Reg. No.

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**

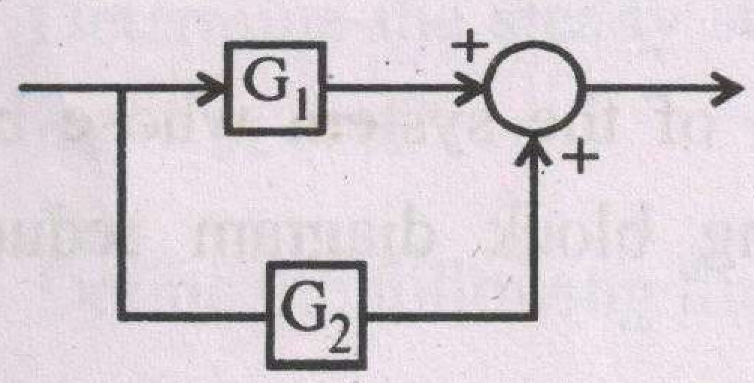
(Provide Graph Sheet, Semilog sheet)

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

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

(i)



(ii)

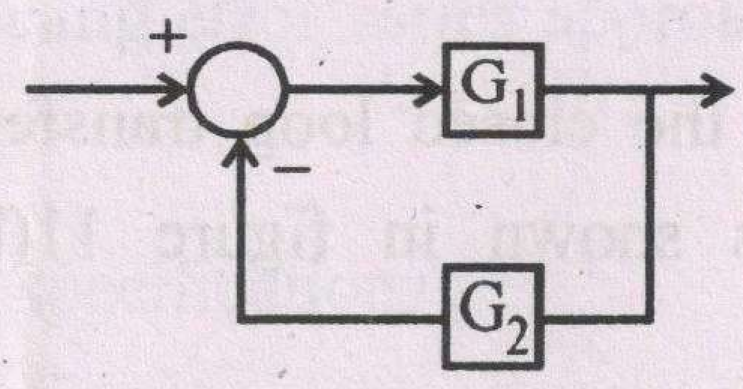


Figure-1 **Figure-2**

2. List any two properties of signal flow graph.

3. Define steady state error.

4. Write the expression for the transfer function of PI Controller.

5. Define phase margin.

6. What is the use of M and N circles ?

7. 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)**

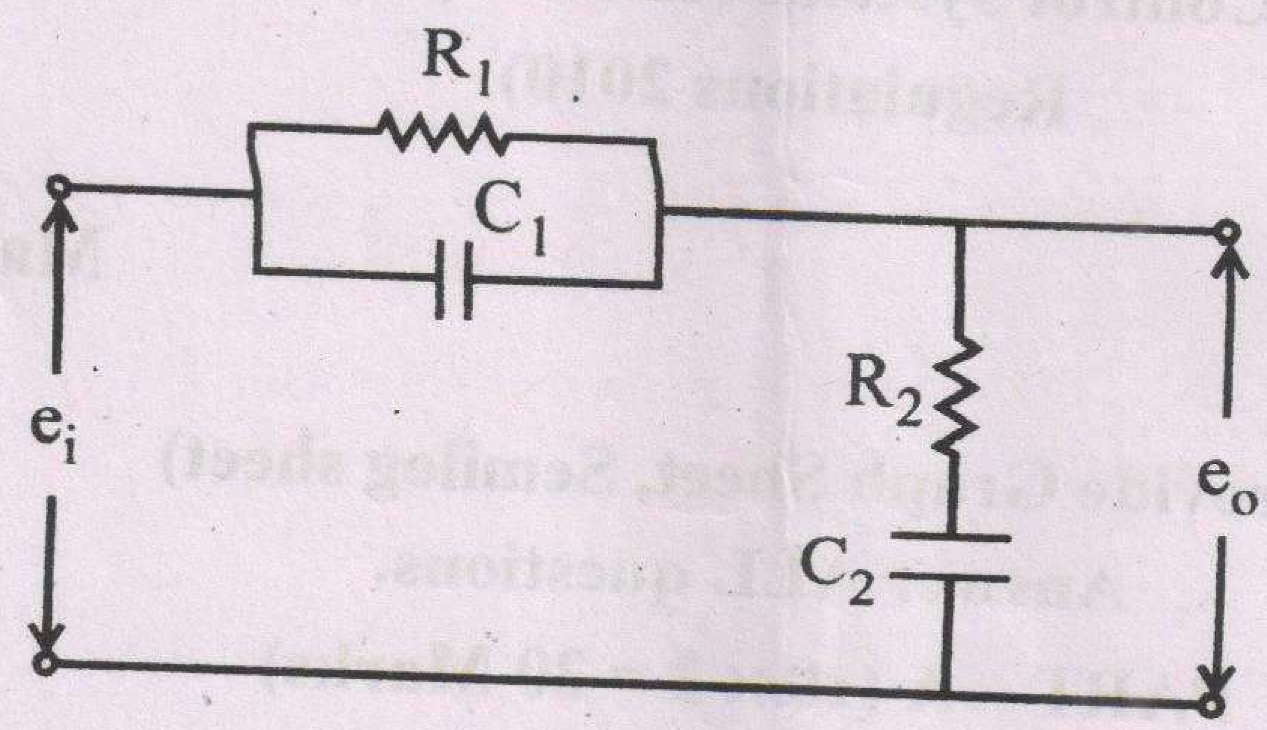


Figure-11(a) (ii)

