

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: EE303

Course Name: LINEAR CONTROL SYSTEMS

Max. Marks: 100

Duration: 3 Hours

(Graph sheets and semi-log graph sheets will be provided)

PART A

Answer all questions, each carries 5 marks

Marks

- | | | |
|---|---|-----|
| 1 | Give a comparison between open loop and closed loop control systems. Give an example for each. | (5) |
| 2 | Explain the working of an AC Tachogenerator with a schematic diagram. | (5) |
| 3 | For a closed loop system with $G(s) = 1/(s+5)$ and $H(s) = 5$, calculate the generalized error coefficients. | (5) |
| 4 | What is a root locus? What are the information obtained from a root locus? | (5) |
| 5 | Derive an expression for resonant frequency and resonant peak of a second order system. | (5) |
| 6 | Explain Gain margin and Phase margin. | (5) |
| 7 | State and explain Nyquist stability criterion. | (5) |
| 8 | Write notes on the following: | (5) |
| | i) Non-minimum phase systems ii) Transportation lag. | |

PART B

Answer any two full questions, each carries 10 marks

- | | | |
|----|---|------|
| 9 | Derive the transfer function of an armature-controlled dc motor driving a load consisting of inertia and friction. Also draw the block diagram. | (10) |
| 10 | a) Sketch the unit step response of an under damped second order system and mark various time domain specifications. (3) | (3) |
| | b) Obtain the closed loop transfer function $C(s)/R(s)$ using Mason's gain formula for a system whose signal flow graph is shown in Fig.1. (7) | (7) |

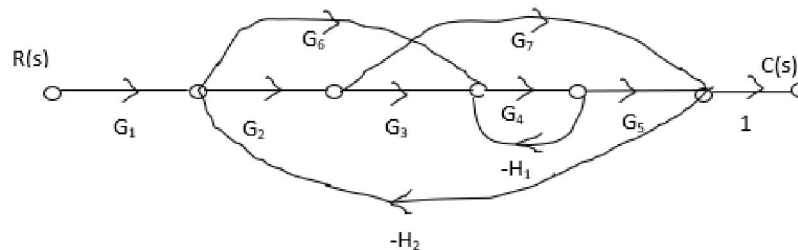


Fig.1

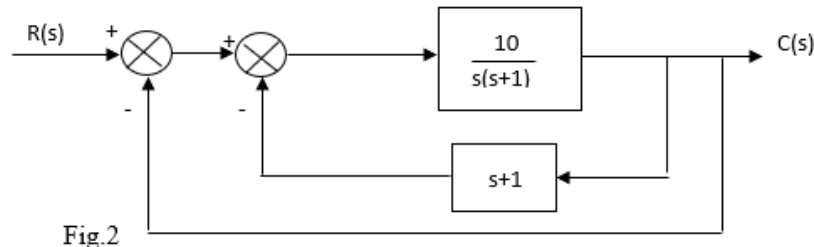
- | | | |
|----|---|-----|
| 11 | a) Derive an expression for peak time and settling time of an under damped second order system. (7) | (7) |
| | b) A unity feedback control system is characterized by an open loop transfer function (3) | (3) |

$G(s) = \frac{K}{s(s+10)}$. Determine the gain K so that the system will have a damping ratio of 0.5

PART C

Answer any two full questions, each carries 10 marks

- 12 a) For the system shown in Fig.2, find the static error coefficients. Also find the steady state error for an input of $2u(t)$. (7)



- b) Explain the effect of adding a pole to a system on time response. (3)
- 13 Ascertain stability of the system whose characteristic equation is (10)
- $$s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0$$
- Also find the number of roots lying on the left half, right half and imaginary axis of the s-plane.
- 14 Sketch root locus for a system with (10)

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

Hence determine the range of K for the system stability.

PART D

Answer any two full questions, each carries 10 marks

- 15 Construct bode plot for the system whose open loop transfer function is (10)
- $$G(s)H(s) = \frac{4}{s(1 + 0.5s)(1 + 0.08s)}$$
- Determine the following:
- i) Gain margin ii) Phase margin iii) Closed loop stability
- 16 Sketch the polar plot of a unity feedback control system having an open loop transfer function (10)

$$G(s) = \frac{K}{s(1 + 0.5s)(1 + 4s)}$$

Also determine the value of K so that:

- i) Gain margin is 20dB ii) Phase margin is 30°

- 17 Draw Nyquist plot for the system whose open loop transfer function is (10)
- $$G(s)H(s) = \frac{K}{s(s+2)(s+10)}$$

Determine the range of K for which the closed loop system is stable
