Question Paper Code : 51448

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2014.

Fifth Semester

Aeronautical Engineering

EE 2365/EE 58/AE 1304/080180023/10122 AE 505 – CONTROL ENGINEERING

(Regulation 2008/2010)

Time : Three hours Maximum : 100 marks

(Semi log sheet and Graph sheet should be provided)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Fill up the table with respect to analogous quantities in Torque-current analogy.

Parameter	Mechanical rotational system	Electrical system
Mass		
Velocity		

2. Give the mathematical expression representing the system dynamics of a hydraulic system.

3. Give the expression for Mason's gain formula.

4. Give the reduced form of the following block diagram.

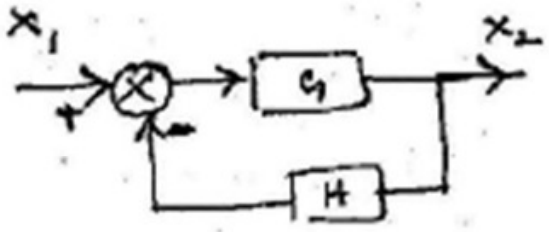

Figure 1 (a)

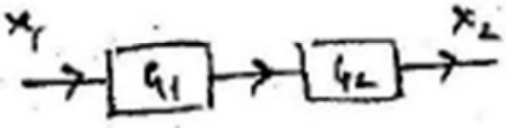

Figure 1 (b)

5. Name the following standard test signals.

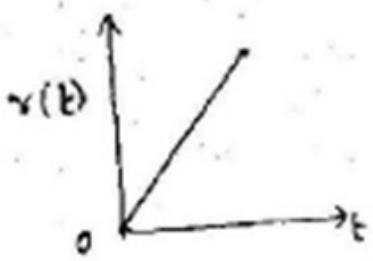

Figure 2 (a)

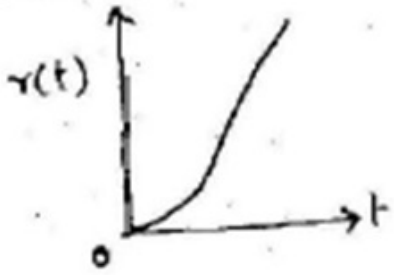

Figure 2 (b)

6. Define steady state error.
7. Give the expression for finding the 'centroid' in the construction of root locus.
8. List any two advantages of frequency response analysis over the time domain analysis.
9. Give the mathematical expression for the output of a digital PID controller.
10. List any two advantages of digital controller.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Explain in detail, with the help of a neat block diagram, the automatic flight landing system. (10)

(ii) From the fundamentals, derive the expression for the transfer function of a thermal system. (6)

Or

(b) (i) Give the pictorial representation and the corresponding mathematical expressions for the three translatory elements and the three rotational elements of a mechanical system. (6)

(ii) For the mechanical system shown in Figure 3, draw the electrical networks for

(1) Force-voltage analogy and

(2) Fore-current analogy. (5+5)

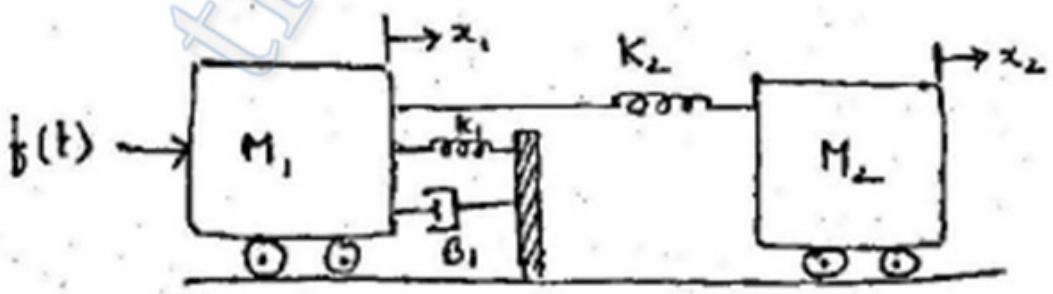

Figure 3

12. (a) (i) For the signal flow graph shown in the Figure 4, find the transfer function using Mason's gain formula. (10)

