MOHAMED SATHAK A J COLLEGE OF ENGINEERING

Siruseri IT park, OMR, Chennai - 603103

LESSON PLAN

Department of Electrical and Electronics Engineering

Name of the Subject	CONTROL SYSTEMS	Name of the handling Faculty	Mr.N.SURESH
Subject Code	EC3351	Year / Sem	II/III
Acad Year	2022-23	Batch	2021-25

Course Objective

To introduce the components and their representation of control systems

To learn various methods for analyzing the time response, frequency response and stability of the systems

To learn the various approach for the state variable analysis.

Course Outcome

Compute the transfer function of different physical systems.

Analyse the time domain specification and calculate the steady state error

Illustrate the frequency response characteristics of open loop and closed loop system response.

Analyse the stability using Routh and root locus techniques

Illustrate the state space model of a physical system and discuss the concepts of sampled data control system.

Lesson Plan

Sl. No.	Topic(s)	T / R* Book	Periods Required	Mode of Teaching (BB / PPT / NPTEL / MOOC / etc)	Blooms Level (L1-L6)	CO	PO
UNIT I SYSTEMS COMPONENTS AND THEIR REPRESENTATION							
1	Control System: Terminology and Basic Structure	T1	1	BB	L2	CO1	PO1
2	Feed forward and Feedback control theory	T1	1	BB	L2	CO1	PO1-PO3
3	Mechanical Transfer Function model	T1	1	BB	L4	CO1	PO1-PO3
4	Mechanical to Electrical circuit analogy	T1	1	BB	L4	CO1	PO1-PO3
5	Blockdiagram reduction technique rules	T1	1	BB	L4	CO1	PO1-PO3
6	Blockdiagram reduction technique -Problems	T1	1	BB	L4	CO1	PO1-PO3
7	Signal flow graph and Mason gain Formula	T1	1	BB	L4	CO1	PO1-PO3
8	DC and AC Servo systems, Synchros	T1	1	BB	L2	CO1	PO1-PO3
9	Multivariable Control system	T1	1	BB	L2	CO1	PO1-PO3

Suggested Activity: Assignment .

Evaluation method :
Assignments on Determination of Transfer function

UNIT II TIME RESPONSE ANALYSIS							
10	Transient response & steady state response-	T1	1	BB	L2	CO2	PO1-PO3
11	Measures of performance of the standard first order	T1	1	BB	L3	CO2	PO1-PO3

12	Measures of performance of the standard second order system	T1	1	BB	L3	CO2	PO1-PO3
13	Problems on measures of performance of the standard second order system	T1	1	BB	L4	CO2	PO1-PO3
14	Effect on an additional zero and an additional pole	T1	1	BB	L2	CO2	PO1-PO3
15	Steady error constant and system type number	T1	1	BB	L2	CO2	PO1-PO3
16	Problems on steady error constant	T1	1	BB	L4	CO2	PO1-PO3
17	PID control	T1	1	BB	L3	CO2	PO1-PO3
18	Analytical design for PD, PI,PID control systems	T1	1	BB	L4	CO2	PO1-PO3

Suggested Activity: Tutorial

Evaluation method
Tutorials on Steady state error

UNIT III FREQUENCY RESPONSE AND SYSTEM ANALYSIS

19	Closed loop frequency response of Performance specification in frequency domain	T1	1	BB	L2	CO3	PO1-PO5,PO7
20	Frequency response of standard second order system	T1	1	BB	L3	CO3	PO1-PO5,PO7
21	Bode Plot	T1	1	BB	L2	CO3	PO1-PO5,PO7
22	Problems on Bode Plot	T1	1	BB	L4	CO3	PO1-PO5,PO7
23	Polar Plot	T1	1	BB	L2	CO3	PO1-PO5,PO7
24	Problems on Polar Plot	T1	1	BB	L4	CO3	PO1-PO5,PO7
25	Cascade lead compensation	T1	1	BB	L4	CO3	PO1-PO5,PO7
26	Cascade lag compensation	T1	1	BB	L4	CO3	PO1-PO5,PO7
27	Cascade lag-lead compensation	T1	1	BB	L4	CO3	PO1-PO5,PO7

Suggested Activity: Assignment

Evaluation method
Assignment on Derivation of frequency domain specifications

UNIT IV CONCEPTS OF STABILITY ANALYSIS

28	Concept of stability	T1	1	BB	L2	CO4	PO1-PO5,PO7
29	Bounded - Input Bounded - Output stability	T1	1	BB	L2	CO4	PO1-PO5,PO7
30	Routh stability criterion	T1	1	BB	L2	CO4	PO1-PO5,PO7
31	Problems on Routh stability criterion	T1	1	BB	L4	CO4	PO1-PO5,PO7
32	Root locus concept-Guidelines for sketching root locus	T1	1	BB	L3	CO4	PO1-PO5,PO7
33	Problems on Root locus	T1	1	BB	L4	CO4	PO1-PO5,PO7
34	Problems on Root locus	T1	1	BB	L4	CO4	PO1-PO5,PO7
35	Nyquist stability criterion	T1	1	BB	L2	CO4	PO1-PO5,PO7
36	Problems on Nyquist stability criterion	T1	1	BB	L4	CO4	PO1-PO5,PO7

Suggested Activity: Tuorials .

