

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)

- 1 Answer the following: (10 X 02 = 20 Marks)
- In Torque-Voltage analogy, what are the analogous electrical quantities for: (i) Torque. (ii) Moment of Inertia. (iii) Angular displacement. (iv) Stiffness.
 - 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 $G(s)$.
 - Sketch the unit step response of a first-order system and show how 'Time Constant' is defined?
 - What are the most important advantageous features of: (i) Integral control? (ii) Derivative control?
 - What is the condition to be satisfied by the real part of the poles of a system for the system to be stable?
 - 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?
 - Draw the Bode plots for Phase Lead Compensator.
 - Define: (i) Gain Margin. (ii) Phase Margin with reference to Bode Plots.
 - Enumerate any four important advantages of state space approach over transfer function approach.
 - 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 $G(s) = \frac{4}{s(s+5)}$.

Contd. in page 2

Code: 13A02402

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.

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

$$Y = [1 \quad 0]X$$

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.