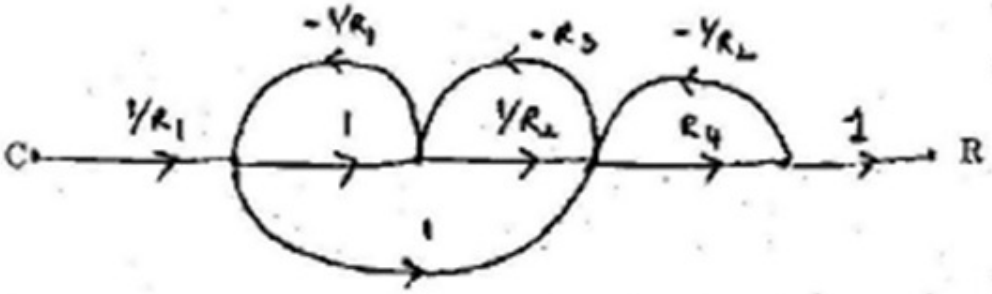

Figure 4

(ii) Define the following with respect to signal flow graph.

(1) Forward path

(2) Loop

(3) Non-touching loop.

Or

(b) (i) For the block diagram show in the Figure 5, find the transfer function using block diagram reduction technique.

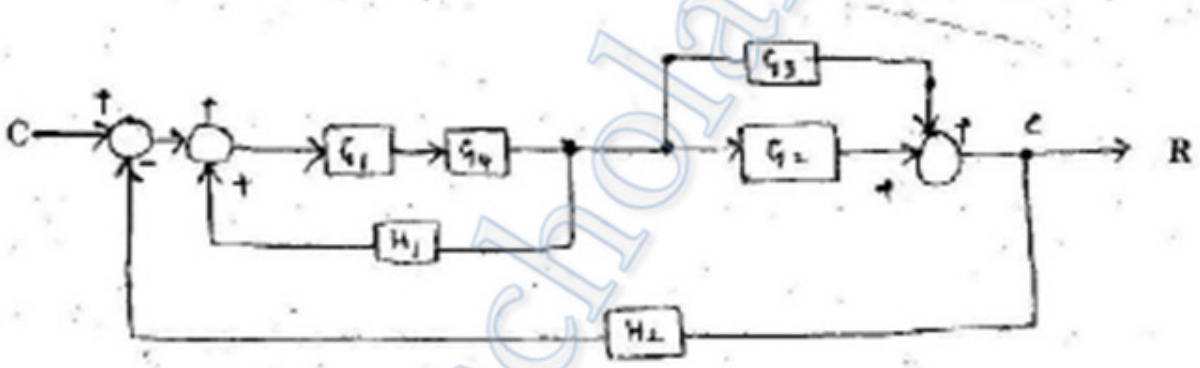

Figure 5

(ii) Draw the signal flow graph for the block diagram shown in Figure 4. (6)

13. (a) (i) Derive an expression for time response of a second order, under damped, unity feedback system when excited with an unit step input.

(ii) Also derive the expression for peak time, rise time and peak overshoot. (10+6)

Or

(b) (i) A unity feedback system has a open loop transfer function as, $G(s) = \frac{10(s+1)}{s^3(5s+6)}$. Determine the steady state error, if $r(t) = 1 + 4t + 3t^2$. (10)

(ii) Define the following :

(1) Peak over shoot

(2) Peak time

(3) Rise time. (6)

14. (a) (i) Determine Routh's array and hence comment on the stability of the system, whose characteristic equation is given by. $s^4 + s^3 + 2s^2 + 2s + 1 = 0$. (6)

(ii) Sketch the root locus of a unity feedback system whose open loop transfer function is given by $G(s)H(s) = K / s(s+1)(s+2)$. (10)

Or

(b) Draw the bode magnitude plot and phase plot for the unity feedback system whose open loop transfer function is given by $G(s)H(s) = \frac{200}{(s+2)(s+4)(s+5)}$ and find the phase margin and gain margin. Also comment on the stability. (7+7+2)

15. (a) (i) List the advantages of velocity form of digital PID algorithm over the position form. (4)

(ii) Derive the expressions for position form of

(1) Digital PI control algorithm

(2) Digital PID control algorithm. (6+6)

Or

(b) (i) Explain in detail with the help of neat block diagram the working of a Direct Digital Control (DDC) scheme. (10)

(ii) Write the significance of sampling and hold circuit in a digital control system. (6)