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10ME/PM82

Eighth Semester B.E. Degree Examination, Dec.2015/Jan.2016

Control Engineering

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. What are the requirements of an ideal control system? **(06 Marks)**

b. Explain the concepts of open loop and closed loop control system, with examples and block diagrams. **(08 Marks)**

c. What are the characteristics of a P-I controller? **(06 Marks)**

2 a. Derive the transfer function for an armature controlled D.C. motor, which relates output angular displacement (θ) with input voltage (e). **(10 Marks)**

b. A thermometer is dipped in a vessel containing liquid at a constant temperature of θ_i. The thermometer has a thermal capacitance for storing heat as C and thermal resistance to limit heat flow as R. If the temperature indicated by thermometer is θ_0, obtain the transfer function of the system. **(07 Marks)**

c. Distinguish between hydraulic and pneumatic systems. **(03 Marks)**

3 a. Reduce the given block diagram shown in Fig.Q3(a) and determine the transfer function of the system.

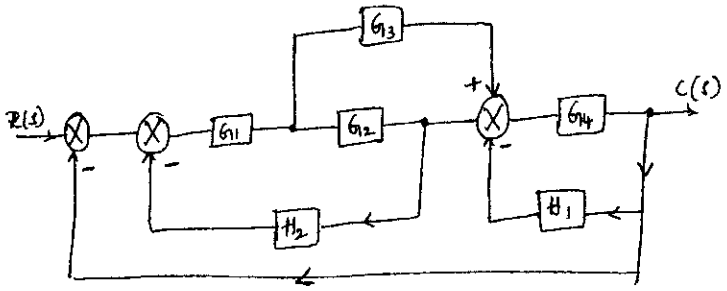

Fig.Q3(a) **(10 Marks)**

b. For the system shown in Fig.Q3(b), determine the transfer function using Mason's gain formula.

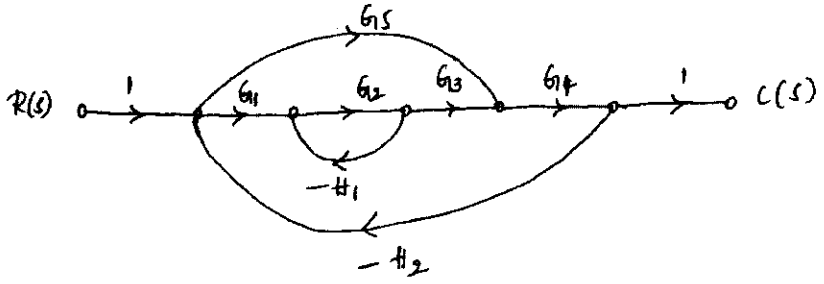

Fig.Q3(b) **(10 Marks)**

4 a. By applying Routh criterion, discuss the stability of the closed loop system, whose characteristics equation is $s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$. **(08 Marks)**

b. A system has the following transfer function,

$$\frac{C(s)}{R(s)} = \frac{20}{s+10}.$$

Determine its unit impulse, step and ramp response with zero initial conditions. Sketch the responses. **(12 Marks)**

PART – B

5 A feedback control system has open loop transfer function:

$$G(s)H(s) = \frac{K}{s(s+4)(s^2+4s+20)}.$$

Plot the root locus for K = 0 to ∞. Indicate the points on it. **(20 Marks)**

6 a. Define the terms gain margin and phase margin. Explain how these can be determined from Bode plots. **(06 Marks)**

b. Sketch the Bode plot for the transfer function

$$G(s) = \frac{Ks^2}{(1+0.2s)(1+0.02s)}.$$

Determine the value of K for the gain cross over frequency to be 5 rad/sec. **(14 Marks)**

7 a. What is system compensation? Explain the (i) series compensation, (ii) feedback compensation. **(08 Marks)**

b. Explain with a block diagram the (i) Lag-compensator, (ii) Lead-compensator. **(12 Marks)**

8 a. Draw the Nyquist plot for a given control system,

$$G(s)H(s) = \frac{K}{s(s+2)(s+10)}.$$

Determine the range of K for which the system is stable. **(14 Marks)**

b. State and explain the Nyquist stability criterion. **(06 Marks)**

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