Roll No. .....

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306403

May 2019

B.Tech. IV Semester

CONTROL SYSTEM ENGINEERING

(EI-401)

Time : 3 Hours]

[Max. Marks : 75

Instructions :

(i) It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.

(ii) Answer any four questions from Part-B in detail.

(iii) Different sub-parts of a question are to be attempted adjacent to each other.

PART–A

1. (a) Define an optimal control problem.

   (b) Write Mason's Gain Formula ? Describe each notation used in it.

   (c) Define BIBO stability of a control system.

   (d) Differentiate between ORDER & TYPE of a control system.

   (e) Define State Transition Matrix. Write down its properties.

(f) Write the transfer fn. of a lead compensator and draw its Bode plot.

(g) Define Gain Margin and Phase Margin. What should be their values for a stable system?

(h) What is the effect of adding a PI controller to the response of system.

(i) For a unity feedback system, the open loop transfer fn. $G(s) = \frac{10}{s(0.1s+1)}$. Find steady state error constants.

(j) Name the various non-linearities present in a control system. (1.5×10=15)

PART–B

2. (a) A second order servo has unity feedback and an open loop transfer function :

$$G(s) = \frac{500}{s(s+15)}.$$

Draw a block diagram for the closed loop system. Obtain the characterstic eq^{n}., % maximum overshoot and time for maximum overshoot. 8

(b) For the system represented by the following equations, find the transfer fn. X(S)/U(S) by signal flow graph technique. $x = x_1 + bu$, $\frac{dx_1}{dt} = -a_1x_1 + x_2 + b_2u$,

$\frac{dx_2}{dt} = -a_2x_1 + b_1u$. 7

3. (a) State and Explain the rules of construction of root loci of $G(s)H(s)$. 8

(b) Determine the stability of the system represented by the following characteristic eq^n :

$s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0.$ 7

4. Write short notes on :

(a) PID Control.

(b) Stability of Control System. (7.5×2=15)

5. (a) Construct the state model for a system characterized by the diff. eq^n. :

$$\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 6y = u.$$ 7

(b) Define Polar plot. Explain all the steps of sketching a polar plot in detail. 8

6. (a) Define compensation. Derive the expression for the maximum phase lead provided by lead compensator. 7

(b) Sketch Bode Plot for the transfer fn. and find its gain margin and phase margin

$$G(s) = \frac{60}{s(s+2)(s+6)}.$$