus. For a given unstable system, students shall be able to **identify** and **select** the suitable compensator. To make the system stable **select** and **design** the suitable compensator for implementation. To **develop** the compensator by using Root Locus.

CO-PO MAPPING:

	CO	**PO1** Engineering Knowledge	**PO2** Problem Analysis	**PO3** Design/development of solutions	**PO4** Conduct investigations into complex problems	**PO5** Modern tool usage	**PO6** Engineer and Society	**PO7** Environment and Sustainability	**PO8** Ethics	**PO9** Individual and Team work	**PO10** Communication	**PO11** Project Management and Finance	**PO12** Lifelong learning
CO1	Given a system, students shall be able to **represent** the system in mathematical form, **identify** type of the system**, apply** block reduction technique and Mason's Gain formula to obtain the transfer function of the given system, and **formulate** differential equation to represent the model of a mechanical system into equivalent electrical system and **solve** using Laplace transform.	**3**	**3**	**2**	**1**	**1**	**1**		**1**	**1**			**1**
CO2	For a given system, **student** shall be able to **analyze** and **evaluate** the system in time domain and **predict** the performance in time domain for different standard input signals. **Evaluate** the steady-state error.	**3**	**3**	**3**	**2**	**1**	**1**			**1**			**1**
CO3	For a given system, student shall be able to **analyze** the system in frequency domain and explain the nature of stability. **Examine** and **analyze** the stability by Nyquist criterion and Bode Plot	**3**	**3**	**3**	**2**	**1**	**1**			**1**			
CO4	For a given unstable system, students shall be able to **identify** and **select** the suitable compensator. To make the system stable **select** and **design** the suitable compensator for implementation. To **develop** the compensator by using Bode Plot and Root Locus.	**3**	**3**	**3**	**2**	**1**				**2**			
CO5	For a given system student shall be able to study and understand the concept Root Locus. For a given unstable system, students shall be able to **identify** and **select** the suitable compensator. To make the system stable **select** and **design** the suitable compensator for implementation. To **develop** the compensator by using Root Locus.	**3**	**3**	**2**	**2**					**1**			
3: Strong contribution, 2: average contribution, 1: Low contribution													

SYLLABUS WITH CO:

UNIT	CONTENT	CO
I	**Introduction to Control Systems:** Introduction to control, open-loop control, feedback control. System modeling; Modeling of electromechanical systems, Modeling of thermal and liquid systems, Laplace transform: Properties of Laplace transform, Laplace transforms of electromechanical systems, Transfer functions, Poles, zeros. Representation of multiple subsystems: Block diagrams, Signal flow graphs.	**1**
II	**Controllers:** Basic control action- characteristics of on-off, proportional, single-speed floating, integral and derivative control modes- P+I, P+D and P+I+D control modes-Pneumatic and electronic controllers to realize various control actions. Tuning of PID controller- Ziergler Nichols method damped oscillation method.	**2**
III	**Time Response:** Response of first and second order system, system response versus pole zero location, approximation of higher order system by low order system. Stability analysis: stability analysis using Routh-Hurwitz test. Feedback systems: Steady state and tracking analysis.	**3**
IV	**Frequency Response Analysis,** Bode plot technique, Stability Analysis: The Nyquist theorem , Stability Margins, Closed loop frequency response, Frequency domain compensation techniques: Lead and Lag compensators.	**4**
V	**Root Locus:** Sketching a root locus, Selection of gain from the root locus, Controller design using root locus: Lead Compensation, Lag Compensation.	**5**

RECOMMENDED BOOKS:

Text Books:

1. B.C Kuo, Automatic Control System, PHI
2. Katsuhiko Ogata, Modern Control Engineering, PHI
3. I.J.Nagrath & M.Gopal, Control System Engineering, New Age International Publishers
4. Norman S. Nise, Control System Engineering, John Wiley & Sons

Reference Books:

1. S.K. Bhattacharya, Control System Engineering, Pearson Education.
2. S. Hasan Saeed, Automatic Control System, Kataria and sons, New Delhi
3. Narendra Singh Beniwal & Ruby Beniwal, Automatic Control Systems with MATLAB Programming, Laxmi Publications, India.