17538

11819

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) ***Use*** *of Non-programmable Electronic Pocket Calculator is permissible.*
(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

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

a) Define Linear time variant and linear time invariant control systems with examples.

b) Define steady state error. Derive equation for steady state error for type-0 system.

c) State Routh's stability criterion. List advantages and limitations of it (any two).

d) State need of Bode plot. Define Gain margin and phase margin. Write the condition of gain margin and phase margin for stable system.

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

a) For system whose transfer function equation is $\frac{C(S)}{R(S)} = \frac{S(S+4)}{(S+5)(S^2+10S+21)}$

Find values of :

i) Poles

ii) Zero's

iii) Characteristic equation

iv) Order of system and

v) Represent poles and zeros in S-plane.

b) Draw Bode plot for system whose open loop transfer function is,

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

P.T.O.

Marks

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

a) Determine stability of system using Routh's criterion whose characteristic equation is $S^5 + 2S^4 + 2S^3 + 4S^2 + 11S + 10 = 0$

b) Draw PID controller using OP-Amp. Give its output equation. State two advantages of it.

c) Determine transfer function of given block diagram using block diagram reduction rules (Fig. No. 1).

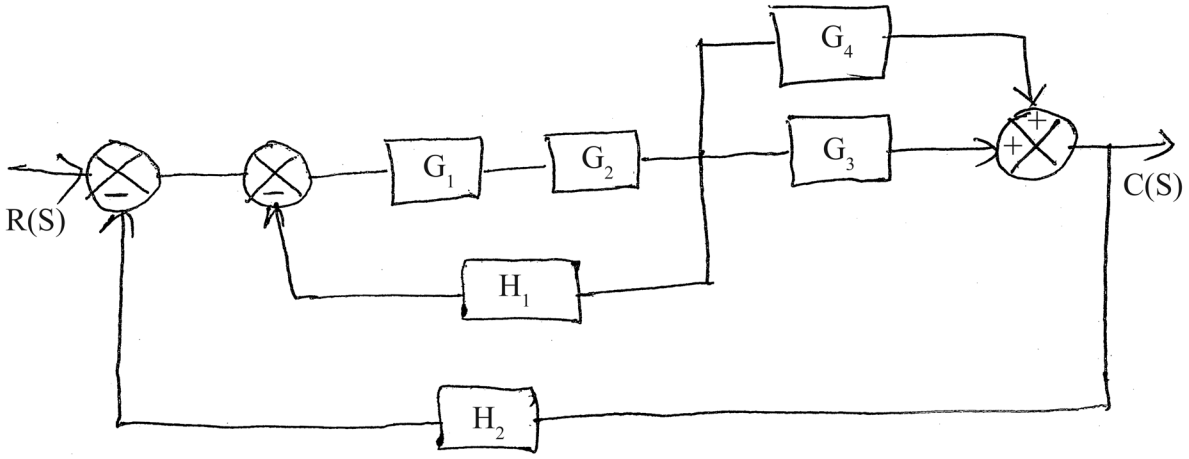

Fig. No. 1

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

a) Obtain transfer function of given electrical circuit (Fig. No. 2)

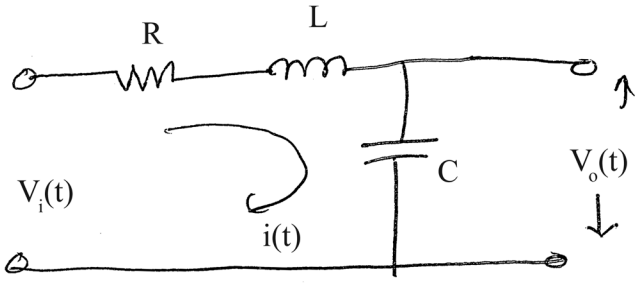

Fig. No. 2

b) Draw the diagram of S-plane with root location. For –

1) Stable system

2) Unstable system.

Define critically stable system.

c) Draw block diagram of process control system. Explain each block in details.

Marks

d) For unity feedback system whose open loop transfer function is

$$G(S) \cdot H(S) = \frac{K(S+2)}{S(S^2+7S+12)}$$

Determine :

i) Type of system

ii) Kp, Kv, Ka.

e) State how AC servo motor differ from a normal 2-phase induction motor.

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

a) Find the underdamped, overdamped system from following :

1) $\frac{9}{S^2+9}$

2) $\frac{9}{S^2+6S+9}$

3) $\frac{9}{S^2+3S+9}$

b) Write two advantages and disadvantages of frequency domain analysis.

c) Why controlled is required in control system ? Draw the PI controller response to .....

d) Define servo system. List different servo components used in servo system.

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

a) Draw the block diagram of DC servo system. Write the uses of servo system (two).

b) Transfer function of system is given by $\frac{C(S)}{R(S)} = \frac{100}{S^2+5S+100}$

Calculate :

i) Damped frequency of oscillations

ii) Peak time (tp)

iii) Peak overshoot (% MP)

iv) Settling time (ts).

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

a) State any four block diagram reduction rules.

b) List four standard test input signals. Draw and define these test signals.

c) Describe variable reluctance stepper motor with neat diagram.

d) Define ON-OFF controller. Explain "Neutral Zone" in ON-OFF controller.

e) Determine the range of K for stable system with characteristic equation as follow :

$S^4 + 4S^3 + 13S^2 + 36S + K = 0$

f) Draw potentiometer as error detector. State its working principle.

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

a) Compare D.C. servo motor with AC servo motor (Any 4 points).

b) Compare proportional and derivative control action on the basis of :

i) Nature of input

ii) Response to error

iii) equation

iv) applications.

c) Find the stability of a control system whose closed loop transfer function is given as

$$T(S) = \frac{10}{S^5 + 7S^4 + 6S^3 + 42S^2 + 8S + 56}$$

d) Draw the time response of 1st order and 2nd order system.

e) Draw the time response of a system and indicate transient response and steady state response in it.