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 carries5 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.

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)

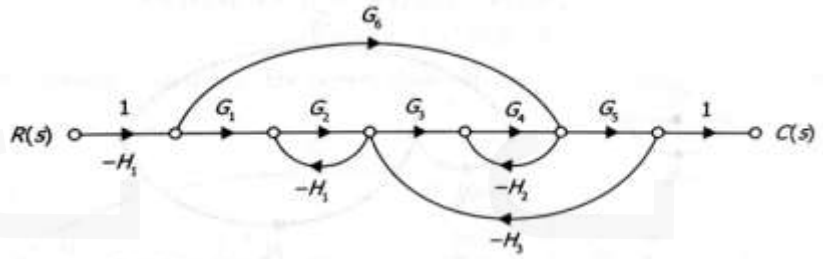

Fig.1

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,Ω_1 and Ω_2 are angular velocities at J_1 and J_2. (5)

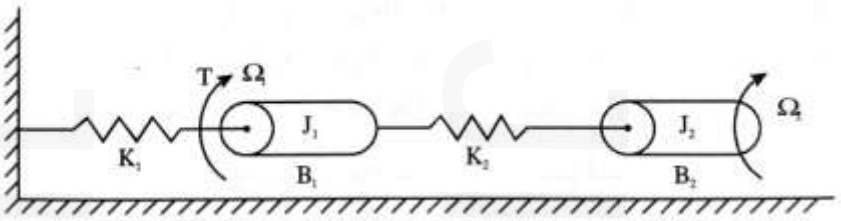

Fig.2

PART C

Answer any two full questions, each carries 10 marks.

12 Sketch the root locus of the open loop system $G(s)H(s) = \frac{K}{s(s+2)(s+3)}$, determine the marginal value of K for stability. Also mark this value of K on the root locus plot. (10)

13 a) Find the stability of a system having characteristic equation $s^6 + 2s^5 + 7s^4 + 10s^3 + 14s^2 + 8s + 8 = 0$ (5)

b) Check whether the point $s = -1$ lies on the root locus of the open loop system $G(s)H(s) = \frac{K}{s(s+2)(s+3)}$ using angle condition. (5)

14 a) Determine the position , velocity, acceleration error coefficients for the unity (6)

feedback system whose open loop transfer function is given by $G(s) = \frac{K}{s(s^2+2\xi\omega_n s+{\omega_n}^2)}$

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 $G(s) = \frac{30}{s(0.5s+1)(0.08s+1)}$. Draw the bode plot and hence determine the stability of closed loop system. (10)

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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