Code No: AEEB16

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER

B. Tech IV Semester Regular Examinations, April/May 2020

Regulations: R18

CONTROL SYSTEMS

(**Common to EEE & ECE**)

Time: 3 hours **Max. Marks: 70**

Answer ONE Question from each Module
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

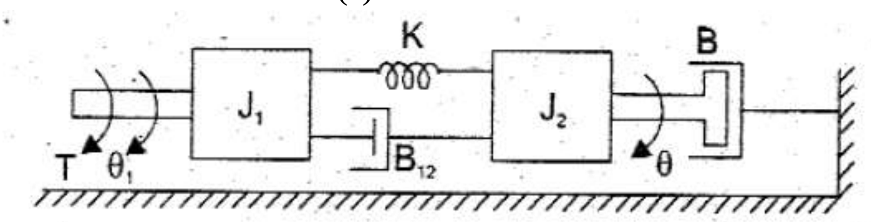
MODULE – I

1. a) Explain open loop and closed loop control systems with suitable examples. **[7M]**

   b) Explain the classification of control systems. **[7M]**

2. a) Determine the transfer function of RLC series circuit if the voltage across the capacitor is a output variable and input is voltage source v(s). **[7M]**

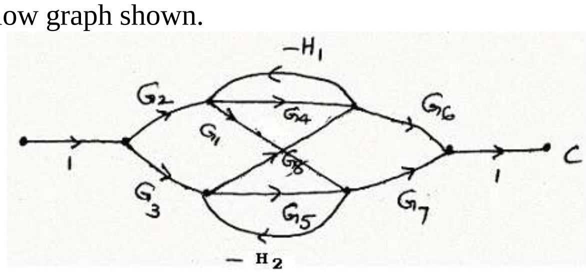
   b) Find the transfer function $\frac{\theta(s)}{T(s)}$ for the system shown in figure. **[7M]**



MODULE – II

3. a) Derive the transfer function of an armature controlled DC servomotor and develop its block diagram **[7M]**

   b) Discuss Mason's gain formula. Obtain the overall transfer function C/R from the signal flow graph shown. **[7M]**



4. a) Explain the effect of P, PI, PD and PID control on the performance of control system? **[7M]**

   b) For a system $G(s)H(s) = \frac{K}{s^2(s+2)(s+6)}$ Find the value of K to limit steady state error to 10 when input to system is $1 + 10t + \frac{40}{2}t^2$ **[7M]**

MODULE – III

5. a) State and explain the advantages and limitations of Routh Hurwitz criteria. **[7M]**

b) The open loop transfer function of a unity feedback system is given by $G(s) = \frac{K(s+13)}{S(s+3)(s+7)}$.find the restriction on k so that the closed loop system is stable. **[7M]**

6. a) state the effect of addition of poles and zeros on root locus and the stability of the system. **[7M]**

b) The open loop transfer function of a control system is given by G(s) H(s) $=\frac{K}{S(S+6)(S^2+4S+13)}$ sketch complete root locus. **[7M]**

MODULE – IV

7. a) Write short notes on various frequency domain specifications. **[7M]**

b) Sketch the bode plot for a system with unity feedback having the transfer function, and assess its closed-loop stability. **[7M]**

$$G(s) = \frac{100(1+0.1S)}{S(1+0.2s)(1+0.5s)}$$

8. a) A unity feedback control system has G(s)=$\frac{K}{s(s+1)(1+\frac{s}{10})}$.find the value of K so that GM=12db and PM=30deg. **[7M]**

b) Obtain the range of values of K for which the following open loop transfer function is stable. Use nyquist stability criterion .G(S)H(S)=K/s(s^2+2s+2). **[7M]**

MODULE – V

9. a) Derive the expression for the calculation of the transfer function from the state variables for the analysis of system? **[7M]**

b) Obtain the state space model of a series RLC circuit **[7M]**

10. a) Consider the differential equation system given by $2\dddot{y}+3\ddot{y}+5\dot{y}+2y=u$ y(0)=0.1,y(0)=0.05. Obtain the response y(t),subjected to the given intial condition **[7M]**

b) Design a lead compensator using root locus for the system with , **[7M]**
G(S) = $\frac{4}{S(S+2)}$ to meet the specifications as
Damping ratio = 0.5 b. setting time = 2 sec.

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COURSE OBJECTIVES:

The course should enable the students to:

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I	Organize modeling and analysis of electrical and mechanical systems.
II	Analyze control systems by block diagrams and signal flow graph technique.
III	Demonstrate the analytical and graphical techniques to study the stability.
IV	Illustrate the frequency domain and state space analysis.

