# B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2013

Fifth Semester

Aeronautical Engineering

EE 2365/EE 58/ AE 1304/080180023 — CONTROL ENGINEERING

(Regulation 2008)

Time : Three hours

Maximum : 100 mar

Use of Book Plot and graph sheet is Permitted.

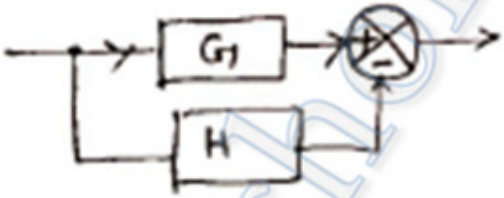
Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Draw the block diagram of a flight control system and name the various si blocks in it.
2. Give the expressions to represent the dynamics of Thermal system.
3. Give the reduced forms of following block diagrams :

(a)


(b)




4. Define the following with respect to signal flow graph
   (a) Forward path
   (b) Loop
5. List any four input signals used to obtain time response of a control syste
6. Define steady state error.
7. State Routh-Hurwitz stability criteria.
8. Why 'logarthmic scale' is used on x-axis to draw the bode plots?
9. List any four advantages of a digital controller.
10. What is the role of 'D' controller in a PID control scheme.

PART B — (5 × 16 = 80 marks)

11. (a) For the mechanical system shown in Figure 1, carryout the following :

(i) Draw the mechanical network.

(ii) Write the Torque – angular velocity equation.

(iii) Draw the electrical network.

(iv) Write the Torque – voltage equation. (4 + 4 + 4 + 4)

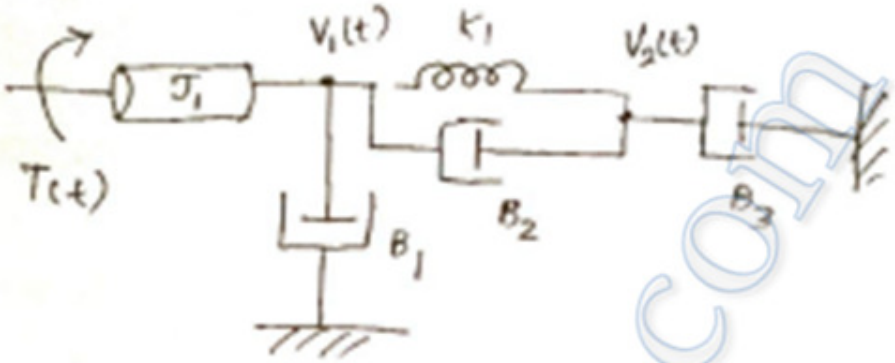



Figure 1

Or

(b) (i) From the fundamentals, derive the expression for the transfer function of an hydraulic actuator. (8)

(ii) Fill up the following table with respect to analogous quantities

| | | Analogous quantity in | | |
|---|---|---|---|---|
| Sl.No | Quantity in Electrical system | Thermal system | Liquid – level system | Pneumatic system |
| 1. | | | | |
| 2. | | | | |

12. (a) For the block diagram show in Figure 2, carryout the following : (4 + 12)

(i) Draw the signal flow graph.

(ii) Find the transfer function using Mason's gain formula

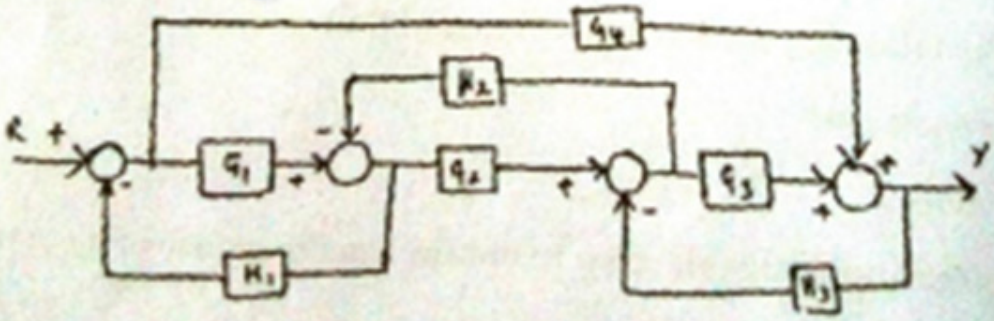



Figure 2

(b) (i) Obtain the transfer function of a system whose signal flow graph is shown in Figure 3, using Mason's gain formula. (8)

