Total No. of Questions : 10] [Total No. of Printed Pages : 4

Roll No. ....

EC–402

B. E. (Fourth Semester) EXAMINATION, June, 2009

(New Scheme)

(Electronics & Communication Engg. Branch)

CONTROL SYSTEM

(EC – 402)

Time : Three Hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : Attempt *one* question from each Unit. Provide graph and log papers.

Unit – I

1. (a) Determine the T. F. C (s)/R (s) for the block diagram shown in fig. 1 by reduction method and signal flow graph method. 12

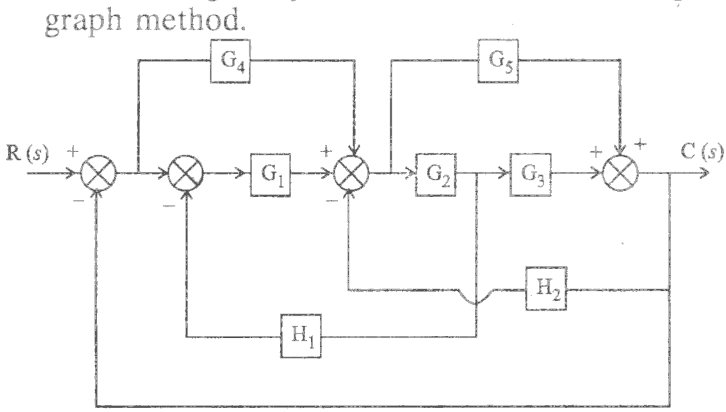


Fig. 1

(b) Describe the working principle of optical encoder. 8

Or

2. (a) A DC motor (fig. 2) drives a pointer, which is spring loaded to return to the reference position. If k_b = back

P. T. O.

e. m. f. constant, k_t = torque constant, k_s = spring constant and J = moment of inertia, find the transfer function : 10

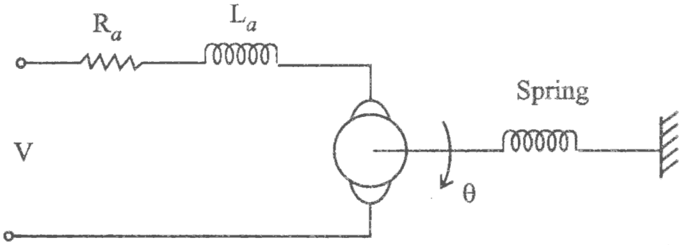


Fig. 2

(b) Describe the single-stack and multi-stack variable reluctance stepper motor. 10

Unit – II

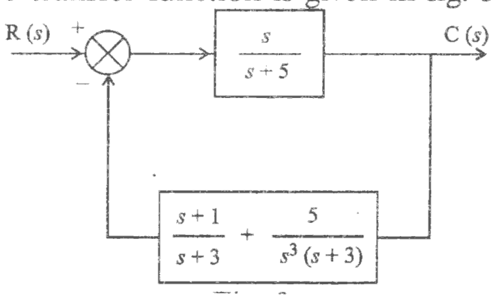
3. (a) How the dynamics are affected by the feedback system ? 8

(b) A second order control system is represented by a transfer function given by $\frac{\theta_0(s)}{T(s)} = \frac{1}{js^2 + fs + k}$ where θ_0 is the proportional output and T is the input torque. A step input of 10 Nm is applied to the system and test results are (i) $M_p = 6\%$, (ii) $t_p = 1$ sec, (iii) the steady state value of the output is 0·5 radian. Determine the value of j, f and k. 12

Or

4. (a) Describe the effect of addition of poles and zeroes to the closed loop transfer function. 10

(b) Find the error coefficients (k_p, k_v and k_a) of the system whose transfer function is given in fig. 3. 10



Unit – III

5. (a) The open loop transfer function of a unity feedback control system is given by $G(s) = \dfrac{K}{s(1+sT_1)(1+sT_2)}$. Applying Routh-Hurwitz criterion determine the value of K in terms of T_1 and T_2 for the system to be stable. 10

(b) Sketch the Bode plot for the transfer function : 10

$$G(s) = \frac{1000}{s(1+0\cdot 1\,s)(1+0\cdot 001\,s)}$$

Determine the :

(i) Gain cross over frequency.

(ii) Phase cross over frequency.

(iii) GM and PM.

(iv) Stability of the given system.

Or

6. Draw the Root locus of the system whose open loop transfer function 20

$$G(s)\,H(s) = \frac{k}{s(s+3)(s^2+3s+11\cdot 25)}$$

Unit – IV

7. (a) Describe the types of compensation. 5

(b) Draw the block diagram and characteristic curve for the PI, PD and PID control action. Also find out the transfer functions. 15

Or

8. (a) Describe the phase-lead compensation circuit and find out the transfer function. 5

(b) Design a compensating network for : 15

$$G(s) = \frac{K}{s(1+0\cdot 2\,s)(1+0\cdot 01\,s)}$$

so that its phase margin at least will be 40° and the steady-state error will not exceed 2% of the final velocity.

Unit – V

9. (a) Determine the state model for the electrical circuit shown in fig. 4. 10

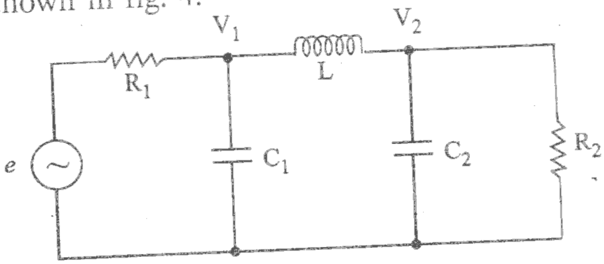


Fig. 4

(b) Obtain the state transition matrix in the form e^{At} and determine the time response for the system $\dot{X} = AX$, 10

where :

$$A = \begin{bmatrix} 0 & 1 \\ -2 & 0 \end{bmatrix} \text{ and } x_1(0) = 1,\ x_2(0) = 1$$

Or

10. (a) The system equations are given by : 10

$$\dot{x}(t) = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$

$y(t) = [1 \quad 0]\, x(t)$ find the T. F. of the system.

(b) A SISO system is given as : 10

$$\dot{x}(t) = \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & -3 \end{bmatrix} x(t) + \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix} u$$

$$y = [1 \quad 0 \quad 2]\, x(t)$$

Test for controllability and observability.