

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Fifth Semester B.Tech Degree (S,FE) Examination January 2022 (2015 Scheme)

**Course Code: EE303****Course Name: LINEAR CONTROL SYSTEMS*****Instructions: Graph sheets and semi log sheets are to be provided***

Max. Marks: 100

Duration: 3 Hours

**PART A*****Answer all questions, each carries 5 marks.***

Marks

- |   |   |     |
|---|---|-----|
| 1 | What are the principles which a system to be satisfied to become linear?  | (5) |
| 2 | Explain the working of synchro. How is a synchro useful as error detector?  | (5) |
| 3 | Given open loop system $G(s)H(s) = \frac{s+1}{(s+4)}$ . Find the generalised error series for the given input $r(t)=t$ .            | (5) |
| 4 | With the addition of a zero to an existing transfer function, what is the effect on root locus and stability? Explain with example. | (5) |
| 5 | Using rough sketch illustrate the relation between type of a system and polar plot.   | (5) |
| 6 | Given open loop transfer function $G(s) = \frac{1}{s}$ in unity feedback, analyse using rough sketch the bode plot of the system.   | (5) |
| 7 | What are the advantages of frequency response analysis? Any three   | (5) |
| 8 | Explain Nyquist Stability Criterion. What are it applications.  | (5) |

**PART B*****Answer any two full questions, each carries 10 marks.***

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|----|--|------|
| 9  | The closed loop transfer function of a system is given by $\frac{C(s)}{R(s)} = \frac{16}{s^2 + 1.6s + 16}$ , find the rise time, peak time, maximum overshoot and settling time of the system                  | (10) |
| 10 | a) Derive the transfer function of an RC series circuit with input voltage $V_i(s)$ and output voltage $V_o(s)$ be the voltage across capacitor. Also represent the system using Block diagram representation. | (4)  |
|    | b) Find the overall transfer function of the system shown in Fig.1 using Mason's gain formula.   | (6)  |

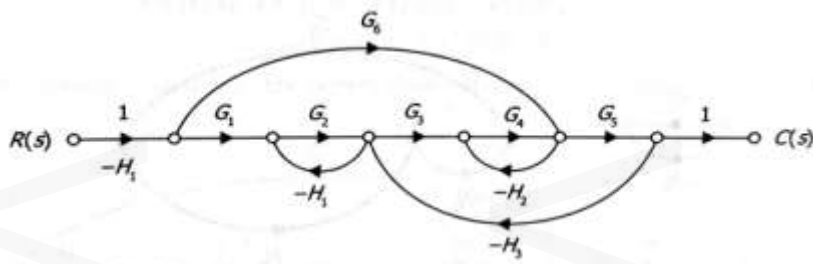


Fig.1

- 11 a) Derive the step response of a first order system for a unit step input. Draw the input and output response of the same. (5)
- b) Obtain the electrical analogous of the mechanical system shown in Fig.2 using Force current analogy. Here  $T$  is the input torque,  $\Omega_1$  and  $\Omega_2$  are angular velocities at  $J_1$  and  $J_2$ . (5)

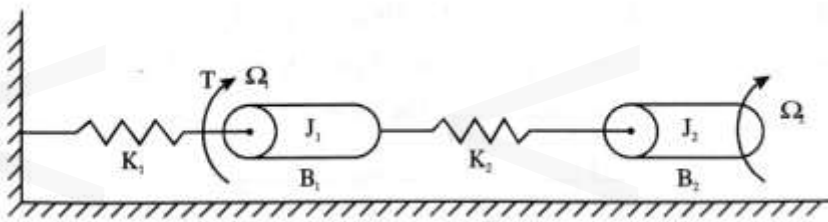


Fig.2

**PART C**

*Answer any two full questions, each carries 10 marks.*

- 12 Sketch the root locus of the open loop system  $G(s)H(s) = \frac{K}{s(s+2)(s+3)}$ , (10)  
determine the marginal value of  $K$  for stability. Also mark this value of  $K$  on the root locus plot.
- 13 a) Find the stability of a system having characteristic equation (5)  
 $s^6 + 2s^5 + 7s^4 + 10s^3 + 14s^2 + 8s + 8 = 0$
- b) Check whether the point  $s = -1$  lies on the root locus of the open loop system (5)  
 $G(s)H(s) = \frac{K}{s(s+2)(s+3)}$  using angle condition.
- 14 a) Determine the position, velocity, acceleration error coefficients for the unity (6)

feedback system whose open loop transfer function is given by

$$G(s) = \frac{K}{s(s^2 + 2\zeta\omega_n s + \omega_n^2)}$$

- b) Illustrate the time response of a second order system according to the nature of roots of the characteristic equation. (4)

### PART D

*Answer any two full questions, each carries 10 marks.*

- 15 a) Define the resonant frequency, resonant peak, bandwidth, phase margin and gain margin of a control system (5)
- b) Draw the polar plot of the open loop system  $G(s) = \frac{1}{s(s+1)}$  and analyse the closed loop stability. Here rough sketch is sufficient. (5)
- 16 The open loop transfer function of unity feedback system is (10)
- $$G(s) = \frac{30}{s(0.5s+1)(0.08s+1)}$$
- . Draw the bode plot and hence determine the stability of closed loop system.
- 17 Given open loop system  $G(s) = \frac{1}{s(s+1)}$ , analyse the closed loop stability using Nyquist stability criterion. (10)

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