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

Question Paper Code: 45302

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

Fifth Semester

Electrical and Electronics Engineering

14UEE502 - CONTROL SYSTEMS

(Regulation 2014)

Duration: Three hours | Maximum: 100 Marks

Answer ALL Questions
(Polar Graph sheets to be provided)

PART A - (10 x 1 = 10 Marks)

1. The principles of homogeneity and superposition are applied to
   (a) Linear time variant systems (b) Non-linear time variant systems
   (c) Linear time invariant systems (d) Non-linear time invariant systems

2. Signal flow graphs can be used to represent
   (a) only linear systems
   (b) only nonlinear systems
   (c) both linear and nonlinear systems
   (d) time invariant as well as time varying systems

3. The impulse response of the system is $5e^{-10t}$. Its step response is equal to
   (a) $0.5e^{-10t}$ (b) $(1 - e^{-10t})$
   (c) $0.5(1 - e^{-10t})$ (d) $(1 - e^{-10t})$

4. The Terzaghi's general bearing capacity equation is represented as
   (a) qf = 5.7 c + $\bar{\sigma}$ (b) qf = c Nc + $\bar{\sigma}$. Nq + 0.5γBNγ
   (c) qf = c Nc + $\bar{\sigma}$. Nq (d) qf = c Nc

5. The relation between resonant frequency and undamped natural frequency is
   (a) $\omega_r = \omega_n\sqrt{1-2\zeta^2}$ (b) $\omega_n = \omega_r\sqrt{1-2\zeta^2}$
   (c) $\omega_r = \omega_n\sqrt{2\zeta^2-1}$ (d) $\omega_n = \omega_r\sqrt{2\zeta^2-1}$

6. The Phase Margin of the system is 0^0. It represents a
   (a) Stable system (b) Unstable system
   (c) Conditionally stable system (d) Marginally stable system

7. The number of sign changes in the element of the first column of the routh array denotes
   (a) the number of zeros of the closed loop system in the RHP
   (b) the number of poles of the closed loop in the RHP
   (c) the number of zeros of the closed loop system in the LHP
   (d) the number of poles of the closed loop in the LHP

8. _____ can be extended to systems which are time -varying.
   (a) Bode-Nyquist stability methods (b) Transfer functions
   (c) Root locus design (d) State model Representatives

9. According to the property of state transition method, e^0 is equal to
   (a) I (b) A (c) e^{-At} (d) $-e^{At}$

10. State model representation is possible using
   (a) Physical variables (b) Phase variables
   (c) Canonical state variables (d) All the above

PART - B (5 x 2 = 10 Marks)

11. Write Masons' Gain Formula.

12. What are the transient and steady state response of a control system?

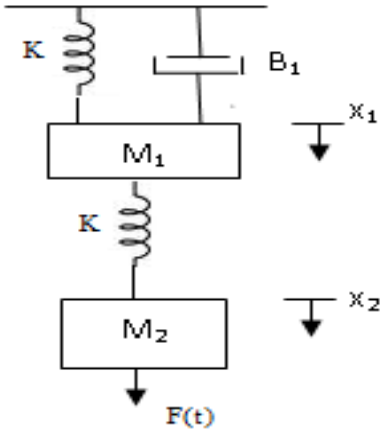
13. State phase and gain margin.

14. Define absolute stability and relative stability.

15. State the properties of the state transition matrix.

PART - C (5 x 16 = 80 Marks)

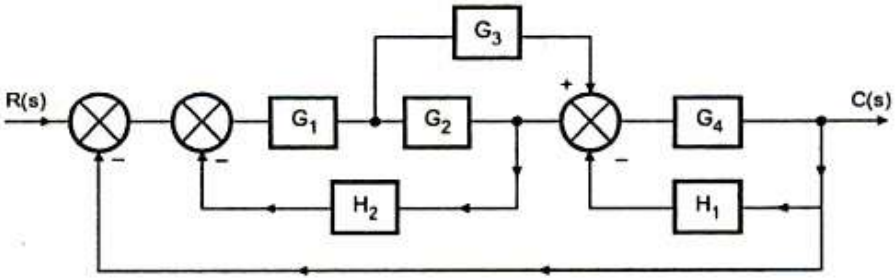
16. (a) (i) Obtain the transfer function $\frac{X_2(s)}{F(s)}$ of the given mechanical translational system. (8)



(ii) Derive the expression for transfer function of armature controlled DC servomotor. (8)

Or

(b) (i) Obtain the closed loop transfer function *C(s)/R(s)* of the system whose block diagram is shown in figure. (16)



17. (a) (i) The forward path transfer function of a certain unity negative feedback control system is *G(s)*. The system is subjected to unit step input. From the transient response curves, it is observed that the system peak overshoot is 20% and the time at which it occurs is $\pi/2$ *sec*. Determine the closed loop transfer function of the system. (16)

Or

(b) Sketch the Root Locus of the control system whose forward path transfer function is $G(s)=\frac{K}{s(s+2)(s+5)}$. (16)

18. (a) Sketch the Bode plot for the following transfer function and determine the system gain margin and phase margin. $G(s)=\frac{10}{s(1+0.5s)(1+0.05s)}$. (16)

Or

(b) Derive the expression for constant *M* and *N* circles. Show that their loci are circles. (16)

19. (a) Define pile foundation. Briefly discuss about the type of pile and their functions. (16)

Or

(b) The open loop transfer function of an uncompensated system is $G(s) = \frac{K}{S(S+4)(S+80)}$ Design a phase lag compensator to get a Phase margin of 33° and velocity error of $K_v = 30\ sec^{-1}$. (16)

20. (a) (i) Obtain the state space representation of this system in three canonical forms $T(s) = \frac{5(S+4)}{S^3+10S^2+31S+20}$. (8)

(ii) Compute the state transition matrix e^{At} for the state model whose system matrix $A = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}$. (8)

Or

(b) The state space representation of a system is given by.

$$\begin{pmatrix} \dot{x}1 \\ \dot{x}2 \\ \dot{x}3 \end{pmatrix} = \begin{pmatrix} -2 & 1 & 0 \\ 0 & -3 & 1 \\ -3 & -4 & -5 \end{pmatrix} \begin{pmatrix} x1 \\ x2 \\ x3 \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} u$$

$Y = (0\ 1\ 0) \begin{pmatrix} x1 \\ x2 \\ x3 \end{pmatrix}$ obtain the transfer function. (16)