Reg. No. : | | | | | | | | | | |

Question Paper Code: 50542

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2017

Fourth Semester

Electronics and Instrumentation Engineering

15UEI402 - CONTROL ENGINEERING

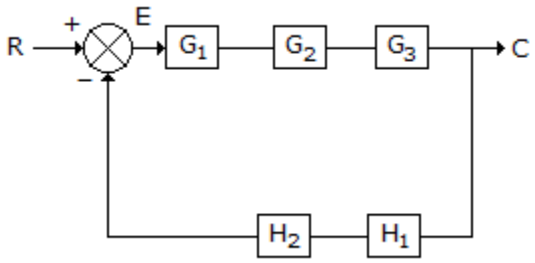
(Regulation 2015)

Duration: Three hours | Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. What is the overall transfer function (C/R) of the following block diagram if $G = G_1 . G_2 . G_3$ and $H = H_1 . H_2$



(a) $\frac{1}{1+GH}$ (b) $\frac{G}{1+GH}$ (c) $\frac{H}{1+GH}$ (d) $\frac{G}{1-GH}$

2. In a feed-back control system G and H denote open loop and close loop transfer functions respectively. The output-input relationship is

(a) $\frac{G}{1+H}$ (b) $\frac{H}{1+G}$ (c) $\frac{G}{H}$ (d) $\frac{H}{G}$

3. The second order system with the transfer function $\frac{4}{S^2+2S+4}$ has a damping ratio of

(a) 2.0 (b) 0.5 (c) 1.0 (d) 4.0

4. What is the Laplace transform of impulse input having magnitude 'X'?

(a) X (b) X^2 (c) 1/X (d) 1

5. Bode diagram is a plot of

(a) log (AR) vs. log (f) and (Φ) vs. log (f) (b) log (AR) vs. f and log Φ vs.f
(c) AR vs. log (f) and Φ vs. log (f) (d) none of these

6. The transfer function of a compensator is given as Gc(s) $=\frac{s+a}{s+b}$. Gc(s) is a lead compensator if

(a) a = 1, b = 2 (b) a = 3, b= 2 (c) a = -3, b = -1 (d) a = 3, b = 1

7. The root locus plot of the roots of the characteristics equation of a closed loop system having the open loop transfer function $\frac{K(S+1)}{2(2S+1)(3S+1)}$ will have a definite number of loci for variation of *K* from 0 to ∞. The number of loci is open

(a) 1 (b) 3 (c) 4 (d) 2

8. The characteristic equation of a feedback-control system is $s^3 + Ks^2 + 5s + 10 = 0$ for the system to be critically stable, the values of K should be

(a) 1 (b) 2 (c) 3 (d) 4

9. The number of integrators in a state diagram is equal to number of

(a) State variables (b) Phase variables
(c) State vector (d) Input vector

10. Consider a second order system whose state-space representation is of the form X = AX + Bu. If $x_1(t) = x_2(t)$, the system is

(a) controllable (b) uncontrollable
(c) observable (d) unstable

PART - B (5 x 2 = 10 Marks)

11. Give the advantages of open loop system.

12. Define ramp signal.

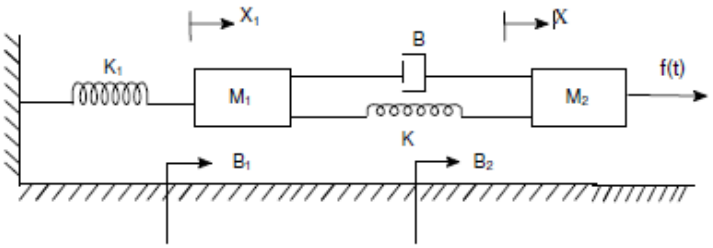
13. Define resonant peak(Mr).

14. The Routh-Hurwitz criteria give absolute stability. Justify your answer?

15. Define state.

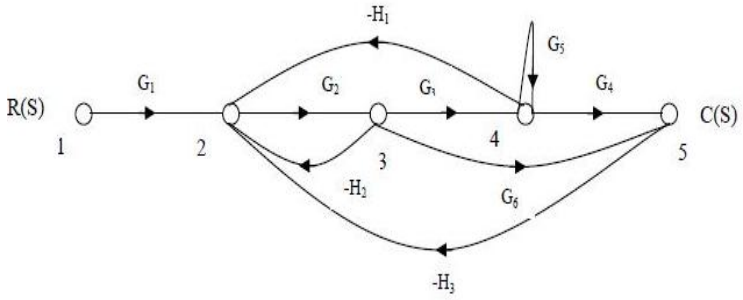
PART - C (5 x 16 = 80 Marks)

16. (a) Write the differential equations governing the mechanical system shown in below figure and determine the transfer function. (16)



Or

(b) Resolve the system flow graph shown in below figure and determine the overall gain C(s) / R(s) of the system. (16)

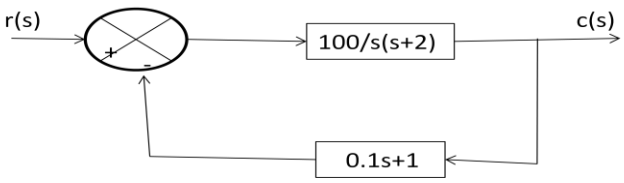


17. (a) (i) Derive the expression for second order system in under damped condition when input is unit step and also draw its response. (12)

(ii) Outline the significance of test signals. (4)

Or

(b) (i) A positional control system with velocity feedback is shown in below figure. What is the response of the system for unit step input? (10)



(ii) Illustrate the time domain specifications. (6)

18. (a) (i) The open loop transfer function of a unity feedback system is given by G(s) $=\frac{1}{s^2(1+s)(1+2s)}$. Sketch the polar plot and determine the gain margin and phase margin. (10)

(ii) Derive the correlation between time and frequency domain specifications. (6)

Or

(b) Given G(s) $=\frac{Ke^{-0.2s}}{s\,(s+2)(s+8)}$. By using Bode plot, find K so that the system is stable with, (i) gain margin equal to 2db and (ii) phase margin equal to 45º. (16)

19. (a) (i) The characteristic polynomial of a system is $s^7+5s^6+9s^5+9s^4+4s^3+20s^2+36s+36=0$. Determine the location of roots on the s-plane and the stability of the system. (10)

(ii) Write the the procedure for constructing Routh array with a row of all zeros. (6)

Or

(b) (i) Apply Routh stability criterion to determine the location of roots on the s-plane and the stability of the system represented by the characteristic equation, $s^6+s^5+3s^4+3s^3+3s^2+2s+1=0$. (10)

(ii) For the system represented by the following characteristic equation say whether the necessary condition for stability is satisfied or not: (i) $s^4+3s^3+4s^2+5s+10=0$ (ii) $s^6-2s^5+s^3+s^2+s+6=0$. (6)

20. (a) Obtain the solution of non-homogeneous state equation using Laplace transform method, and explain Laplace transform method of obtaining e^{At}. (16)

Or

(b) Obtain the state model for the given electrical network shown in below figure in the standard form. (16)