17538

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3 Hours / 100 Marks Seat No. | | | | | | | | |

Instructions : (1) All Questions are *compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. (a) Attempt any THREE : **12**

(i) Differentiate between time varying and time invarying system. (3 points)

(ii) Name the standard test inputs. Draw them and give their Laplace transform.

(iii) Define stability. Draw the location of poles for stable, unstable and marginally stable systems.

(iv) Draw electronic PD controller and write its output equation. State why derivative controller is not used alone.

(b) Attempt any ONE : **6**

(i) Find the transfer function of the RLC circuit in figure 1.

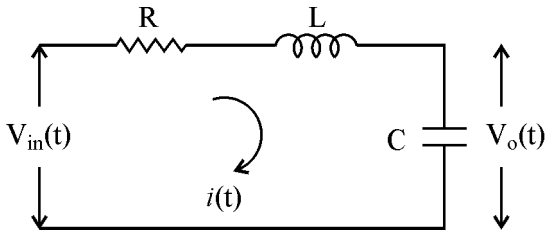

Fig. 1

(ii) Draw Bode plot for the open loop transfer functions.

$$G(S)\,H(S) = \frac{20}{S(1 + 0.25)}$$

2. Attempt any TWO : **16**

(a) By Routh's Array, find out the stability of the system with characteristic equation.

$$S^5 + S^4 + 2S^3 + 2S^2 + 2S + 2 = 0$$

(b) (i) State how AC servomotor is different from two phase induction motor.

(ii) Define servo system. Draw its block diagram and explain each block.

(c) Find the transfer functions of the given block diagram. (fig. 2)

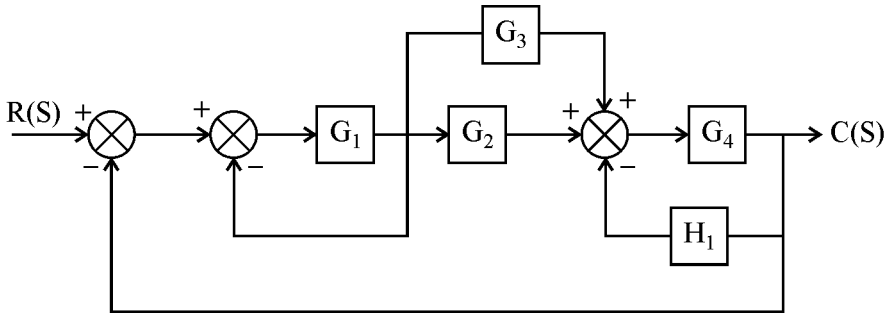

Fig. 2

3. Attempt any FOUR : **16**

(a) Draw and explain the construction and working of any one type of stepper motor.

(b) Explain on-off controller. Give example.

(c) For the transfer function

$$Tf = \frac{10\,(S + 5)}{S\,(S^2 + 5S + 6)} \text{ find}$$

Poles, zeros and characteristic equation.

(d) Define : (i) Gain Margin (ii) Phase Margin (iii) Band width (iv) Cut off frequency.

(e) A system has G(S) H(S) = K/S (S + 1) (S + 2) find the range of K for the system to be stable.

4. (a) Attempt any THREE : **12**

(i) Derive the transfer function of closed loop transfer function.

(ii) Define Time constant. State its significance on system response.

(iii) Define Marginal stability. Show the response of a marginally stable system w.r. to the location of poles.

(iv) Compare stepper motor and DC servo motor (any 6 points).

(b) Attempt any ONE : **6**

(i) A unity feedback system has $G(S) = \frac{10\,(S + 1)}{S(S + 2)\,(S + 10)}$

Find (1) Type of the system (2) Error coefficients K_p, K_v, K_a and steady state errors.

(ii) Explain proportional controller action with equation and response. Define Proportional Band and offset. State the methods to eliminate offset.

P.T.O.

5. Attempt any TWO : **16**

(a) The transfer function of a system is

$$\frac{C(S)}{R(S)} = \frac{25}{S^2 + 6S + 25}$$

Find out (1) Rise time (2) Peak time (3) Peak overshoot (4) Settling time

(b) Draw electronic PID controller. State its equation. Explain its control action in brief. State its advantages and disadvantages. (2 each)

(c) (i) Draw and explain synchro error detector.

(ii) Compare AC servo motor and DC servo motor. (any 6 points)

6. Attempt any FOUR : **16**

(a) Draw the effect of damping on a system response with the help of location of poles and output response. (for all 4 cases of damping factor)

(b) Derive the unit step response of a 1^{st} order system.

(c) State two advantages and disadvantages of frequency response analysis.

(d) Find out the stability of the following system with characteristic equation.

$S^4 + 2S^3 + 8S^2 + 4S + 3 = 0$

(e) Draw the block diagram of process control system and explain each block.
