22232

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) 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. Attempt any FIVE of the following : **10**

(a) Define transfer function and write the transfer function of first order control system.

(b) Write the transfer function standard equation of second order system.

(c) Define and draw the transient and steady state response.

(d) Write the Laplace transform of unit step input and step input with amplitude of 5 units.

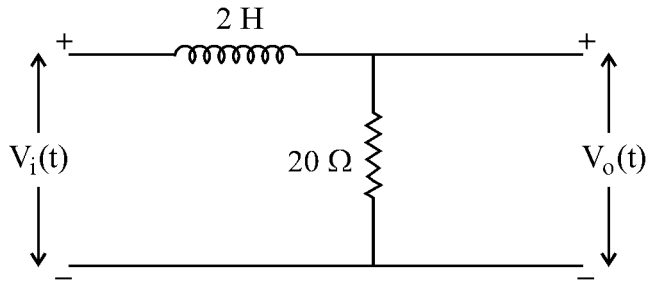
(e) Draw the block diagram of electric iron as control system.

(f) Draw the block diagram of process control system.

(g) Write the advantages of frequency response analysis.

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

(a) Find the transfer function of the given circuit



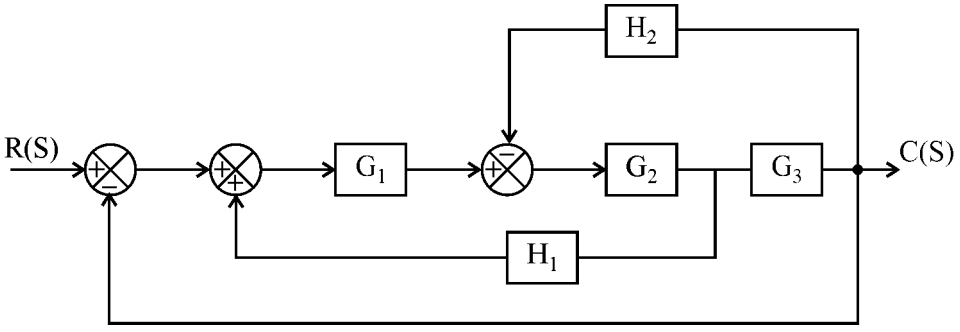
(b) (i) State the need for the controller in process control system.

(ii) Draw the circuit diagram of electronic PID controller.

(c) (i) Calculate the (1) order, (2) Poles and (3) time constant of the T.F. = $\frac{20}{(0.15 + 1)}$

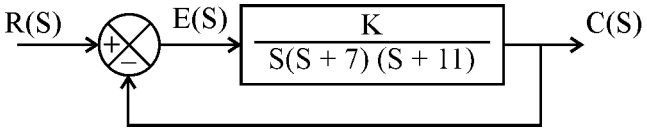
(ii) State the effect of time constant (if increased) on the step response of the T.F.

(d) Find the Transfer Function of the given system using block diagram reduction :

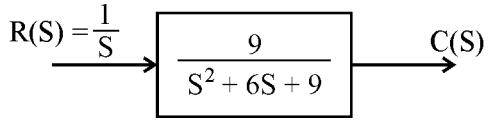


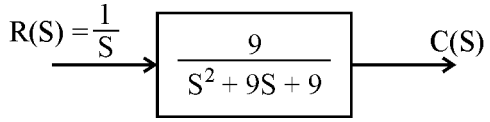
3. Attempt any THREE of the following : **12**

(a) Find the range of K that will cause the system to be stable or unstable.

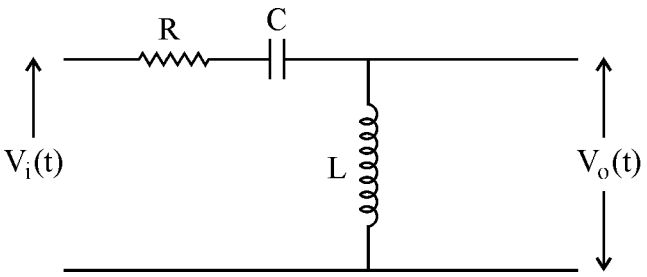


(b) Find the system which is critically damped and over-damped from the following :

(i) 

(ii) 

(c) Derive the transfer function of the given circuit



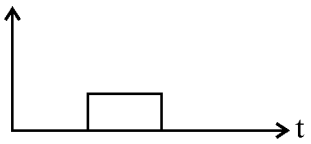
(d) Draw the S-plane with pole, zero location for stable, unstable, marginally stable control system and critically stable control system.

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

(a) Write the output equations for –

(i) On-Off (ii) PI (iii) PD and (iv) PID controller.

(b) Draw the output response of PI and PD controller for the error signal.



(c) Compare PI and PID controller.

(d) Draw the DC servomotor and AC servomotor characteristics.

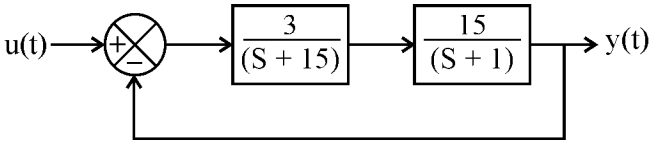
(e) Compare stepper motor with DC servo motor.

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

(a) (i) Write the classification of controllers.

(ii) Write one application of On-Off, P, PD controller.

(b) Calculate the steady state error coefficients and steady state error for the given system to unit step input :



(c) (i) Define servo system.

(ii) Draw the block diagram of servo system.

(iii) Compare DC servo motor with normal DC motor.

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

(a) Calculate (i) W_d, (ii) t_r, (iii) t_s and (4) % M_p for the T.F. of the system

$$\frac{C(S)}{R(S)} = \frac{100}{S^2 + 5S + 100}$$

(b) (i) Draw the Bode plot for the system with

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

(ii) Calculate the gain margin.

(c) Find the stability of the control system with characteristics equation.

$S^4 + 8S^3 + 18\,S^2 + 16S + 5 = 0$ using Routh criteria.

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