Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (R,S) / S6 (PT) / (WP) Exam April 2025 (2019 Scheme)

Course Code: EET302

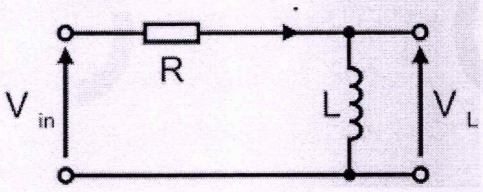
Course Name: LINEAR CONTROL SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks. Marks

1 Define transfer function and find the transfer function of the given RL network. (3)



2 Give the characteristics of a lead compensator. (3)

3 Draw the unit step response of a first order system. (3)

4 A unity feedback system has an open loop transfer function $G(s)H(s) = \frac{s+2}{s(s+1)((s+10)}$. Determine the static error coefficients and steady state errors. (3)

5 Explain magnitude and angle criterion referred to root locus? (3)

6 Explain the effect of adding poles and zeros on root locus. (3)

7 Write the advantages of frequency response analysis. (3)

8 Define the phase cross over frequency and gain cross over frequency of a system. (3)

9 State the advantages of Nyquist Plot. (3)

10 Explain the need for compensation in control system. (3)

PART B

Answer one full question from each module, each carries 14 marks.

Module I

11 a) Determine the transfer function of a lead-lag compensator using RC circuit components. List the characteristics of the lead-lag compensators. (8)

b) Explain the working of an AC Servomotor with a schematic diagram. (6)

OR

12 a) Derive the transfer function of a field controlled DC motor and represent the system in block diagram form. (8)

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b) Explain the working of a synchro. (6)

Module II

13 a) Derive the expression for rise time and settling time of an under damped second order system. (8)

b) Determine the damping ratio, damped frequency of oscillation, rise time, peak time, peak overshoot and settling time for the system having closed loop transfer function $\frac{C(s)}{R(s)} = \frac{25}{s^2+6s+25}$. (6)

OR

14 a) The forward path transfer function of a unity feedback control system is given by $G(s) = \frac{4s+1}{4s^2}$. Determine the unit step response of the system. (8)

b) Using Routh's stability criterion determine the stability of the given system whose characteristic equation is $s^6+2s^5+8s^4+15s^3+20s^2+16s+16=0$. (6)

Module III

15 a) Determine the value of K for which the system with an open loop transfer function $G(s) = \frac{K}{s(s+1)(s+5)}$ exhibit a step response with damping ratio 0.707 using Root locus plot. (10)

b) Explain PI and PD controllers, with suitable block diagrams. (4)

OR

16 a) Consider a unity feedback system with an open loop transfer function, $G(s) = \frac{K}{s(s+2)(s+8)}$. Design a suitable compensator to meet the following specifications. (10)

(i) Percentage Peak overshoot = 16% for unit step input.

(ii) Steady state error ≤ 0.125 for unit ramp input.

b) Explain the PID controllers and its functions in any closed loop control system. (4)

Module IV

17 a) Sketch Bode Plot for the system with an open loop transfer function $G(s)H(s) = \frac{1}{s(1+0.02s)(1+0.04s)}$. From Bode plot, determine gain margin and phase margin and assess the stability of the system. (10)

b) Define resonant frequency, resonant peak, bandwidth and cut off rate for a standard second order system. (4)

OR

18 a) Sketch Polar Plot for the given open loop transfer function $G(s)H(s) = \frac{10(s+2)}{s(s+1)(s+3)}$ and determine the gain margin and phase margin (10)

b) Define gain margin and phase margin. (4)

Module V

19 Investigate the closed loop stability for the system having an open loop transfer function $G(s)H(s) = \frac{1+4s}{s^2(1+s)(1+2s)}$, using Nyquist stability criterion. (14)

OR

20 A unity feedback system has an open loop transfer function $G(s) = \frac{K}{s(1+2s)}$ (14)

Design a suitable lag compensator so that phase margin is 40^0 and the steady state error for ramp input is less than or equal to 0.2.

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