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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh Semester B.Tech Degree (S, FE) Examination January 2023 (2015 Scheme)

Course Code: EC409

Course Name: CONTROL SYSTEMS

Max. Marks: 100 Duration: 3 Hours

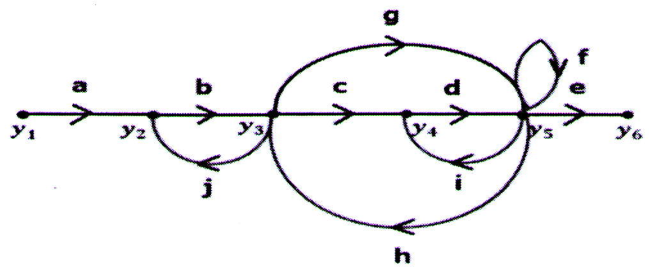
Note: Provide normal and semi log graph sheets

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) What are the general requirements of a control system. (2.5)

b) Explain Masons gain formula and find the overall transfer function of the SFG given below .Mark the input node, output node, mixed nodes (10)



c) List out the limitations of Transfer function approach (2.5)

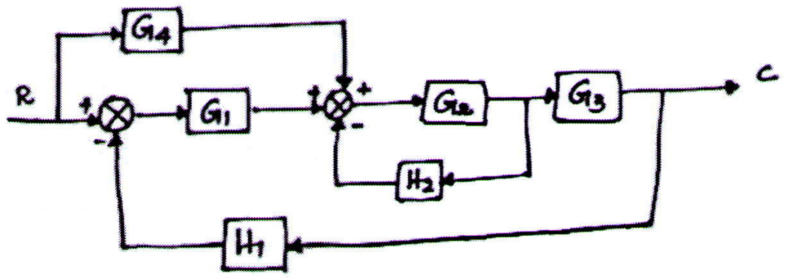
2 a) The open loop transfer function of a system is given by $G(s)=\frac{10(s+2)(s+3)}{s(s+1)(s+4)(s+5)}$ (7)

Determine all the error constants and steady state error when subjected to an input $r(t)= 3 + 2t + t^2$

b) Obtain the time response of a 2^{nd} order under damped system subjected to a step input and mark all its time domain specifications (8)

3 a) Differentiate between type and order of a system and how it relates to stability of a system with example (5)

b) Find the overall transfer function using block reduction rule (10)



PART B

Answer any two full questions, each carries 15 marks.

4 a) The characteristic equation of the system is given by $s^5 + 6s^4 + 15s^3 + 30s^2 + 44s + 24 = 0$. Investigate stability using R H criteria and comment on the location of roots (5)

b) Plot the **Root Locus** of the system whose open loop transfer function and comment on the stability of the system (10)

$$G(s) = \frac{k}{s(s+5)(s^2+4s+20)}$$

5 a Draw the Bode plot of the open loop transfer function given and find frequency domain specifications and comment on the stability (10)

$$G(s)\,H(s) = \frac{30}{s(1+0.5s)(1+0.08s)}$$

b) Comment on the stability using Nyquist stability criteria and plot for the given $G(s) = \frac{(s+2)}{(s+1)(s-1)}$ (5)

6 a) Compare P PI & PID controllers (9)

b) Differentiate between Minimum phase and non minimum phase system with an example (6)

PART C

Answer any two full questions, each carries 20 marks.

7 a) List out the advantages of state space technique (4)

b) A system described by the following differential equation. Represent it in state space model in phase variable form (8)

$$\frac{d^3x}{dt^3} + 3\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 4x = u_1(t) + 3u_2(t) + 8u_3(t)$$

Output equations are

$$y_1 = 4\frac{dx}{dt} + 3u_1(t)$$

$$y_2 = 4\frac{d^2x}{dt^2} + 4u_2(t) + u_3(t)$$

c) List out the properties of State transition matrix. Find Ø(t), given $A = \begin{matrix} -1 & 1 \\ 0 & 4 \end{matrix}$ by using Laplace transform method (8)

8 a) A discrete time system is represented by the difference equation (4)

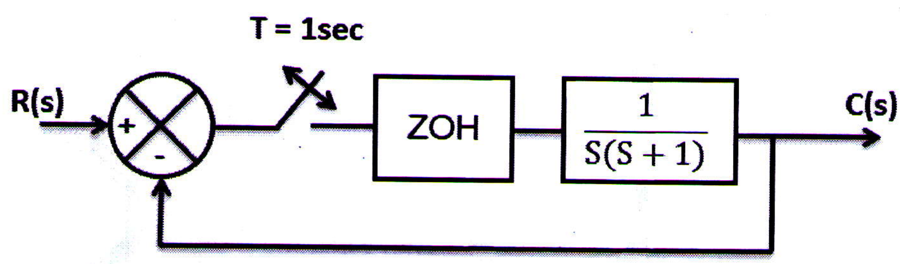
$$y(k+3) + 4y(k+2) + 3y(k+1) + 5y(k) = u(k+1) + u(k)$$

Find the transfer function $\frac{Y(z)}{U(z)}$ of the system.

b) Explain Jurys stability test on discrete control systems. Check the stability (8)

$F(z) = z^4 - 1.7z^3 + 1.05z^2 - 0.268z + 0.025$

c) Obtain the pulse transfer function of the system shown below (8)



9 a) Explain Kalmans Test and Gilbert test for observability of a system. Test the observability of the system using Kalmans test. (12)

Given

$$A = \begin{matrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{matrix} \; ; \; B = \begin{matrix} 0 \\ 0 \\ 1 \end{matrix} \; ; C = 3 \quad 5 \quad 2$$

b) Explain open loop and closed loop sampled control systems with schematic. (8)

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