PAPER ID-410842

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# B.TECH
## (SEM V) THEORY EXAMINATION 2021-22
## CONTROL SYSTEM

***Time: 3 Hours*** ***Total Marks: 100***

**Note: 1.** Attempt all Sections. If require any missing data; then choose suitably.

### SECTION A

**1. Attempt *all* questions in brief. 2 x 10 = 20**

a. Write down mathematical expression of various test signals used in control system

b. Distinguish between open loop and closed loop control system on the basis of gain, stability.

c. Obtain the damping ratio, natural frequency of unity feedback system whose open loop transfer function is G(s)=5/s.(s+4)

d. Explain Mason Gain Formula.

e. Write the necessary Time domain specifications for design of a control system..

f. Explain BIBO stability.

g. What causes an entire row of zeros to show up in the Routh table?

h. What are the main advantages of Root Locus plot?

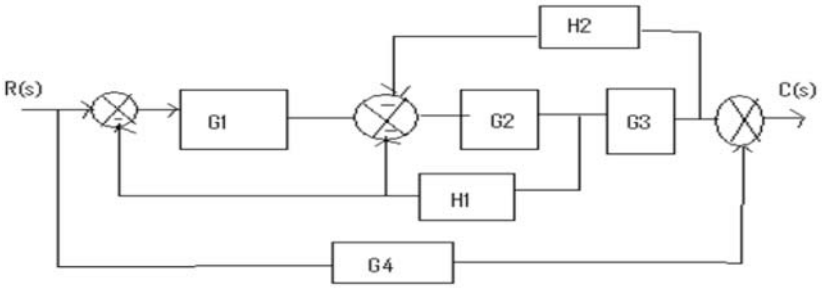
i. What is the compensator? What are the different types of compensator?

j. Explain the term- STATE, STATE VECTOR.

### SECTION B

**2. Attempt any *three* of the following: 10 x 3 = 30**

a. Using block diagram reduction techniques obtain C/R by reducing the block diagram shown below :

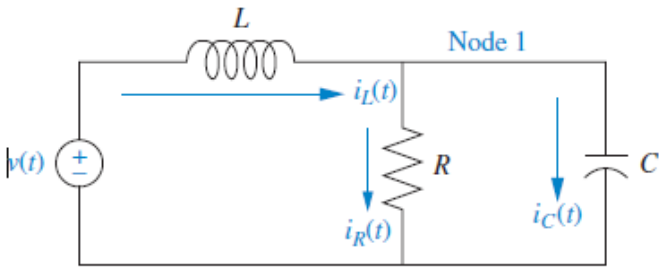



b. Discuss Proportional- Integral- Derivative (PID) controller with block diagram; also write their advantage & disadvantages.

c. Explain stability on the basis of location of poles, Determine value of K & α so that system oscillates at frequency of 2 rad/sec?
G(s)= K(s+1) / s^3 + α s^2 +2s +1 , H(s)=1

d. Draw Polar Plot of following G(s) H(s) = 10/s(s+1)(s+2) also find Gain Margin, Phase Margin.

e. For the given the electrical network , find out state-space representation ,if the output is the current through the resistor.



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## SECTION C

**3. Attempt any *one* part of the following: 10 x 1 = 10**

(a) Define the following SFG terminology by suitable example:
(a) Forward Path
(b) Loop
(c) Self loop
(d) Non-touching loops
(e) Source, Sink Node

(b) Explain the effect of negative feedback on –Parameter Variation, Disturbance

**4. Attempt any *one* part of the following: 10 x 1 = 10**

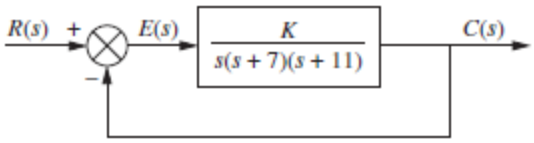
(a) Obtain the Unit-Step response of a unity-feedback 2nd order system for under damped response.

(b) The open loop transfer functions of unity feedback systems are given as
i. $G(s)=5/(s+2).(s+1)$ ii. $G(s)=2/s.(s+4).(s+6)$
Determine respectively the positional, velocity and acceleration error constants for these systems.

**5. Attempt any *one* part of the following: 10 x 1 = 10**

(a) Sketch the root locus of the system whose open loop transfer function is
$G(s)\,H(s) = K / s(s+2)(s^2+4s+13)$

(b) State and explain the Routh stability criterion. Find the range of gain, K, for the system of shown below that will cause the system to be stable, unstable, and marginally stable. Assume $K > 0$.




**6. Attempt any *one* part of the following: 10 x 1 = 10**

(a) Sketch Bode plot for the following transfer function and determine stability
$G(s)\,H(s) = (s+20) / (s+1)(s+7)(s+50)$

(b) Enlist various frequency domain specification terms, also Derive correlation between time and frequency domain specification.

**7. Attempt any *one* part of the following: 10 x 1 = 10**

(a) What do you mean by Controllability & Observiability explain in detail. also check whether following system is controllable.

$$\dot{\mathbf{x}} = \mathbf{A}\mathbf{x} + \mathbf{B}u = \begin{bmatrix} -1 & 1 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -2 \end{bmatrix} \mathbf{x} + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u$$

(b) Design a lag-lead compensator for the plant, $G(s)=k/s(s+5)(s+10)$
meet the following requirements: (1) a maximum of 20% overshoot, (2) a peak time of no more than 0.5 seconds, (3) a static error constant of no less than 6.