



USN

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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 (theta) with input voltage (e). (10 Marks)
b. A thermometer is dipped in a vessel containing liquid at a constant temperature of theta\_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 theta\_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. (10 Marks)

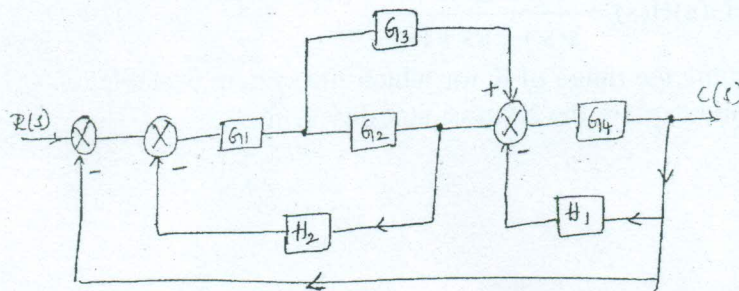


Fig.Q3(a)

(10 Marks)

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

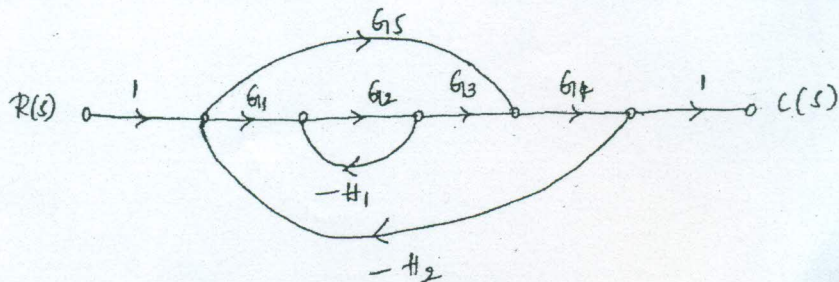


Fig.Q3(b)

(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)

Important Note : 1. On completing your answers, carefully draw diagonal cross lines on the remaining blank spaces. 2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.



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  $\infty$ . 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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