22541

24225

3 Hours / 70 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. Attempt any FIVE of the following: **10**

a) Define open-loop control system and closed-loop control system.

b) Define the transfer function and order of linear time-invariant system.

c) Draw the neat labelled block diagram of closed-loop control system.

d) Define the time constant of first order system with its graphical representation.

e) Define the terms- Gain Margin and Phase Margin.

f) State the importance of neutral zone in the operation of ON-OFF controller.

g) Define servo system.

Marks

2. Attempt any THREE of the following: **12**

a) Derive the transfer function of L-R-C circuit shown in Figure No. 1.

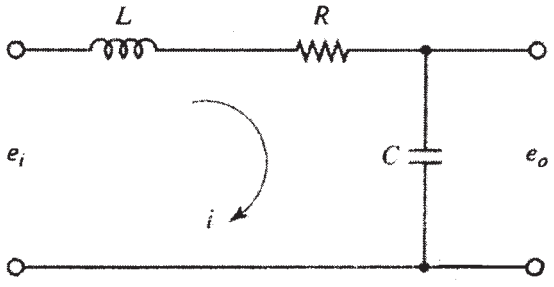

Fig. No. 1

b) Define the following transient response specifications for second-order system with unit step input:

i) Rise time, t_r

ii) Peak time t_p

iii) Maximum overshoot M_p

iv) Settling time, t_s

c) State the advantages and disadvantages of frequency response analysis method over time response analysis method.

d) Explain in brief P-controller with reference to –

i) output equation

ii) unit step response plot

iii) offset and

iv) application.

Marks

3. Attempt any THREE of the following: **12**

a) Consider the system given by following transfer function.

$$\frac{Y(s)}{U(s)} = \frac{s + 3}{s^2 + 3s + 2}$$

Obtain the state - space representation of above system.

b) Derive transfer function of negative feedback control system.

c) Examine stability by Routh criterion for characteristic equation

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

d) Compare stepper motor with DC servo motor. (Any 4 points)

4. Attempt any THREE of the following: **12**

a) Draw the circuit diagram of electronic PID controller and write its output equation.

b) Explain in brief PI-controller with reference to –

i) output equation

ii) unit step response plot

iii) reset time, and

iv) application.

c) Identify which servo component can be used as error detector in DC servo system. Draw and describe it's working.

d) With neat circuit diagram, explain synchro as an error detector.

e) Draw and explain working of PM type Stepper motor.

Marks

5. Attempt any TWO of the following: **12**

a) Simplify the block diagram shown in Figure No. 2 using reduction rules and obtain the transfer function.

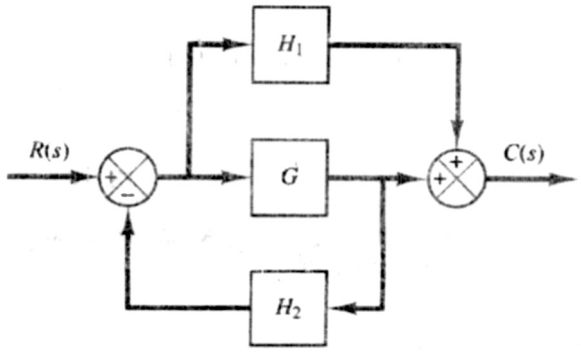

Fig. No. 2

b) Sketch the standard test inputs - Step, Ramp, Parabolic and Impulse. Also write their mathematical equations and transfer function forms.

c) Consider the following characteristic equation:

$s^4 + 2s^3 + (4 + K)s^2 + 9s + 25 = 0$

Using the Routh stability criterion, determine the range of K for stability.

6. Attempt any TWO of the following: **12**

a) A unity-feedback system is characterized by the open-loop transfer function.

$$G(s) = \frac{1}{s(0.5s + 1)\ (0.2s + 1)}$$

Determine the –

i) Type of system

ii) Error constants Kp, Kv, Ka

iii) Steady state error for unit ramp input.

b) Draw Bode plot for the system with open loop transfer function

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

c) Describe ON-OFF controller with neat diagram. List it's advantages and applications. (Any two points)