R13

Code: 13A02402

B.Tech II Year II Semester (R13) Regular & Supplementary Examinations May/June 2016

CONTROL SYSTEMS ENGINEERING

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) In Torque-Voltage analogy, what are the analogous electrical quantities for: (i) Torque. (ii) Moment of Inertia. (iii) Angular displacement. (iv) Stiffness.

(b) Illustrate the following rule in block diagram algebra: Moving a take-off point from the input node to the output node of a block having the transfer function G(s).

(c) Sketch the unit step response of a first-order system and show how 'Time Constant' is defined?

(d) What are the most important advantageous features of: (i) Integral control? (ii) Derivative control?

(e) What is the condition to be satisfied by the real part of the poles of a system for the system to be stable?

(f) The open loop transfer function of a system is given by $\frac{4\,(s+4)(s+6)}{s\,(s+8)(s+12)}$. What portions of the real axis contain the branches of the root locus?

(g) Draw the Bode plots for Phase Lead Compensator.

(h) Define: (i) Gain Margin. (ii) Phase Margin with reference to Bode Plots.

(i) Enumerate any four important advantages of state space approach over transfer function approach.

(j) If A, B, and C are the Matrices in the state space model of a system, how is the equivalent transfer function of the system evaluated using A, B and C? Deduce the relation.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 (a) Compare and contrast 'open loop control systems' and 'closed loop control systems'.

(b) What are the various ways of classifying control systems? Discuss in detail the effects of feedback on system performance.

OR

3 (a) Write Mason's gain formula and explain the meaning of all the terms in the formula.

(b) Draw the circuit diagram of armature-controlled D.C Motor. Derive its transfer function.

UNIT – II

4 (a) Define position error constant K_p. Find the steady state error of Type 0, Type 1, and Type 2 systems to unit step input

(b) The open loop transfer function of a unity feedback control system is given by $G(s) = \frac{K}{s(s+1)(s+2)}$. Find the minimum value of K for which the steady state error is less than 0.1 for unit ramp input.

OR

5 (a) What are the important time domain specifications for transient response? Explain.

(b) Obtain the expression for the unit step response $c(t)$ of a unity feedback system whose open loop transfer function is $G(s) = \frac{4}{s(s+5)}$.

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UNIT – III

6 (a) Determine the stability of the system having the characteristic equation given below:

$$s^3 + 4s^2 + 6s + 4 = 0$$

(b) A certain unity negative feedback system has the open loop transfer function $G(s) = \frac{K(s+1)}{s(s-1)(s+6)}$. Find the value of K which makes the closed loop system lose stability. What are the locations of unstable poles in the s-plane for this value of K.

OR

7 (a) State and explain the rules for construction of root loci, which are concerned with: (i) Angle of asymptotes. (ii) Breakaway point on real axis.

(b) Consider the loop transfer function $G(s)H(s) = \frac{K(s+2)}{(s^2+2s+2)}$. Construct the root locus and comment on stability.

UNIT – IV

8 (a) Define and explain various frequency domain specifications with relevant expressions.

(b) Construct the Bode plots for the transfer function $G(s)H(s) = \frac{30}{s(1+0.5s)(1+0.08s)}$. There from, determine the gain margin and phase margin. Is the closed loop system stable?

OR

9 (a) State and explain the Nyquist Criterion.

(b) Sketch the Nyquist plot for $G(s)H(s) = \frac{e^{-Ts}}{(s+p)}, p > 0$.

UNIT – V

10 Determine the: (i) State Transition Matrix. (ii) State response. (iii) Unit step response of the system having the following state model.

$$\dot{X} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u, \quad X(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix};$$

$$Y = \begin{bmatrix} 1 & 0 \end{bmatrix} X$$

OR

11 (a) Compare and contrast classical approach and modern approach used for control system analysis and design.

(b) Derive the solution of:

(i) Homogeneous state equation.

(ii) Non homogeneous state equation.

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