ARSD College, University of Delhi

Model Course Handout/Lesson Plan

Course Name : B.Sc. Electronics(H) , V semester						
Semester	**Course Code**	**Course Title**	**Lecture (L)**	**Tutorial (T)**	**Practical (P)**	**Credit (C)**
II	558	Control Systems – DSE (THEORY)	4	-	--	4
Teacher/Instructor(s)		Mr. PUNEET SEHGAL				
Session		EVEN SEMESTER				

Course Objective:

The course is aimed at providing knowledge in the following major topics of control systems: Mathematical modelling and analysis of open-loop and closed-loop control systems. Time-domain and Frequency-domain analysis of control systems. Methods for accessing absolute and relative stability of control systems. State-space analysis

Course Learning Outcomes: At the end of this course, students will be able to

CO1 Understand the concepts of closed loop control systems.
CO2 Analyze the stability of closed loop systems.
CO3 Apply the control techniques to any electrical systems.
CO4 Compute and assess system stability.

Lesson Plan:

Unit No.	Learning Objective	Lectures	Topics to be covered
UNIT 1. Introduction to Control Systems:		1	Open loop and Closed loop control systems,
		2	Mathematical modeling of physical systems (Electrical, Mechanical and Thermal),
		3	Mathematical modeling of physical systems (Electrical, Mechanical and Thermal),
		4	Mathematical modeling of physical systems (Electrical, Mechanical and Thermal),
		5	Mathematical modeling of physical systems (Electrical, Mechanical and Thermal),
		6	Mathematical modeling of physical systems (Electrical, Mechanical and Thermal),

	7	Derivation of transfer function, Armature controlled and field controlled DC servomotors,
	8	Derivation of transfer function, Armature controlled and field controlled DC servomotors,
	9	Derivation of transfer function, Armature controlled and field controlled DC servomotors,
	10	Derivation of transfer function, Armature controlled and field controlled DC servomotors,
	11	Derivation of transfer function, Armature controlled and field controlled DC servomotors,
	12	Derivation of transfer function, Armature controlled and field controlled DC servomotors,
	13	AC servomotors, block diagram representation & signal flow graph, Reduction Technique, Mason‘s Gain Formula. Effect of feedback on control systems
	14	AC servomotors, block diagram representation & signal flow graph, Reduction Technique, Mason‘s Gain Formula. Effect of feedback on control systems
	15	AC servomotors, block diagram representation & signal flow graph, Reduction Technique, Mason‘s Gain Formula. Effect of feedback on control systems
	16	AC servomotors, block diagram representation & signal flow graph, Reduction Technique, Mason‘s Gain Formula. Effect of feedback on control systems
UNIT 2: Time Domain Analysis and Concept of Stability:	17	Time domain performance criteria
	18	transient response of first, second & higher order systems
	19	transient response of first, second & higher order systems
	20	transient response of first, second & higher order systems
	21	transient response of first, second & higher order systems
	22	transient response of first, second & higher order systems
	23	steady state errors and static error constants, Performance indices.
	24	steady state errors and static error constants, Performance indices.
	25	steady state errors and static error constants, Performance indices.
	26	Asymptotic stability and conditional stability, Routh – Hurwitz criterion, relative stability analysis, Root Locus plots and their applications

	27	Asymptotic stability and conditional stability, Routh – Hurwitz criterion, relative stability analysis, Root Locus plots and their applications
	28	Asymptotic stability and conditional stability, Routh – Hurwitz criterion, relative stability analysis, Root Locus plots and their applications
	29	Asymptotic stability and conditional stability, Routh – Hurwitz criterion, relative stability analysis, Root Locus plots and their applications
	30	revision
UNIT 3: Frequency Domain Analysis:	31	Correlation between time and frequency response,
	32	Correlation between time and frequency response,
	33	Polar and inverse polar plots,
	34	Polar and inverse polar plots,
	35	frequency domain specifications, Logarithmic plots (Bode Plots),
	36	frequency domain specifications, Logarithmic plots (Bode Plots),
	37	frequency domain specifications, Logarithmic plots (Bode Plots),
	38	gain and phase margins, Nyquist stability criterion
	39	gain and phase margins, Nyquist stability criterion
	40	gain and phase margins, Nyquist stability criterion
	41	relative stability using Nyquist criterion
	42	relative stability using Nyquist criterion
	43	constant M & N circles.
	44	constant M & N circles.
UNIT 4: State Space Analysis and Controllers and Compensation Techniques:	45	Definitions of state, state variables, state space,
	46	representation of systems,
	47	Solution of time invariant, homogeneous state equation, Solution of time invariant, homogeneous state equation, state transition matrix and its properties.tate transition matrix and its properties.
	48	Solution of time invariant, homogeneous state equation, state transition matrix and its properties.
	49	Solution of time invariant, homogeneous state equation, state transition matrix and its properties.
	50	Solution of time invariant, homogeneous state equation, state transition matrix and its properties.
	51	Solution of time invariant, homogeneous state equation, state transition matrix and its properties.
	52	Response with P, PI and PID Controllers,
	53	Response with P, PI and PID Controllers,
	54	Response with P, PI and PID Controllers,
	55	Response with P, PI and PID Controllers,
	56	Concept of compensation, Lag, Lead and Lag-Lead networks