COURSE OUTCOMES (COs):

CO 1	Classify the types and configurations of control systems and describe the mathematical models of dynamic systems.
CO 2	Apply various techniques to obtain transfer functions and examine the time response of control systems using standard test signals.
CO 3	Analyze the system response and stability in time domain
CO 4	Examine the characteristics and stability of control systems in frequency domain.
CO 5	Obtain the models of control systems in state space form and design compensators to meet the desired specifications.

COURSE LEARNING OUTCOMES (CLOs):

AEEB16.01	Differentiate between open loop, closed loop system and their importance in real time applications.
AEEB16.02	Predict the transfer function of translational and rotational mechanical, electrical system using differential equation method.
AEEB16.03	Analyze the analogy between electrical, translation and rotational mechanical systems.
AEEB16.04	Apply the block diagram and signal flow graph technique to determine transfer function of an control systems.
AEEB16.05	Demonstrate the response of first order and second order systems with various standard test signals.
AEEB16.06	Estimate the steady state error and its effect on the performance of control systems and gives the importance of PID controllers.
AEEB16.07	Summarize the procedure of Routh – Hurwirtz criteria to study the stability of physical systems
AEEB16.08	List the steps required to draw the root – locus of any control system and predict the stability.

AEEB16.09	Explain the effect on stability by adding zeros and poles to the transfer function of control system.
AEEB16.10	Discuss the method of Bode plot and Polar plot to calculate gain margin and phase margin of control system.
AEEB16.11	Describe the characteristics of control system and its stability by plotting Nyquist plot**.**
AEEB16.12	Compare the behavior of control system in terms of time domain and frequency domain response.
AEEB16.13	Define the state model of control system using its block diagram and give the role of diagonalization in state space analysis.
AEEB16.14	Formulate the state transmission matrix and explain the concept of controllability and observability.
AEEB16.15	Design of lag, lead, lag – lead compensator to improve stability of control system.
AEEB16.16	Apply the concept of different stability criterions and time, frequency response solution to solve real time world applications.
AEEB16.17	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations.

MAPPING OF SEMESTER END EXAMINATION - COURSE OUTCOMES

SEE Question No		**Course Learning Outcomes**		**Course Outcomes**	**Blooms Taxonomy Level**
1	a	AEEB16.01	Differentiate between open loop, closed loop system and their importance in real time applications.	CO 1	Analyze
	b	AEEB16.01	Differentiate between open loop, closed loop system and their importance in real time applications.	CO 1	Analyze
2	a	AEEB16.02	Predict the transfer function of translational and rotational mechanical, electrical system using differential equation method.	CO 1	Apply
	b	AEEB16.03	Analyze the analogy between electrical, translation and rotational mechanical systems.	CO 1	Analyze
3	a	AEEB16.04	Apply the block diagram and signal flow graph technique to determine transfer function of an control systems.	CO 2	Apply
	b	AEEB16.04	Apply the block diagram and signal flow graph technique to determine transfer function of an control systems.	CO 2	Apply
4	a	AEEB16.06	Estimate the steady state error and its effect on the performance of control systems and gives the importance of PID controllers.	CO 2	Apply
	b	AEEB16.05	Demonstrate the response of first order and second order systems with various standard test signals.	CO 2	Apply
5	a	AEEB16.07	Summarize the procedure of Routh – Hurwirtz criteria to study the stability of physical systems	CO 3	Understand

	b	AEEB16.07	Summarize the procedure of Routh – Hurwirtz criteria to study the stability of physical systems	CO 3	Understand
6	a	AEEB16.09	Explain the effect on stability by adding zeros and poles to the transfer function of control system.	CO 3	Understand
	b	AEEB16.08	List the steps required to draw the root – locus of any control system and predict the stability.	CO 3	Analyze
7	a	AEEB16.10	Discuss the method of Bode plot and Polar plot to calculate gain margin and phase margin of control system.	CO 4	Understand
	b	AEEB16.10	Discuss the method of Bode plot and Polar plot to calculate gain margin and phase margin of control system.	CO 4	Understand
8	a	AEEB16.10	Discuss the method of Bode plot and Polar plot to calculate gain margin and phase margin of control system.	CO 4	Understand
	b	AEEB16.11	Describe the characteristics of control system and its stability by plotting Nyquist plot.	CO 4	Understand
9	a	AEEB16.13	Define the state model of control system using its block diagram and give the role of diagonalization in state space analysis.	CO 5	Remember
	b	AEEB16.13	Define the state model of control system using its block diagram and give the role of diagonalization in state space analysis.	CO 5	Remember
10	a	AEEB16.14	Formulate the state transmission matrix and explain the concept of controllability and observability.	CO 5	Apply
	b	AEEB16.15	Design of lag, lead, lag – lead compensator to improve stability of control system.	CO 5	Create

Signature of Course Coordinator **HOD, EEE**