



Reg. No. : .....

Name : .....

**First Semester M.Tech. Degree Examination, March 2014  
(2013 Scheme)**

**Branch : Electrical and Electronics Engineering  
Streams Control Systems, Power Control and Drives, Guidance and  
Navigational Control, Electrical Machines, Power System Control,  
Industrial Instrumentation and Control  
ECC 1003 : DYNAMICS OF LINEAR SYSTEMS**

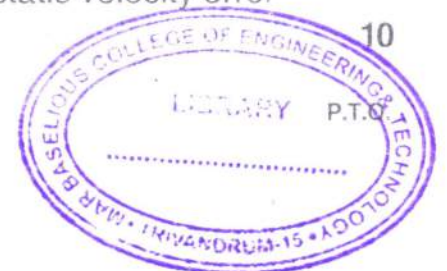
Time : 3 Hours

Max. Marks : 60

**Instructions :** 1) Answer **any two** full questions from **each** Module.  
2) **Each** full question carry **10** marks.

**MODULE – 1**

1. a) Realize an analog lag compensator using operational amplifiers. 3
- b) Design a suitable compensator for a unity feedback system  $\frac{k}{s(s+1)(s+5)}$  such that it meets the following specifications.  $W_n = 3.5$  rad/sec,  $\delta = 0.45$ ,  $k_v > 30$  s<sup>-1</sup>. 7
2. a) Give the design steps for the lead compensation design using frequency response. 3
- b) Design a suitable compensator for a unity feedback system  $\frac{10}{s(s+1)}$  such that the closed loop system will satisfy the requirements  $k_v = 20$  s<sup>-1</sup>, phase margin = 50° and gain margin  $\geq 10$  dB. 7
3. Consider a unity feedback control system whose feed forward transfer function is given by  $G(s) = \frac{10}{s(s+2)(s+8)}$ . Design a compensator such that the dominant closed loop poles are located at  $s = -2 \pm j2\sqrt{3}$  and the static velocity error constant  $k_v$  is equal to 80 sec<sup>-1</sup>. 10





## MODULE – 2

4. a) How can the effect of constant disturbance vector be eliminated using Integral error feedback ? 3
- b) Obtain the controllable sub realization of the system represented by
- $$\dot{x} = \begin{bmatrix} -2 & 1 \\ 1 & -2 \end{bmatrix} x + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$
- 7
5. Given a unity feedback system with an open loop transfer function  $H(s) = \frac{1}{s(s-2)}$ . Design a cascade compensator so that the overall transfer function has the form  $H_0(s) = \frac{\beta(s)}{(s+1)^2}$ , where  $\deg \beta(s) \leq 2$ . 10
6. a) Obtain the Bass-Gura formula for the state feedback gain. 5
- b) Explain the difference between :
- Controllability and Reachability.
  - Stabilizability and Detectability. 5

## MODULE – 3

7. Consider the system defined by

$$\dot{x} = Ax + Bu$$

$$y = Cx$$

$$\text{where } A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -5 & -6 & 0 \end{bmatrix} \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \quad C = [1 \ 0 \ 0].$$

Design a full order observer, assuming that the desired poles for the observer are located at  $s = -10$ ,  $s = -10$ ,  $s = -15$ . 10

8. Explain the procedure to obtain the controllable companion and observable companion form for a MIMO system. 10
9. a) Obtain the transfer function of a combined observer – controller compensator. 5
- b) Explain in detail the separation property of the observer – controller design procedure. 5