

22541

11920

3 Hours / 70 Marks

Seat No.

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- 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. Attempt any FIVE of the following:** **10**
- a) Define Linear time invariant control system.
 - b) Draw and express mathematical equation of step and ramp test input.
 - c) Draw the location of poles in S-plane for stable and marginally stable control system.
 - d) Draw and express the output of ON-OFF controller.
 - e) Define servo system and list the elements / blocks required in servo system.

P.T.O.

f) Write the order of control system for:

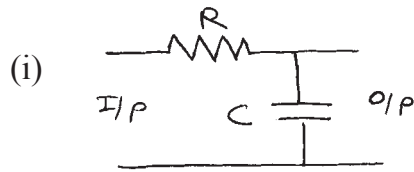


Fig. No. 1

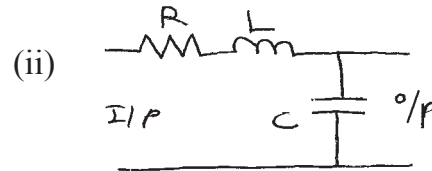


Fig. No. 2

g) Compare DC motor and DC servo motor.

2. Attempt any **THREE** of the following:

12

a) Find the transfer function of Refer Figure No. 3

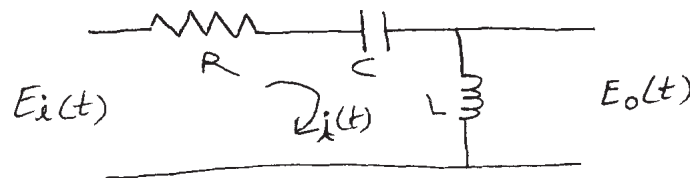


Fig. No. 3

b) For a given TF, $T.F. = \frac{(s+4)}{s(s+2)(s+7)}$

Find:

- (i) Poles,
 - (ii) Zeroes,
 - (iii) Type of the system and
 - (iv) Characteristic equation.
- c) Explain the working of variable reluctance type stepper motor with neat diagram.
- d) Obtain the rise time (t_r), damping ratio (ζ), settling time (t_s) and maximum peak overshoot (M_p) for a unity feedback control system with open - loop T.F., $G(s) = \frac{1}{s(s+1)}$.

3. Attempt any THREE of the following:

12

- a) Obtain the differential equation and output equation into standard form of state space representation of the following circuit.

Refer Figure No. 4

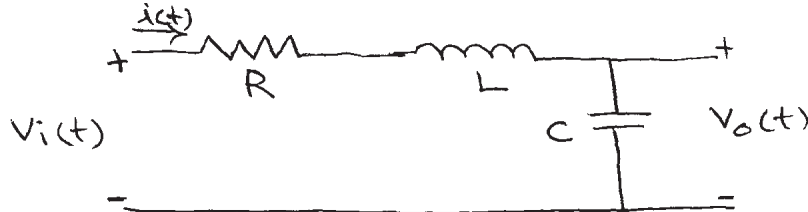


Fig. No. 4

- b) Define time constant. Draw the time response of first order and second order control system for step input.
- c) Calculate the range of K or values of K for the stability of feedback control system with T.F., $T(s) = \frac{K}{s^3 + 18s^2 + 77s + K}$
- d) Describe the function of D.C. servo system with block diagram.

4. Attempt any THREE of the following:

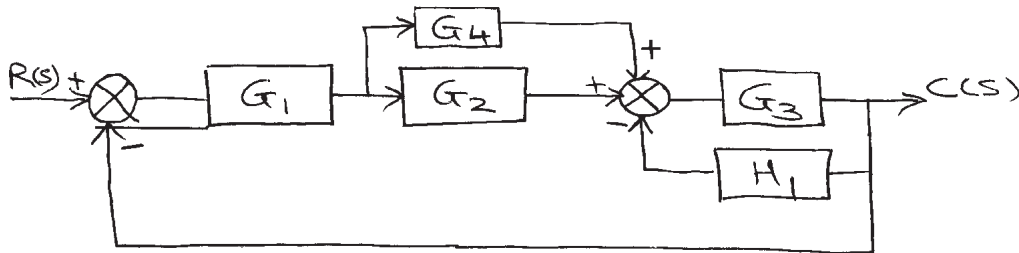
12

- a) Derive the transfer function of closed loop control system with negative feedback.
- b) Describe the effect of damping on second order control system.
- c) Write two advantages and two specifications of frequency response analysis.
- d) Draw the circuit of op-amp based PID controller and write the effects of proportional and derivative action on rise time and overshoot.
- e) Find the stability of control system where characteristic equation is given as $s^5 + 6s^4 + 15s^3 + 30s^2 + 44s + 24 = 0$ using Routh's Stability Criteria.

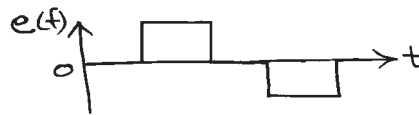
5. Attempt any TWO of the following:

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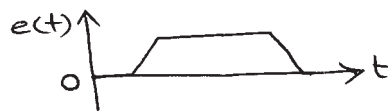
- a) Derive the transfer function of given system using block reduction rules. Refer Figure No. 5.

Fig. No. 5

- b) Draw the bode plot for - $G(s) \cdot H(s) = \frac{10}{s(s+1)(s+5)}$ and find the stability based on gain and phase margin.
- c) (i) List the classification of controllers.
- (ii) Draw the controller output for given error signal.
- 1) PID controller

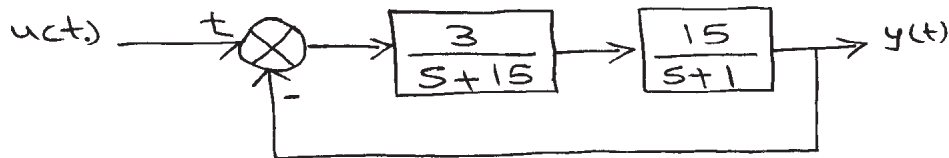
Fig. No. 6

- 2) PI Controller

Fig. No. 7

6. Attempt any TWO of the following:

- a) (i) Draw the characteristics of DC servo motor and AC servo motor.
- (ii) Compare AC servo motor and DC servo motor.
- b) (i) Compare P and D controller.
- (ii) Write one advantages and application of ON – OFF controller.
- (iii) Explain neutral zone with plot in ON-OFF controller.
- c) Calculate the steady state error for unit step input.
Refer Figure No. 8

**Fig. No. 8**
