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Question Paper Code : 51451

B.E./B. Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Fourth Semester

Electronics and Communication Engineering

EC 2255/EC 46/EE 1256 A/080290023/10144 EC 406 – CONTROL SYSTEMS

(Regulations 2008/2010)

(Common to 10144 EC 406 – Control Systems for B.E. (Part-time) Third Semester ECE – Regulations 2010)

Time : Three Hours

Maximum : 100 Marks

(Provide Graph Sheet, Semilog sheet)

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Draw the equivalent block diagrams for the figures 1 and 2 given below :

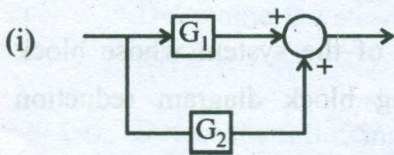


Figure-1

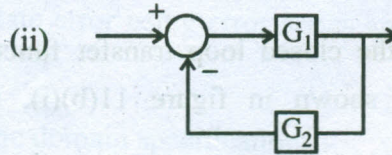


Figure-2

- List any two properties of signal flow graph.
- Define steady state error.
- Write the expression for the transfer function of PI Controller.
- Define phase margin.
- What is the use of M and N circles ?
- State Routh-Hurwitz stability criterion.

8. List any two advantages of Nyquist stability criterion.
9. Define observability.
10. State sampling theorem.

PART – B (5 × 16 = 80 Marks)

11. (a) (i) A certain system is described by the differential equation, $\frac{d^2y}{dt^2} + 14 \frac{dy}{dt} + 40y = 5$. Find the expression for $y(t)$, assuming initial conditions to be zero. (8)

- (ii) Find the transfer function of the electric circuit shown in figure 11(a) (ii). (8)

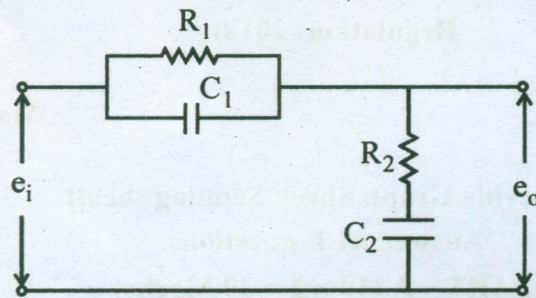


Figure-11(a) (ii)

OR

- (b) (i) Determine the closed loop transfer function of the system whose block diagram is shown in figure 11(b)(i), using block diagram reduction technique. (8)

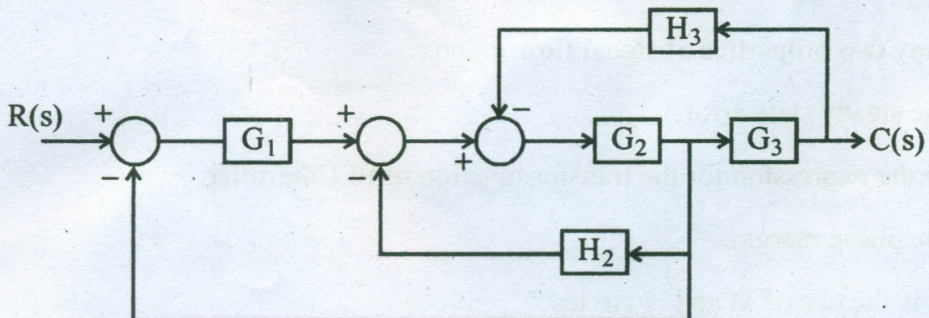


Figure-11(b) (i)

- (ii) Determine the closed loop transfer function of the system whose signal flow graph is shown in figure 11(b) (ii), using Maron's gain formula. (8)

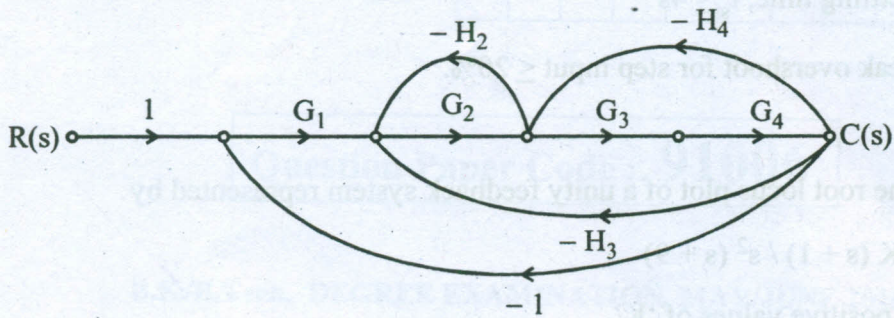


Figure-11(b) (ii)

12. (a) Derive expressions for the following, for a second order, under damped unity feedback system when excited by a unit step input.

(1) Output response $c(t)$

(2) Peak time (t_p)

(3) Rise time (t_r)

(10 + 3 + 3)

OR

- (b) (i) The open loop transfer function of a unity feedback system is given by

$$G(s) = 40/(s(0.2s + 1))$$

Determine the steady state error using error series approach for the input,

$$r(t) = 3t + 4t^2$$

(10)

- (ii) Define the following time domain specifications :

(a) Peak time (b) Rise time (c) Peak overshoot

(2 + 2 + 2)

13. (a) (i) List any four frequency domain specifications. (4)

- (ii) Draw the bode magnitude and phase plot for the unity feedback system

with $G(s) = \frac{40}{s(1 + 0.1s)}$ and hence determine phase margin and gain margin.

(6 + 6)

OR

(b) A unity feedback, type-2 system has a open loop transfer function, $G(s) = K/s^2$. Design a lead compensator to meet the following specifications :

(i) Settling time, $t_s \leq 4s$

(ii) Peak overshoot for step input $\leq 20\%$. (16)

14. (a) Draw the root locus plot of a unity feedback system represented by

$$G(s) = K(s + 1) / s^2(s + 9)$$

For the positive values of 'K'. (16)

OR

(b) For the feedback system whose open loop transfer function is ,

$G(s)H(s) = K/s(s + 3)(s + 5)$, investigate the stability of the system for various values of 'K' using Nyquist stability criteria. (16)

15. (a) (i) List any four advantages of state space representation of a system. (4)

(ii) For the state variable representation given below, determine the transfer function of the system.

$$\dot{X} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -40 & -44 & -14 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} U$$

$$Y = [0 \ 1 \ 0] X \quad (12)$$

OR

(b) (i) Obtain the state equation and output equation of a system described by the

differential equation $\frac{d^2y}{dt^2} + 5\frac{dy}{dt} + 4y = u$. (4)

(ii) A control system represented in state space form has the following data :

$$[A] = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix}; B = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}; C = [3 \ 4 \ 1]$$

Examine its observability. (12)