Roll No											

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
END TERM EXAMINATION - JAN 2023

Semester : Semester V - 2020 Batch
Course Code : EEE2007
Course Name : Sem V - EEE2007 - Control Systems Engineering
Program : B.Tech. Electrical and Electronics Engineering

Date : 4-JAN-2023
Time : 9.30AM - 12.30PM
Max Marks : 100
Weightage : 50%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.

PART A

ANSWER ALL THE TEN QUESTIONS **10 X 2 = 20M**

1. Whenever the control system doesn't obey the linearity and super position theorem, then the system is _____

a) Time-invariant system (CO1) [Knowledge]
b) Linear system
c) Non-linear system
d) Linear time-invariant system

2. A closed loop system is distinguished from open loop system by ----------

a) Servomechanism (CO1) [Knowledge]
b) Feedback
c) Output pattern
d) Input pattern

3. Settling time is inversely proportional to product of the damping ratio and

a) Time constant (CO2) [Knowledge]
b) Maximum overshoot
c) Peak time
d) Undamped natural frequency of the oscillations

4. Time response for a second order control system depends on value of ξ. If ξ>1 then the system is called as

a) undamped system (CO2) [Knowledge]

b) under damped system

c) over damped system

d) critically damped system

5. The time taken by the response to reach 50% of its final value from the very first time is known as _

a) Delay time (CO2) [Knowledge]

b) Peak time

c) Settling time

d) All of the above

6. The stability analysis is done using Routh-Hurwitz criterion and hence the number of roots on the right is calculated. The given characteristic equation s^4+s^3+2s^2+2s+3=0 has

a) Zero root in the s-plane (CO3) [Knowledge]

b) One root in the RHS of s-plane

c) Two root in the RHS of s-plane

d) no root in the RHS of s-plane

7. Routh Hurwitz criteria are used to determine the. ..... of the system.

a) peak response (CO3) [Knowledge]

b) time response

c) absolute stability

d) all the above

8. Which one of the following techniques is utilized to determine at the actual point at which the root locus crosses the imaginary axis?

a) Nyquist technique (CO3) [Knowledge]

b) Bode plot

c) Routh Hurwitz criteria

d) polar plot

9. The advantage of block diagram representation is that it is possible to evaluate the contribution of each component to the overall performance of the system. The overall transfer function from block diagram reduction for cascaded blocks is

a) Sum of individual gain (CO4) [Knowledge]

b) Product of individual gain

c) Division of individual gain

d) all the above

10. The two systems are said to be analogous to each other if the following two conditions are satisfied. (i). The two systems are physically different & (ii). Differential equation modelling of these two systems are same. Electrical systems and mechanical systems are two physically different systems. The F-V and F – I are two types of electrical analogies of a mechanical translational systems. The equivalent values of F-V analogous systems are;

a) F = V, M=L, B=(1/R), K=(1/L), x=(q) and *v*=i (CO5) [Knowledge]

b) F = V, M=L, B=RK=(1/L), x=(q) and *v*=i

c) F = V, M=L, B=(1/R), K=Lx=(q) and *v*=i

d) F = V, M=L, B=RK=(1/C), x=(q) and *v*=i

PART B

ANSWER ALL THE FOUR QUESTIONS **4 X 10 = 40M**

11. Simplify the BLOCK DIAGRAM as in Fig.1 below, Then obtain the CLOSE-LOOP Transfer Function C(S)/R(S) with a neat step-by-step process.

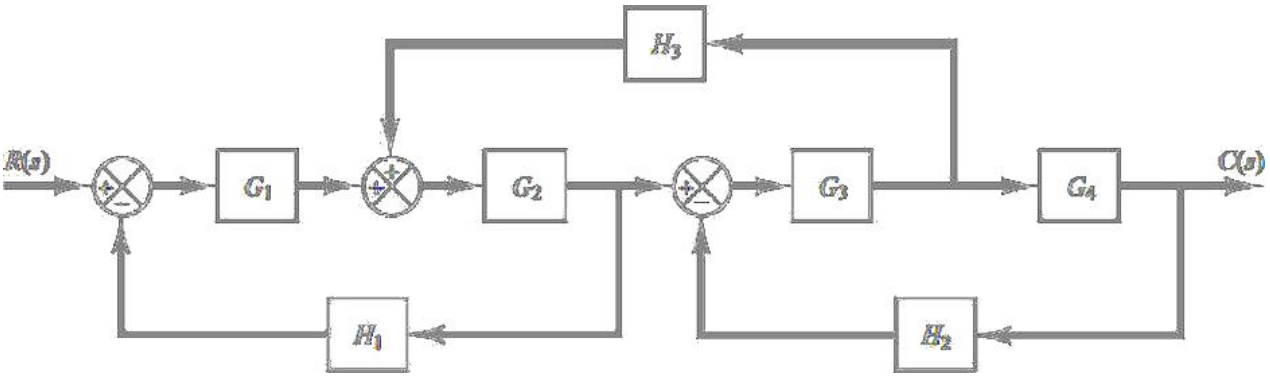

Fig.1

(CO1) [Comprehension]

12. A system has a transfer function G(s),

Compute the time constant, Tc, settling time, Ts, and rise time, Tr. $G(s) = \frac{50}{s + 50}$.

(CO2) [Comprehension]

13. Bode analysis consists of plotting two graphs: the magnitude of Φ0(s) with s = jω, and the phase angle of Φ0(s) with s = jω, both plotted as a function of the frequency ω. Log scales are usually used for the frequency axis and for the magnitude of Φ0(jω).Plot the bode diagram for the transfer function G(s)H(s) = 20 (s+2)/ (s+3)(s-3) .

(CO3) [Comprehension]

14. Construct a state model for a system characterized by the differential equation,

$$\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 6y + u = 0$$

Also give the block diagram representation of the state model.

(CO4) [Comprehension]

PART C

ANSWER ALL THE TWO QUESTIONS **2 X 20 = 40M**

15. Modern control theory is contrasted with conventional control theory in that the former is applicable to multiple-input, multiple-output systems, which may be linear or nonlinear, time invariant or time varying, while the latter is applicable only to linear time invariant single-input, single-output systems. State-space equations for a system. Express the transfer function of the given state space.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -5 & -25 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 25 \\ -120 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

(CO2) [Application]

16. For a unity feedback system, the open loop transfer function is given by

$$G(s) = \frac{K}{s(s+2)(s^2+6s+25)}$$

i. Sketch the root locus for 0<K<infinity
ii. At what value of K the system become unstable
iii. At this point of instability, determine the frequency of oscillation of the system.

(CO3) [Application]

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