

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION(S), DECEMBER 2019

Course Code: EE304

Course Name: ADVANCED CONTROL THEORY

Max. Marks: 100

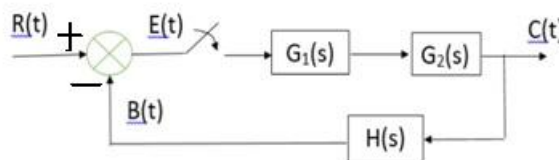
Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks.

Marks

- | | | |
|---|--|-----|
| 1 | Obtain the transfer function of a lead compensator with the help of an electrical network. | (5) |
| 2 | Derive the transfer function of a PID Controller | (5) |
| 3 | Derive a relation between state equation and transfer function for LTI system. | (5) |
| 4 | Obtain the pulse transfer function for the system shown below. | (5) |



- | | | |
|---|---|-----|
| 5 | With a neat diagram explain how the describing function analysis is used to determine the stability of a system? | (5) |
| 6 | What are jump response and limit cycles in connection with nonlinear systems? | (5) |
| 7 | Explain with neat diagram, what is phase trajectory and phase portrait? | (5) |
| 8 | Define positive definite and positive semi definite functions according to Liapunov stability criteria, with suitable examples. | (5) |

PART B

Answer any two full questions, each carries 10 marks.

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|----|--|------|
| 9 | a) Draw the bode-plot of lag compensator and obtain an expression for maximum phase lag and corresponding frequency. | (6) |
| | b) Explain turning of PID controller using Ziegler-Nichols tuning method. | (4) |
| 10 | Explain the procedure for design of a lag Compensator using Bode Plot with suitable example | (10) |
| 11 | Consider a unity feedback system with open loop transfer function | (10) |

$$G(s) = \frac{k}{s(s+8)}$$

Design a lead compensator to meet the following specification:

1. Percentage peak overshoot is 9.5%
2. Natural frequency of oscillations 12 rad/sec
3. Velocity error constant ≥ 10

PART C

Answer any two full questions, each carries 10 marks.

- 12 a) A system is described by $\dot{x}(t) = \begin{bmatrix} 0 & 1 \\ -4 & -4 \end{bmatrix} x(t)$ (5)

Determine state transition matrix for the system.

- b) Define controllability. Explain with a suitable example, how can we check the controllability of a system? (5)

- 13 Derive the state model of the following transfer function in, (10)

(i) Controllable canonical form

(ii) Diagonal canonical form

$$\frac{y(s)}{u(s)} = \frac{5(s+2)}{s(s+1)(s+3)}$$

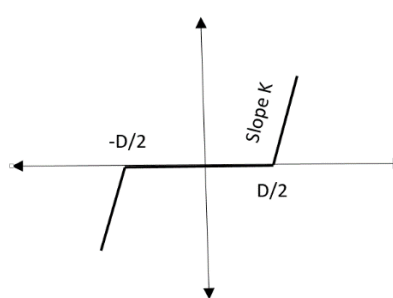
- 14 Examine the stability of the system with the following characteristic equation (10) using Jury's stability test.

$$z^4 - 1.2z^3 + 0.07z^2 + 0.3z - 0.08 = 0$$

PART D

Answer any two full questions, each carries 10 marks.

- 15 Identify the following non linearity and derive a describing function for the same (10)



- 16 Consider the following non linear differential equation. (10)

$$\ddot{y} - \left(0.1 - \frac{10}{3} \dot{y}^2\right) \dot{y} + y + y^2 = 0$$

Find all singular points of the system, classify them and sketch the phase portrait in the neighbourhood of singular points.

- 17 a) Discuss any three non linearities present in nature. (6)

- b) Investigate the stability of the following non-linear system using Liapunov direct method (4)

$$\dot{x}_1 = x_2$$

$$\dot{x}_2 = -x_1 - x_1^2 x_2.$$
