

SEMESTER S6
CONTROL SYSTEMS

Course Code	PEEVT 631	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs.30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Teach mathematical modelling and calculate the transfer function of a system.
2. Discuss the time domain response of first and second order systems.
3. Demonstrate the steps to find the absolute stability of a system.
4. Demonstrate the steps frequency analysis of systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	<p>Introduction: Basic Components of a Control System, Open-Loop Control Systems and Closed-Loop Control Systems, Examples of control system.</p> <p>Mathematical modelling of control systems: Electrical Systems and Mechanical systems.</p> <p>Transfer Function from Block Diagrams and Signal Flow Graphs: impulse response and its relation with transfer function of linear systems. Block diagram representation and reduction methods, Signal flow graph and Mason's gain formula.</p>	9
2	<p>Time Domain Analysis of Control Systems: Introduction- Standard Test signals, Time response specifications. Time response of first and second order systems to unit step input and ramp inputs, time domain specifications.</p> <p>Steady state error and static error coefficients.</p> <p>Frequency domain analysis: Frequency domain specifications, correlation between time and frequency responses.</p>	9

3	<p>Stability of linear control systems: Concept of BIBO stability, absolute stability, Routh Hurwitz Criterion, Effect of P, PI & PID controllers.</p> <p>Root Locus Techniques: Introduction, properties and its construction, Application to system stability studies. Illustration of the effect of addition of a zero and a pole.</p>	9
4	<p>Nyquist stability criterion: Fundamentals and analysis.</p> <p>Relative stability: gain margin and phase margin. Stability analysis with Bode plot.</p> <p>Design of Compensators: Need of compensators, design of lag and lead compensators using Bode plots.</p>	9

**Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)**

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> ● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks <p style="text-align: center;">(8x3 =24marks)</p>	<ul style="list-style-type: none"> ● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. <p style="text-align: center;">(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Determine transfer function of electromechanical systems using block diagram reduction and SFG.	APPLY
CO2	Determine Transient and Steady State behaviour of systems using standard test signals.	APPLY
CO3	Determine absolute stability and relative stability of a system using Routh Hurwitz Criterion and Root Locus Techniques.	APPLY
CO4	Design a control system with suitable compensation techniques using frequency domain techniques.	APPLY

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	-	-	-	-	-	-	-	-	1
CO2	2	3	-	-	-	-	-	-	-	-	-	1
CO3	2	3	-	-	-	-	-	-	-	-	-	1
CO4	2	3	-	-	-	-	-	-	-	-	-	1
CO5	2	3	-	-	-	-	-	-	-	-	-	1

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Automatic Control Systems	Farid Golnaraghi, Benjamin C. Kuo	Wiley India	9 th Edition, 2009
2	Control Systems Engineering	I.J. Nagarath, M.Gopal	New Age International Pub. Co.	5 th Edition, 2007
3	Schaum's Outline of Feedback and Control Systems	Joseph J. DiStefano, Allen Stubberud, Ivan J. Williams	Mc Graw Hill	3 rd Edition, 2013

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Control System Engineering	Norman S. Nise	Wiley India.	5 th Edition and 2009
2	Modern Control Engineering	Ogata K.,	Prentice Hall of India, Pearson Education	4 th Edition and 2002

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/RcuGxWc0HyQ https://youtu.be/PLgxjVQ6sZ8 https://youtu.be/fsxSst10_cE https://youtu.be/E56sENH6hLU https://youtu.be/2hK8RGVWwJs
2	https://youtu.be/8-J0Y7bvVz0 https://youtu.be/z2IpQaGHNIU https://youtu.be/LQ46V5OzEws https://youtu.be/8WYLEsa6dIY
3	https://youtu.be/UTQOQzIYKu0 https://youtu.be/3IM57uKQnXc https://youtu.be/86uzST3SM-0 https://youtu.be/wRnz0JgMIsY
4	https://youtu.be/gueIWqhJDn8 https://youtu.be/JbuTgcb7Tys https://youtu.be/g-ptzF3w94Y https://youtu.be/VCQVsolxCCE https://youtu.be/VSDLCdKfzMo https://youtu.be/w741WYd4Fe4 https://youtu.be/zkdhvPbqJLM https://youtu.be/JCBsyUp3CPw https://youtu.be/_3e6xFyFmAQ https://youtu.be/8zpb1nb082g