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)**

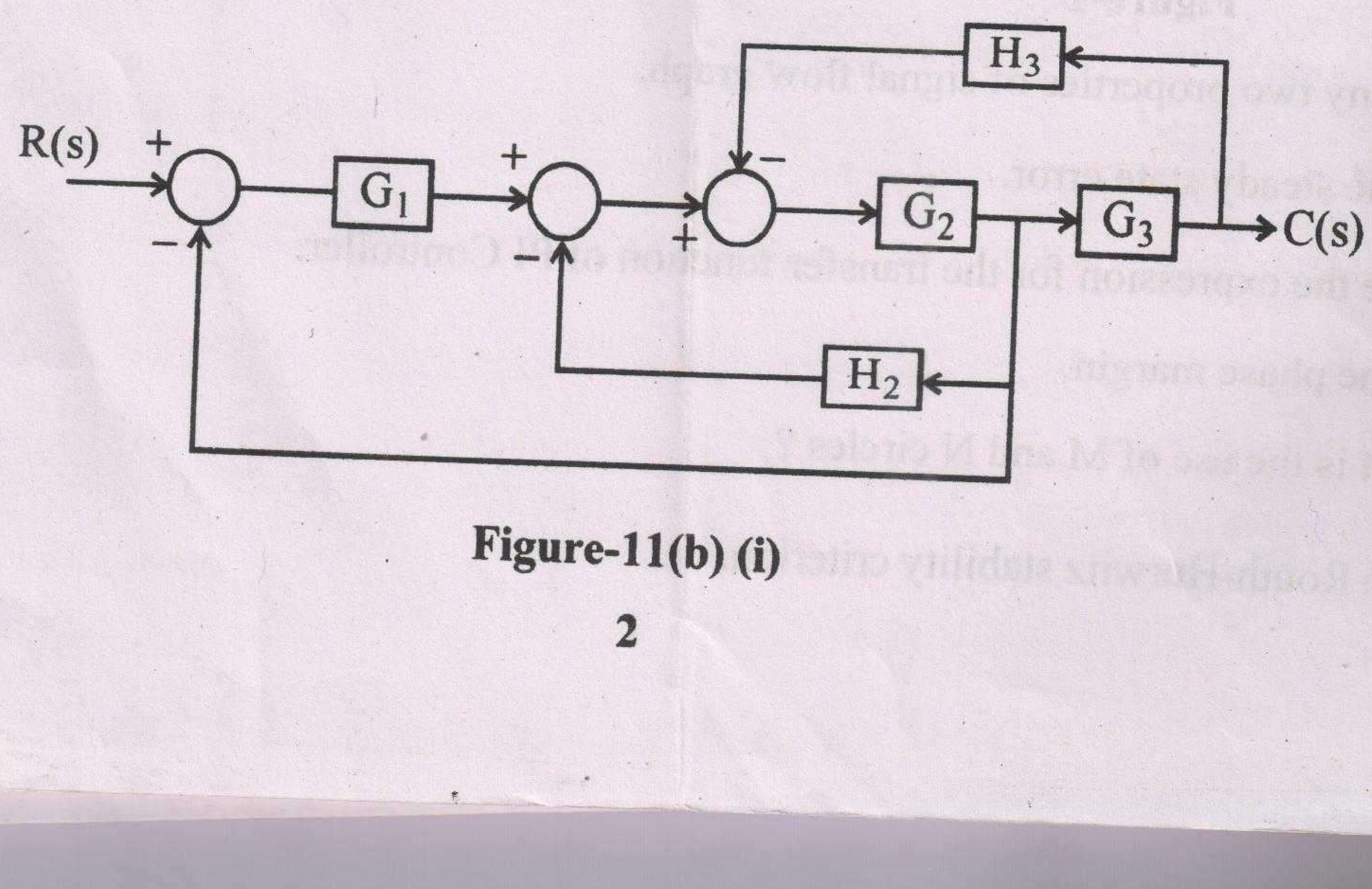


Figure-11(b) (i)

(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)**

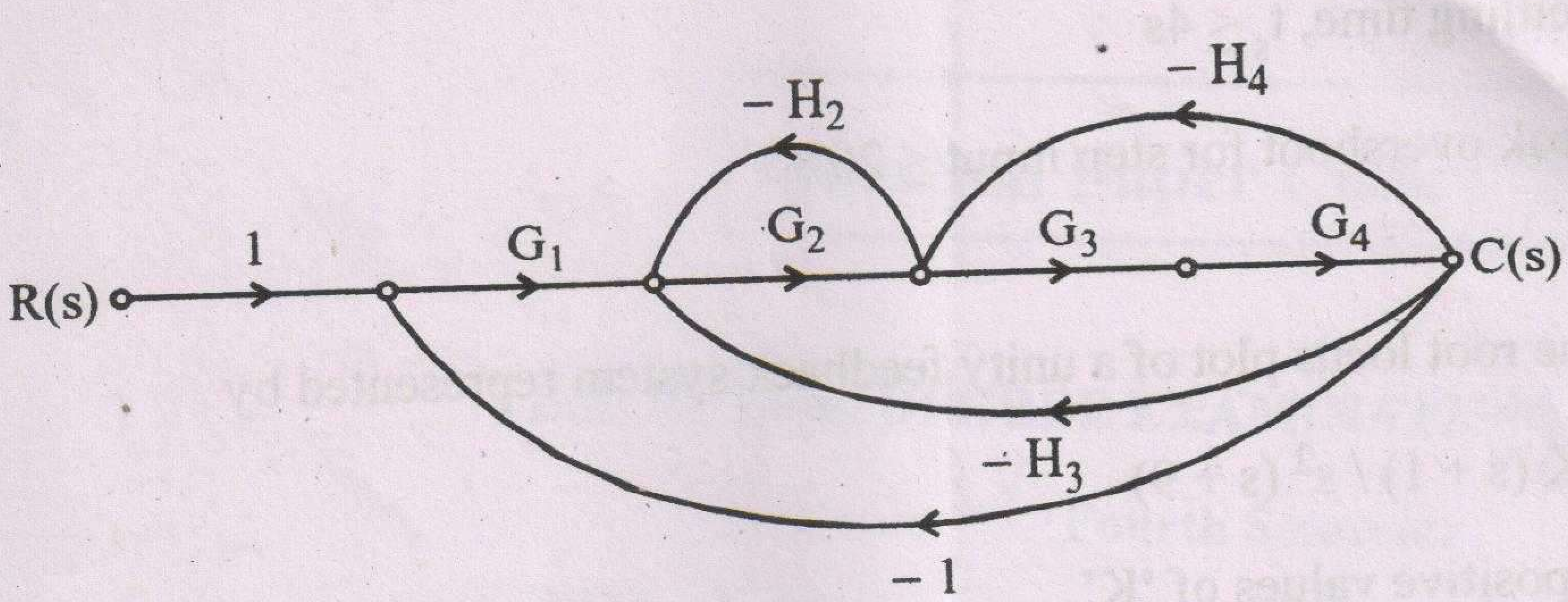


Figure-11(b) (ii)

(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)**

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

(ii) Draw the bode magnitude and phase plot for the unity feedback system with $G(s) = \dfrac{40}{s(1 + 0.1s)}$ 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.

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

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

(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)