(b) Explain, how PID controller improves the time domain specifications of a system ? 7

7. (a) Explain lead compensator in detail with the circuit diagram and transfer function. 8

(b) What are the fundamental principles and mathematical frameworks underlying optimal control theory ? 7

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May 2024

B.Tech. (EIC) (Fourth Semester)

Control System Engineering (El-401)

Time : 3 *Hours*] [*Maximum Marks :* 75

Note : It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any *four* questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other. Assume any missing data.

Part A

1. (a) What do you mean by steady state and transient accuracy ? 1.5

(b) What is the effect of PI and PD controller on time domain specifications of control system ? 1.5

(c) Define necessary and sufficient conditions for stability, 1.5

(d) What are the key characteristics and challenges associated with nonlinear dynamical systems ? 1.5

(e) Define state variables. **1.5**

(f) Explain optimality. **1.5**

(g) Find velocity error coefficient for 1st order system to a step input. **1.5**

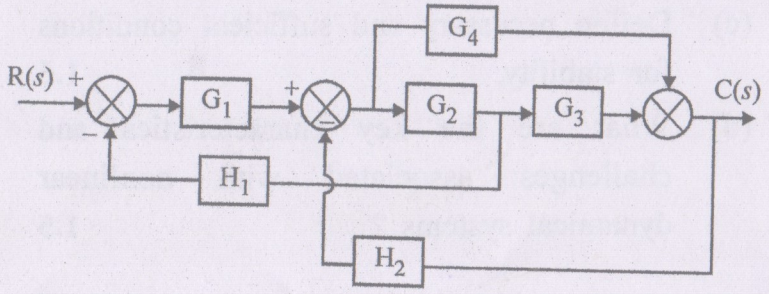
(h) Write Masons gain formula to find the transfer function of a system. **1.5**

(i) Explain how robustness and sensitivity are affected by introducing feedback in control systems. **1.5**

(j) What is the need of compensation in control systems ? List different types of compensation. **1.5**

Part B

2. (a) Reduce the block diagram and find C(s)/R(s) : **8**



(b) Obtain the time domain response of second order control system. 7

3. (a) Obtain the mathematical modelling of DC servo motor and determine the transfer function. 7

(b) Find the steady state error for unit step and unit ramp input for following systems. **8**

$$1000(s + 1)/(s + 10)\ (s + 50)$$

4. Sketch the root locus plot of the following feedback system

$$G(s) = k/s(s + 2)(s^2 + 2s + 4)$$

Find the value of K at breakaway points. **15**

5. (a) Compare time domain and frequency domain specifications. **5**

(b) Obtain the bode plot for the system : **10**

$$G(s) = 100/s(s^2 + 12s + 100)$$

6. (a) Examine the stability of the characteristics polynomial for k using Routh stability criteria. **8**

$$D(s) = s^4 + 20ks^3 + 5s^2 + 10s + 15$$