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

Question Paper Code: 44501

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2018

Fourth Semester

Electronics and Instrumentation Engineering

14UEI401 - CONTROL ENGINEERING

(Regulation 2014)

Duration: Three hours — Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. A system is represented by the differential equation $M\frac{d^2x}{dt^2}+B\frac{dx}{dt}+Kx=f(t)$. The transfer function relating X(s) and F(s) is

   (a) $\frac{M}{MS^2+BS+K}$ (b) $\frac{B}{MS^2+BS+K}$

   (c) $\frac{K}{MS^2+BS+K}$ (d) $\frac{1}{MS^2+BS+K}$

2. Three blocks with gains of 4, 6, and 8 are connected in parallel. The total gain of the arrangement is

   (a) 18 (b) 196 (c) 32 (d) 52

3. Static error co-efficients are used as a measure of the effectiveness of closed loop systems for specified ________ input signal.

   (a) acceleration (b) velocity

   (c) position (d) all the above

4. The type 0 system has ______ at the origin.

   (a) no pole (b) net pole

   (c) simple pole (d) two poles

5. Phase margin of a system is used to specify which of the following?

(a) Frequency response (b) Absolute stability
(c) Relative stability (d) Time response

6. In polar plot the radial lines represent the

(a) Frequency (b) magnitude (c) gain margin (d) phase angle

7. If the poles of a system lie on the imaginary axis, the system will be

(a) stable (b) unstable
(c) marginally stable (d) Conditionally stable

8. A technique which gives quick transient and stability response

(a) Root locus (b) Bode (c) Nyquist (d) Nichols

9. $\frac{dx}{dt} = Ax(t) + Bu(t)$ is called the

(a) System Matrix (b) Input Matrix
(c) State Transition Matrix (d) Output Equation

10. The state variable approach is applicable to

(a) Only linear time in-variant systems
(b) Linear time in-variant as well as time varying systems
(c) Linear as well as non linear systems
(d) All type of systems

PART - B (5 x 2 = 10 Marks)

11. Define transfer function.

12. List the test signals used to find the time response in control systems.

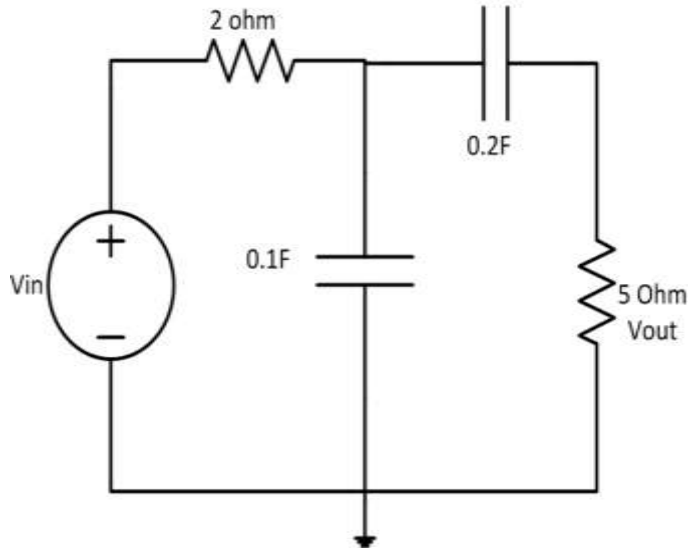
13. What is resonant frequency?

14. The characteristics equation of a system is given by $3s^4 + 10s^3 + 5s^2 + 2 = 0$. Conclude the stability of the system.

15. List the properties of state transition matrix.

PART - C (5 x 16 = 80 Marks)

16. (a) (i) For the electrical circuit in figure-1, Find the transfer function $\frac{V_{out}(s)}{V_{in}(s)}$ (16)



Or

(b) Determine the transfer function *C (s) / R (s)* of the system shown in Figure. 2.

(16)

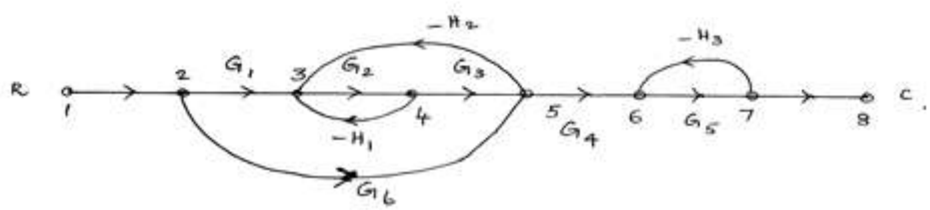


Figure 2

17. (a) (i) The unit step response of a system is given as $C(t) = \frac{5}{2} + 5t - \frac{5}{2}e^{-2t}$. Find the open loop transfer function of the system. (8)

(ii) Derive the output response of the first order system for step input. (8)

Or

(b) Consider a unity feedback system with a closed loop transfer function C(s)/R(s)= $(Ks+b)/(s^2+as+b)$.Determine the open loop transfer function G(s).Show that the steady state error with unit ramp input is given by (a-k)/b.

(16)

18. (a) Design a phase lead compensator for the system shown in fig. to satisfy the following specifications (i) the phase margin of the system ≥45◦ (ii) steady state error for a unit ramp input ≤ 1/15 (iii) the gain cross over frequency of the system must be less than 7.5 rad/sec. (16)

Or

(b) A unity feedback system has an open loop transfer function $G(s) = \frac{K}{s(1+2s)}$.

Design a suitable lag compensator so that phase margin is 40º and steady state error for ramp input is less than or equal to 0.2. (16)

19. (a) Sketch the root locus of the system whose open loop transfer function is G(s) = K/S(S+2)(S+4). Find the value of K so that the damping ratio of closed loop system is 0.5. (16)

Or

(b) Construct the root locus of the system whose open loop transfer function $G(s) = \frac{K}{s(s+2)(s+4)}$. Determine the value of K so that the damping ratio of the closed loop system is 0.5. (16)

20. (a) (i) The transfer function of a control system is given by $\frac{Y(s)}{U(s)} = \frac{s^2+3s+4}{s^3+2s^2+3s+2}$.

Obtain a state model. (8)

(ii) Obtain the transfer function of the system described by

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u \; ; \quad y = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

(8)

Or

(b) Determine the canonical state model of the system, whose transfer function is $T(s) = \frac{2(s+5)}{((s+2)(s+3)(s+4))}$. (16)

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