15116

3 Hours / 100 Marks   Seat No.

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

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

(3)   Figures to the right indicate full marks.

(4)   Assume suitable data, if necessary.

Marks

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

(a)   Compare Time variant & Time-in variant system.

(b)   Draw graphical representation of following test I/P & give their laplace transform.

(i)   Step input

(ii)   Impulse input

(iii) Ramp input

(iv) Parabolic input

(c)   Define stability & explain different types of stability.

(d)   Why 'D' control action is not used alone, justify & give advantages & disadvantages of same. (Any two)

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

(a)   Derive transfer function of given electrical network.
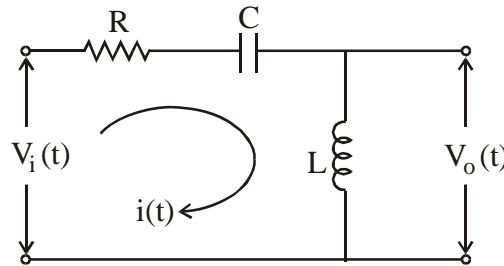
Fig. 1

P.T.O.

(b) Four unity feedback system with transfer function.

$$G(S) = \frac{40 \ (S + 5)}{S \ (S + 10) \ (S + 2)}$$

Draw its bode plot.

2. Attempt any TWO :   **16**

(a) Determine stability of system whose characteristics equation is

$$S^6 + 4S^5 + 3S^4 - 16S^2 - 64S - 48 = 0$$

(b) Explain AC servomotor operation with neat diagram. Compare AC servo motor with normal induction motor. (any 4 points)

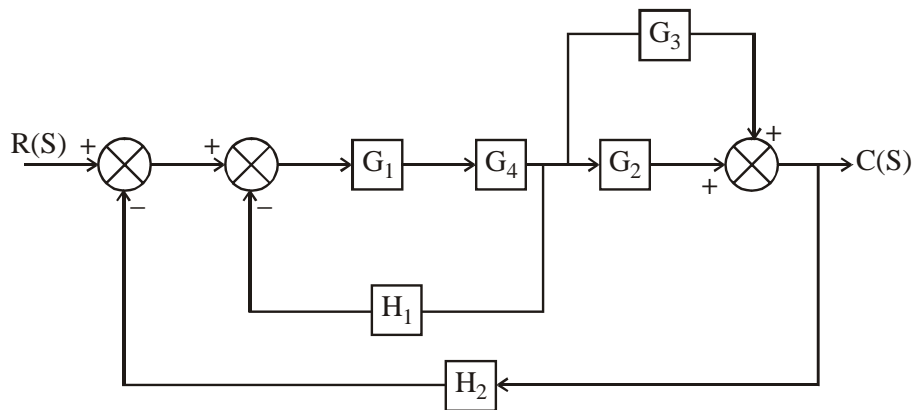(c) Obtain transfer function of following system by using block diagram reduction technique.

Fig. 2

3. Attempt any FOUR :   **16**

(a) Derive transfer function of close loop control system.

(b) Draw labelled time response of 2nd order control system & define

    (i) Delay time

    (ii) Rise time

    (iii) Setting time

    (iv) Peak overshoot

(c) Determine stability of the system using Routh's criterion.

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

(d) Compare stepper motor & DC servo motor. (any 4 points)

(e) Compare proportional & integral controller on the basis of

   (i) Nature of O/P

   (ii) Response of error

   (iii) O/P equation

   (iv) Application

4. (A) Attempt any THREE : 12

   (a) Describe principle of automatic electric iron as ON-OFF controller with its standard equation.

   (b) Give need of bode plot & describe straight line magnitude plot & phase angle plot.

   (c) For the given close T.F.

   $$\frac{C(S)}{R(S)} = \frac{10(S + 6)}{S(S + 2)\,(S + 5)\,(S^2 + 7S + 12)}$$

   Determine

   (i) Poles

   (ii) Zener

   (iii) Characteristics equation

   (iv) Pole-Zero plot on S-plane

   (d) Describe variable reluctance type stepper motor with neat sketch.

(B) Attempt any ONE : 6

   (a) For given transfer function

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

   Determine Tr, Ts, Tp, %Mp for unit step I/p.

   (b) Identify which servo component can be used as error detector in AC servo system. Draw & explain it.

5. Attempt any FOUR : 16

   (a) Draw & explain Block diagram Reduction rules. (any four)

(b) Find all error co-efficients & steady state error for following differential equation :

$$\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 8y(t) = 8x(t)$$

(c) What do you mean by stability ? Define critically stable system.

(d) Give four-advantages & four-disadvantages of Bode plot.

(e) Define Damping. Show effect of damping in response of 2nd order control system.

(f) Draw neat labelled ckt diagram of PID controller & Define (1) Proportional band (2) offset.

6. **Attempt any FOUR :** 16

(a) Give advantages & disadvantages of freq response analysis. (four each)

(b) Derive expression of o/p response of Ist order system for unit step input.

(c) For unity F/B system,

Find : $G(s) = \dfrac{50}{(1 + 0.1S)(1 + 2S)}$ Find

kp, kv, ka

(d) Describe PID control action with neat sketch.

(e) Find range of values of K so that system with following characteristics equation will be stable.

$$F(s) = S(S^2 + S + 1)(S + 4) + K = 0$$

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