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

# Question Paper Code: 54502

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2019

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. The transfer function is defined only for

   (a) Linear time varying system
   (b) Linear time invariant system
   (c) Both Linear and nonlinear system
   (d) Time invariant as well as time varying system

2. PID controller improves

   (a) steady state response only
   (b) transient response only
   (c) both steady state response & transient response
   (d) output of the system

3. What will be the type of the system, the steady state performance of control system yields a non zero finite value of velocity error constant?

   (a) Type 0 (b) Type 1 (c) Type 2 (d) Type 3

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 roots of the characteristic equation are the same as

(a) Open loop poles (b) Open loop zeros
(c) Closed loop poles (d) Closed loop zeros

8. Using Routh's criterion, the number of roots lying in the right half S-plane for the characteristic equation $s^4 + 2s^3 + 2s^2 + 3s + 6 = 0$ is

(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. $\phi(s)$ is called the

(a) State transition matrix (b) Resolution matrix
(c) Resolvent matrix (d) Transfer matrix

PART - B (5 x 2 = 10 Marks)

11. Derive the transfer function of PID controller.

12. For a system having $G(s)H(s) = \frac{K(s+4)}{s(s^3+5s^2+6s)}$ find (a) type of the system (b) order of the system.

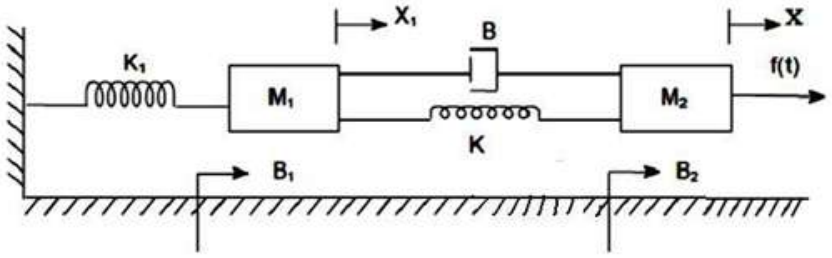
13. Draw the electrical network of lag-lead compensator.

14. State Nyquist stability criterion.

15. List the properties of state transition matrix.

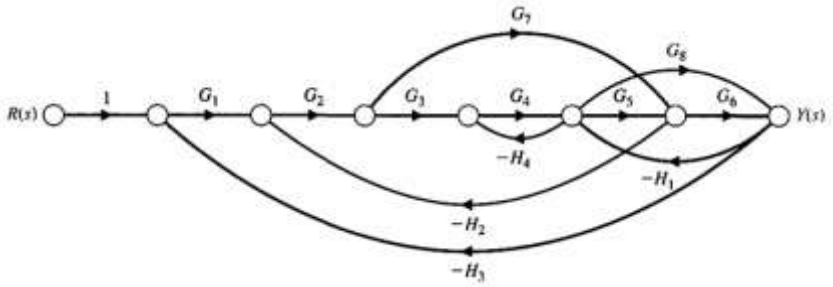
PART - C (5 x 16 = 80 Marks)

16. (a) Determine the transfer function $\frac{X(s)}{F(s)}$ for the mechanical system shown in below figure. (16)




Or

(b) Find the overall transfer function of the system in which its signal flow graph representation is (16)




17. (a) (i) A unity feedback system with open loop transfer function $G(s) = \frac{0.4s+1}{s(s+0.6)}$.

Determine its transient response for unit step input. (8)

(ii) A unity feedback system the open loop transfer function $G(s) = \frac{K}{s(s+10)}$.

Determine the gain K, so that the system will have a damping ratio of 0.5. Also find setting time for 2% error, Peak time, rise time, percentage of peak overshoot. (8)

Or

(b) Derive the expression for second order system in under damped condition when input is unit step and also draw its response. (16)

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) Express nine rules for construction of the root locus. (8)

(ii) Use the Routh-Hurwitz stability criterion to determine the location of roots on the s-plane and hence the stability of the system represented by the characteristic polynomial $s^7 + 5s^6 + 9s^5 + 9s^4 + 4s^3 + 20s^2 + 36s + 36 = 0$. (8)

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) Derive the two state variable modes for the system which has the transfer function of

$$\frac{y(s)}{u(s)} = \frac{50(1 + 0.2s)}{s(s + 0.5)(s + 0.02)}$$

(i) One which the system companion form II

(ii) One which the system matrix is Diagonal (16)

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