D 50622

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FIFTH SEMESTER B.TECH. (ENGINEERING) DEGREE [REGULAR/ SUPPLEMENTARY] EXAMINATION, NOVEMBER 2013

EE 09 503—LINEAR CONTROL SYSTEMS

Time : Three Hours

Maximum : 70 Marks

Part A

Answer all questions.
Each question carries 2 marks.

1. Give one practical example (domestic appliances) of open loop system and closed loop system.

2. Define Transfer function. State its limitations.

3. What are the standard test signals ?

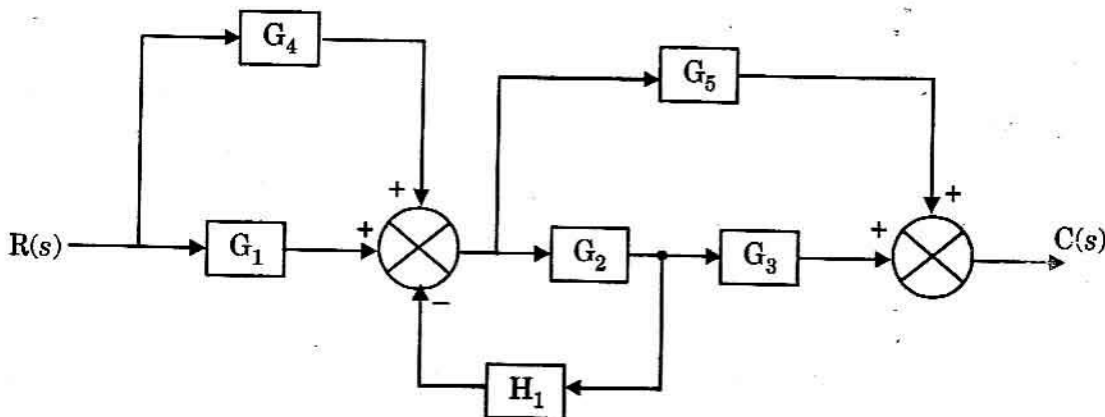4. List the frequency domain specifications.

5. What is a compensator ?

(5 × 2 = 10 marks)

Part B

Answer any four questions.
Each question carries 5 marks.

1. State the reasons for choosing closed loop structure for Automatic control system.

2. Simplify the given block diagram to obtain the overall transfer function.

3. A speed control system is expressed by transfer function $\dfrac{\omega(s)}{V(s)} = \dfrac{100}{2 + 25s}$. Find the output if an input of 2 volt is applied.

4. Given $G(s) = K(s+5) / s(s+6)(s+7)(s+8)$ find the value of K for 10 % steady state error.
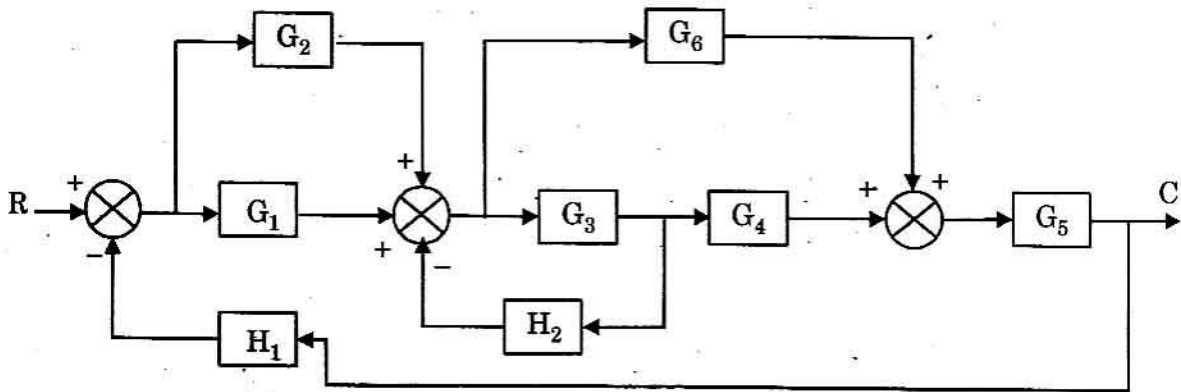
Turn over

5. Given the T.F. $C(s) / R(s) = 5/(s^2 + 2s + 5)$. Find the resonant frequency of oscillations.

6. Draw the BODE plot for Lag compensator and state where this type of compensator is most suited.

(4 × 5 = 20 marks)

Part C

Answer **all** *questions.*
Each question carries 10 marks.

1. Obtain the overall transfer function for the given block diagram by converting into a signal flow graph.

Or

2. Derive the transfer function for the given mechanical system. Also find the electrical analogue by Force-voltage analogy method.
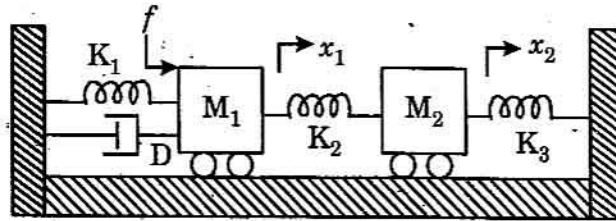
3. (a) The forward path Transfer Function of a unity feed back system is given by $G(s) = \dfrac{4}{s(s+3)}$.

Determine the time response for the system for the unit step input.

(b) Find the static error constants for the given UFB system $G(s) = 20(s+2)/[s(s+3)(s+4)]$.

Or

4. (a) Determine the % M_p the time of first overshoot and setting time for the above (Q.3).

   (b) Obtain the dynamic error coefficients for an unity feedback control system given by $G(s) = 50 / s(1 + s)$ subjected to an input of $r(t) 1 + t + t^2 /2$.

5. (a) Obtain the expression for resonant frequency. Determine the resonant frequency, resonant peak, Bandwidth for the system whose transfer function is given by

$$\frac{C(s)}{R(s)} = \frac{9}{S^2 + S + 9}.$$

   (b) Differentiate between Minimum phase and Non-Minimum phase systems.

Or

6. (a) Unity feedback system has open loop transfer function $G(s) = \dfrac{180}{(s + 2)(s + 3)(s + 5)}$, determine stability of the closed loop system using BODE plot.

   (b) State Nyquist stability criterion.

7. Design the lead compensator for the given system so that the $\zeta = 0.45$ for the dominant roots and velocity error constant is 20. The OLTF of the system is $GH(s) = \dfrac{K}{s(s + 2)}$.

Or

8. Design a PD controller for a plant with $\dfrac{C(s)}{R(s)} = \dfrac{16}{s^2 + 1.6s + 16}$ so that overshoot is less than 5 %.

Compare the overshoot with rate feedback and without rate feedback.

(4 × 10 = 40 marks)