Evaluation method
Tutorials on Root locus technique

UNIT V CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS

37	State variable representation	R4	1	BB	L2	CO5	PO1-PO3
38	Conversion of state variable models to transfer functions	R4	1	BB	L4	CO5	PO1-PO3
39	Conversion of transfer functions to state variable models	R4	1	BB	L4	CO5	PO1-PO3
40	Solution of state equations	R4	1	BB	L2	CO5	
41	Problems on solution of state equation	R4	1	BB	L4	CO5	PO1-PO3
42	Concepts of Controllability	R4	1	BB	L4	CO5	
43	Concepts of Observability	R4	1	BB	L4	CO5	
44	State variable analysis of digital control system-	R4	1	BB	L2	CO5	PO1-PO3
45	Digital control design using state feedback	R4	1	BB	L4	CO5	PO1-PO3, PO12

Suggested Activity: Tuorial

Evaluation method: Tutorial on Solution of state equations

Content Beyond the Syllabus Planned

1	Stability analysis of Digital Control System
2	Lyapnov stability

Text Books

1	M.Gopal,"Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012

Reference Books

1	J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5th Edition, 2007
2	K.Ogata, "Modern Control Engineering", PHI, 5th Edition, 2012.
3	S.K.Bhattacharya, "Control System Engineering", Pearson, 3rd Edition, 2013.
4	Benjamin.C.Kuo, "Automatic Control Systems", Prentice Hall of India, 7th Edition,1995.

Website / URL References

1	https://youtu.be/RcuGxWc0HyQ
2	https://youtu.be/cLyT6OWcmyU
3	https://youtu.be/p8bi5tcSVLg

Blooms Level

Level 1 (L1) : Remembering **Level 2 (L2) : Understanding** **Level 3 (L3) : Applying**	Lower Order Thinking	Fixed Hour Exams	Level 4 (L4) : Analysing Level 5 (L5) : Evaluating Level 6 (L6) : Creating		Higher Order Thinking	Projects / Mini Projects

Mapping syllabus with Bloom's Taxonomy LOT and HOT

Unit No	Unit Name	L1	L2	L3	L4	L5	L6	LOT	HOT	Total
Unit 1	**SYSTEMS COMPONENTS AND THEIR REPRESENTATION**	1	8	3	0	0	0	12	0	12

Unit 2	**TIME RESPONSE ANALYSIS**	0	3	8	1	0	0	11	1	12
Unit 3	**FREQUENCY RESPONSE AND SYSTEM ANALYSIS**	1	3	8	0	0	0	12	0	12
Unit 4	**CONCEPTS OF STABILITY ANALYSIS**	0	3	9	2	0	0	12	2	14
Unit 5	**CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS**	0	10	0	0	0	0	10	0	10
Total		2	27	28	3	0	0	57	3	60
Total Percentage		3.33	45.00	46.67	5.00	0.00	0.00	95.00	5.00	100.00

CO PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	PO6	PO7	PO8	PO9	PO10	PO11	PO12	**PSO1**	**PSO2**
CO1	3	2	2									1		
CO2	3	3	3									1		
CO3	3	3	3	3	3		3					1		3
CO4	3	3	3	3	3		3					1		3
CO5	3	2	2	1	1							3		2
Avg	**3**	**2.6**	**2.6**	**1.4**	**1.4**		1.2					1.4		**1.6**

Justification for CO-PO mapping

CO1	High correlation for PO1 and medium correlation for PO2,PO3 is given as the CO2 can be used to apply knowledge of engineering to Identify , formulate and provide solutions
CO2	High correlation for PO1-PO3 is given as the CO2 can be used to apply knowledge of engineering to Identify , formulate and provide solutions
CO3	High correlation for PO1-PO5 is given as the CO2 can be used to apply knowledge of engineering to Identify , formulate and provide solutions by using relevant techniques and tools. High Correlation for PO7 is given as the solutiond designed must be sustainable. High correlation for PSO2 is given as Transformations are used in the analysis of Electric vehicles.
CO4	High correlation for PO1-PO5 is given as the CO2 can be used to apply knowledge of engineering to Identify , formulate and provide solutions by using relevant techniques and tools.High correlation for PSO2 is given as filters are required for the analysis and design of Electric vehicles.
CO5	High correlation for PO1,medium correlation for PO2,PO3 and low correlation for PO4,PO5 is given as the CO2 can be used to apply knowledge of engineering to Identify , formulate and provide solutions by using relevant techniques and tools. Hgh correlation for PO12 is given as knowledge of new DS processors is required.High Correlation for PO7 is given as the solutiond designed must be sustainable.Medium correlation for PSO2 is given as filters are required for the design of Electric vehicles.

3	**High level**	**2**	Moderate level	1	Low level

Name & Sign of Faculty Incharge : Mr.N.Suresh

Name & Sign of Subject Expert :

Head of the Department :