17538

21415

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**

i) Define transfer function. Derive an expression for transfer function of closed loop system.

ii) What are different standard test inputs ? Draw them and give their laplace transform.

iii) Define stable, unstable and critically or marginally stable system.

iv) Draw electronic PI controller diagram and write its output equation.

B) Attempt **any one** : **6**

i) Find the transfer function of RLC circuit shown in Figure 1.

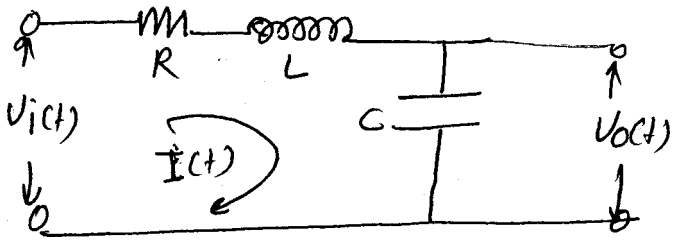

Figure 1 : RLC circuit

ii) Draw the bode plot for the open loop transfer function.

$$G(s)\,H(s) = \frac{10}{s\,(1+5s)(1+20s)}$$

P.T.O.

MARKS

2. Attempt **any two** : **16**

a) Using Routh's criteria, determine the range of K values for system to be stable

$$G(s)\,H(s) = \frac{K}{s\,(s+2)(s+4)(s+5)}$$

b) i) Draw a neat sketch of synchro as an error detector.

ii) Compare DC servomotor and AC servomotor.

c) Derive the transfer function of the system shown in Figure 2 using block diagram reduction techniques.

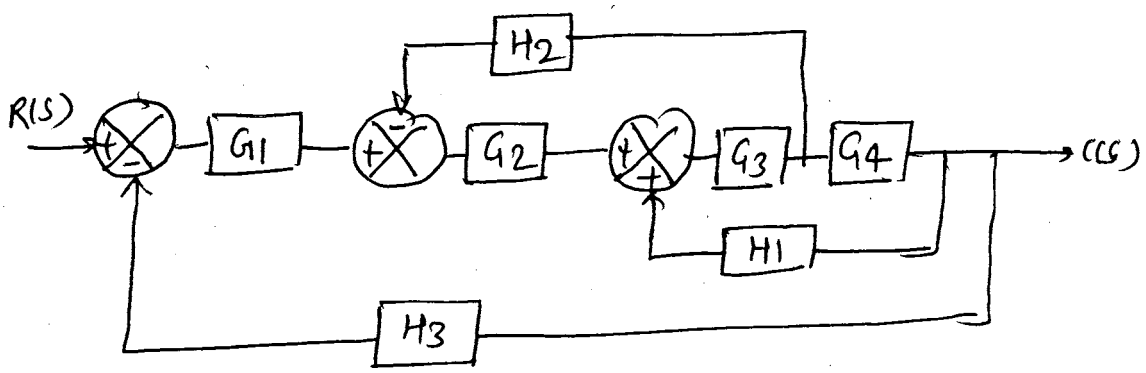

Figure 2

3. Attempt **any four** : **16**

a) Compare open loop and closed loop control system (any four points).

b) Draw neat sketch of unit step response of second order system. Define rise time and settling time.

c) Draw the diagrams for stability of the system w.r.t. root location in s-plane.

d) Compare stepper motor and DC servo motor.

e) Draw and describe the block diagram of process control system.

4. A) Attempt **any three** : **12**

i) Draw electronic PID controller and state its equation.

ii) Define the following terms related with frequency response

a) Bandwidth

b) Cut of frequency

c) Gain margin

d) Phase margin.

MARKS

iii) For open loop transfer function $G(s) = \frac{10}{s(0.5s+1)}$

Determine :

a) Damping ratio

b) Undamped natural frequency

c) Damped natural frequency

d) Maximum overshoot.

iv) With neat sketch, describe potentiometer as an error detector.

B) Attempt **any one** : **6**

i) Describe working of variable reluctance type stepper motor with suitable diagram.

ii) A second order system is given by $\frac{C(s)}{R(s)} = \frac{6}{s^2+5s+6}$.

Determine :

a) Rise time

b) Peak time

c) Settling time

d) Peak overshoot.

5. Attempt **any four** : **16**

a) State how AC servomotor differ from a normal 2-phase induction motor and draw its torque-speed characteristics.

b) Compare P; I and D control actions on the basis of nature of input, response to error, equation and applications.

c) By means of Routh's criteria determine the stability of the system $s^4 + 2s^3 + 8s^2 + 4s + 3 = 0$.

d) Define :

i) Linear system

ii) Nonlinear system

iii) Time variant system

iv) Time invariant system.

e) Derive an expression for unit ramp response of first order system. Draw its response.

f) State two advantages and two disadvantages of frequency response analysis.

MARKS

6. Attempt **any four** : **16**

a) With the help of neat diagram define steady state response and transient response of system.

b) For a given transfer function $\frac{C(s)}{R(s)} = \frac{s(s+2)}{(s^2+2s+2)(s^2+7s+12)}$

Find :

i) Pole

ii) Zero

iii) Pole zero plot

iv) Characteristics equation.

c) A unity feedback control system $G(s) = \frac{40(s+2)}{s(s+1)(s+4)}$

Find :

a) Type of system

b) All error coefficients (Kp, Kv and Ka)

d) State any two advantages and two disadvantages of routh array.

e) Determine the stability of system using routh's criterion.

$s^5 + s^4 + 2s^3 + 2s^2 + 2s + 2 = 0$.