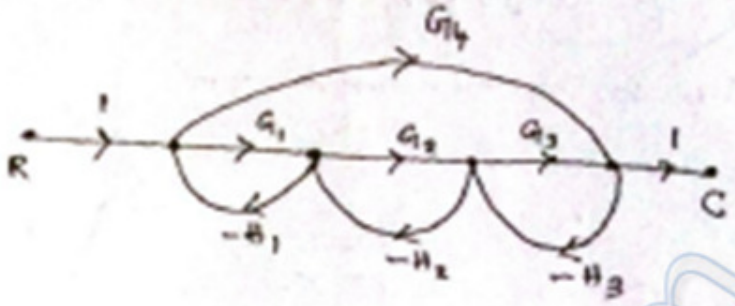



Figure 3

(ii) Find the value of $\frac{C_2}{R_2}$ for a system whose block diagram is shown in Figure 4, using block diagram reduction technique (8)

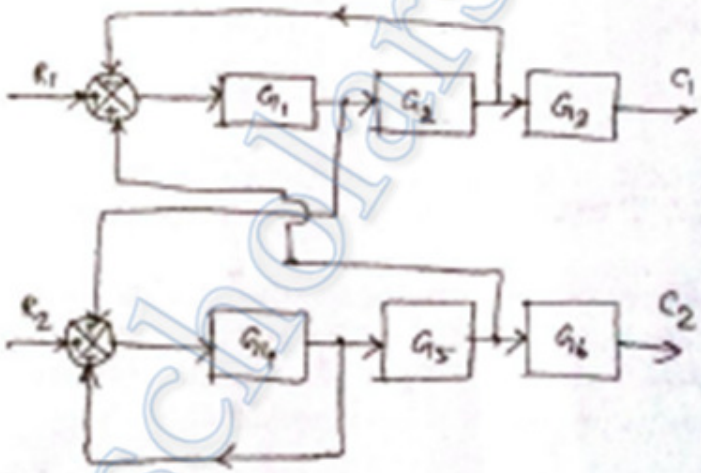



Figure 4

13. (a) (i) The closed loop transfer function of a system is given by $\frac{C(\lambda)}{R(\lambda)} = \frac{100}{\lambda^2+6\lambda+25}$. Determine the values of $w_n, \delta, w_d, M_p, t_p$ and $t_s$ (for 2% tolerance). (12)

(ii) Define the following : (2 + 2)

(1) Peak overshoot

(2) Settling time.

Or

(b) (i) The open loop transfer function of a unity feed back system is given by $G(\lambda)H(\lambda) = \frac{100}{\lambda^2(\lambda+4)(\lambda+12)}$. Determine the steady state error, if $r(t) = 2t^2+5t+10$. (10)

(ii) The unit step response of a stepper motor is as shown in Figure 5. Find its transfer function (6)

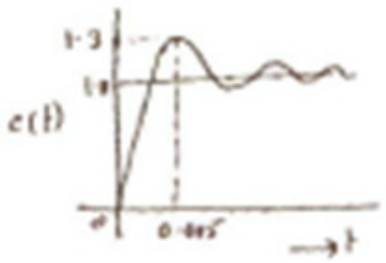



Figure 5

14. (a) Draw the root locus of a unity feedback system whose open loop transfer function is given by $G(\lambda)H(\lambda)=\frac{K}{\lambda(\lambda+3)(\lambda^2+2\lambda+2)}$ when 'K' varies from '0' to '$\alpha$'. (16)

Or

(b) The open loop transfer function of a unity feed back system is given by $G(\lambda)H(\lambda)=\frac{10}{\lambda(1+0.1\lambda)(1+0.05\lambda)}$. Draw the bode plots to find gain margin and phase margin. Hence comment on the stability. (7 + 7 + 2)

15. (a) (i) Explain in detail the functional block diagram of a Direct Digital control (DDC) scheme, with the help of a neat diagram. (8)

(ii) Describe two different ways that can be used to improve the quality of reconstruction of a continuous signal from its discrete time values in a DDC. Also outline relative advantages and disadvantages of the two methods. (4 + 4)

Or

(b) (i) From the fundamentals, derive an expression for the velocity form of digital PI and PID control algorithms. (6 + 6)

(ii) Briefly explain the specific advantages of velocity form of digital PID algorithm over the position form. (4)