SARDAR RAJA COLLEGES

SARDAR RAJA COLLEGE OF ENGINEERING

ALANGULAM

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

MICRO LESSON PLAN

SUBJECT NAME : CONTROL SYSTEMS

SUBJECT CODE : EC 2255

YEAR / SEM : II / IV

COURSE / BRANCH : B.E / E.C.E

STAFF NAME : Mr.V.KALIMUTHU
Asst.Prof / ECE

SUBJECT DESCRIPTION AND OBJECTIVES

AIM

To familiarize the students with concepts related to the operation analysis and stabilization of control systems.

OBJECTIVES

1. To understand the open loop and closed loop (feedback) systems
2.To understand time domain and frequency domain analysis of control systems required for stability analysis.
3. To understand the compensation technique that can be used to stabilize control systems

DESCRIPTION

A **control system** is a device, or set of devices to manage, command, direct or regulate the behavior of other device(s) or system(s). Industrial control systems are used in industrial production. There are two common classes of control systems, with many variations and combinations: logic or sequential controls, and feedback or linear controls. There is also fuzzy logic, which attempts to combine some of the design simplicity of logic with the utility of linear control. Some devices or systems are inherently not controllable.

The term "control system" may be applied to the essentially manual controls that allow an operator, for example, to close and open a hydraulic press, perhaps including logic so that it cannot be moved unless safety guards are in place. An automatic sequential control system may trigger a series of mechanical actuators in the correct sequence to perform a task. For example various electric and pneumatic transducers may fold and glue a cardboard box, fill it with product and then seal it in an automatic packaging machine.

In the case of linear feedback systems, a **control loop**, including sensors, control algorithms and actuators, is arranged in such a fashion as to try to regulate a variable at a set point or reference value. An example of this may increase the fuel supply to a furnace when a measured temperature drops. PID controllers are common and effective in cases such as this. Control systems that include some sensing of the results they are trying to achieve are making use of feedback and so can, to some extent, adapt to varying circumstances. Open-loop control systems do not make use of feedback, and run only in pre-arranged ways.

EC 2255 CONTROL SYSTEMS **L T P C**

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UNIT I CONTROL SYSTEM MODELING **9**

Basic Elements of Control System – Open loop and Closed loop systems – Differential equation - Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems - Block diagram reduction Techniques - Signal flow graph

UNIT II TIME RESPONSE ANALYSIS **9**

Time response analysis - First Order Systems - Impulse and Step Response analysis of second order systems - Steady state errors – P, PI, PD and PID Compensation, Analysis using MATLAB

UNIT III FREQUENCY RESPONSE ANALYSIS **9**

Frequency Response - Bode Plot, Polar Plot, Nyquist Plot - Frequency Domain specifications from the plots - Constant M and N Circles - Nichol's Chart - Use of Nichol's Chart in Control System Analysis. Series, Parallel, series-parallel Compensators - Lead, Lag, and Lead Lag Compensators, Analysis using MATLAB .

UNIT IV STABILITY ANALYSIS **9**

Stability, Routh-Hurwitz Criterion, Root Locus Technique, Construction of Root Locus, Stability, Dominant Poles, Application of Root Locus Diagram - Nyquist Stability Criterion - Relative Stability, Analysis using MATLAB

UNIT V STATE VARIABLE ANALYSIS & DIGITAL CONTROL SYSTEMS **9**

State space representation of Continuous Time systems – State equations – Transfer function from State Variable Representation – Solutions of the state equations - Concepts of Controllability and Observability – State space representation for Discrete time systems. Sampled Data control systems – Sampling Theorem – Sample & Hold – Open loop & Closed loop sampled data systems.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. J.Nagrath and M.Gopal," Control System Engineering", New Age International Publishers, 5th Edition, 2007.

2. M.Gopal, "Control System – Principles and Design", Tata McGraw Hill, 2nd Edition,2002

REFERENCES:

1. Benjamin.C.Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition,1995.

2. M.Gopal, Digital Control and State Variable Methods, 2nd Edition, TMH, 2007. Schaum's Outline Series,'Feedback and Control Systems' Tata McGraw- Hill, 2007.

3. John J.D'azzo & Constantine H.Houpis, 'Linear control system analysis and design', Tata McGrow-Hill, Inc., 1995.

4. Richard C. Dorf & Robert H. Bishop, " Modern Control Systems", Addidon – Wesley,1999

MICRO LESSON PLAN

HOURS	LECTURE TOPICS	READING
UNIT I CONTROL SYSTEM MODELING		
1	System Concept : Basic Definitions, Basic Elements of Control System	T1
2	Open loop and Closed loop systems	T1
3	Differential Equation , Transfer function	T1
4	Modeling of electric systems, Translational systems, Rotational mechanical systems, Simple electro mechanical systems	T1
5	Problems on Mechanical System	T1
6	Problems on Rotational System	T1
7	Modeling of Electrical System	
8	Block diagram representation of systems, Block diagram reduction rules	T1
9	Problems on Block diagram reduction University Problems on Block diagram reduction	T1
10	Problems on Multiple input Block diagram reduction	T1
11	Signal Flow graph and Masson Gain Formula	T1
12	Problems on Signal flow Graph	T1
13	Conversion of Block diagram in to Signal flow graph	T1
14	Revision	
UNIT II TIME RESPONSE ANALYSIS		
15	Time response Analysis and First Order system	T1
16	Time response of second order systems and its derivation	T1
17	Time Domain Specifications and Derivations	
18	Impulse and Step Response analysis	T1
19	Problems on Second order systems	T1
20	Steady state errors and its Derivations	T1
21	Problems on Steady state errors	T1
22,23	P, PI, PD and PID Compensation	T1
UNIT III FREQUENCY RESPONSE ANALYSIS		
24	Introduction to frequency domain analysis	T1
25	Correlation of time and frequency response	T1
26	Stability analysis using Bode plot , Gain and phase margin	T1

27	Problems based on Bode Plots	T1
28	Stability analysis using Polar plot , Gain and phase margin	T1
29	Problems Based on Polar plots	
30	Constant M and N circles	R1
31	Nicholas Chart Use of Nicholas Chart in control System analysis	R1
32	Lead, Lag and Lead-Lag Compensator	R1
33	MATLAB Analysis	T1
UNIT IV STABILITY ANALYSIS		
34	Introduction to Stability	T1
35,36	Routh-Hurwitz Criterion Problems on Routh-Hurwitz Criterion	T1
37,38	Problems on Root Locus	T1
39	Nyquist Stability Criterion	T1
40	Problems on Nyquist	T1
41,42	Analysis using MATLAB	T1
UNIT V STATE VARIABLE ANALYSIS & DIGITAL CONTROL SYSTEMS		
43	State space representation of Continuous Time systems	R1
44,45	State equations	R1
46	Transfer function from state Variable Problems on State Equations	R1
47	Concept of Observabilty and Controllability	R1
48	State Space Representation for Discrete Time systems	R1
49	Sample Data Control System	R2
50,51	Sampling Theorem and the problems based on that Sample and Hold	R2