	57	Concept of compensation, Lag, Lead and Lag-Lead networks
	58	Concept of compensation, Lag, Lead and Lag-Lead networks
	59	Revision
	60	Revision

Evaluation Scheme:

No.	Component	Duration	Marks
1.	Internal Assessment • Quiz • Class Test • Attendance • Assignment		25
2.	End Semester Examination	3 hr	75

Details of the Course		
Unit	**Contents**	**Contact Hours**
1.	Introduction to Control Systems: Open loop and Closed loop control systems, Mathematical modeling of physical systems (Electrical, Mechanical and Thermal), Derivation of transfer function, Armature controlled and field controlled DC servomotors, AC servomotors, block diagram representation & signal flow graph, Reduction Technique, Mason's Gain Formula. Effect of feedback on control systems.	16
2.	Time Domain Analysis: Time domain performance criteria, transient response of first, second & higher order systems, steady state errors and static error constants, Performance indices. Concept of Stability: Asymptotic stability and conditional stability, Routh – Hurwitz criterion, relative stability analysis, Root Locus plots and their applications.	14
3	Frequency Domain Analysis: Correlation between time and frequency response, Polar and inverse polar plots, frequency domain specifications, Logarithmic plots (Bode Plots), gain and phase margins, Nyquist stability criterion, relative stability using Nyquist criterion, constant M & N circles.	14
4	State Space Analysis: Definitions of state, state variables, state space, representation of systems, Solution of time invariant, homogeneous state equation, state transition matrix and its properties. Controllers and Compensation Techniques: Response with P, PI and PID Controllers, Concept of compensation, Lag, Lead and Lag-Lead networks	16
	Total	**60**

Suggested Books:		
Sl. No.	**Name of Authors/Books/Publishers**	**Year of Publication/Reprint**
1.	J. Nagrath& M. Gopal, Control System Engineering, New Age International, 2000	2000
2.	K. Ogata, Modern Control Engineering, PHI 2002	2002
3.	B. C. Kuo , ―Automatic control system‖, Prentice Hall of India, 2000	2000
Mode of Evaluation:	Internal Assessment / End Semester Exam	

Progress Report:

Unit No.	Learning Objective	date	Topics to be covered
UNIT 1. Introduction to Control Systems:			Open loop and Closed loop control systems,
			Mathematical modeling of physical systems (Electrical, Mechanical and Thermal),
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UNIT 2: Time Domain Analysis and Concept of Stability:			Time domain performance criteria
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			transient response of first, second & higher order systems

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UNIT 3: Frequency Domain Analysis:		Correlation between time and frequency response,
		Correlation between time and frequency response,
		Polar and inverse polar plots,
		Polar and inverse polar plots,
		frequency domain specifications, Logarithmic plots (Bode Plots),
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		frequency domain specifications, Logarithmic plots (Bode Plots),
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		gain and phase margins, Nyquist stability criterion
		relative stability using Nyquist criterion
		relative stability using Nyquist criterion
		constant M & N circles.
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UNIT 4: State Space Analysis and Controllers and Compensation Techniques:		Definitions of state, state variables, state space,
		representation of systems,
		Solution of time invariant, homogeneous state equation, Solution of time invariant, homogeneous state equation, state transition matrix and its properties.tate transition matrix and its properties.

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		Concept of compensation, Lag, Lead and Lag-Lead networks
		Concept of compensation, Lag, Lead and Lag-Lead networks
		Concept of compensation, Lag, Lead and Lag-Lead networks
		Revision
		Revision

Mr. Puneet Sehgal
Assistant Professor
Department of Electronic Science