Reg. No.										

प्रज्ञानं ब्रह्म Manipal INSPIRED BY LIFE

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

I SEMESTER M.TECH (EMAL / PESC) MAKE UP EXAMINATIONS,

DEC 2015 / JAN 2016

SUBJECT: CONTROL SYSTEM DESIGN [ELE 501]

REVISED CREDIT SYSTEM

Time: 3 Hours   03 JANUARY 2016   MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitably assumed.
- Use of MATLAB software is allowed

1. For the digital control system shown in Fig.1 design a lead compensator $D(z)$ to satisfy the following specifications. $K_V = 10$, $PM = 48^\circ$, $GM \geq 10dB$. Assume that the sampling period $T = 0.1\text{sec}$

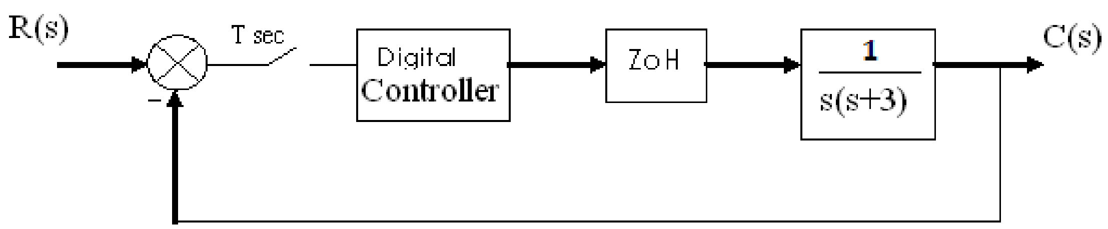

Fig.1 (10)

2. i) Design a state feedback controller for the system represented in state space cascade form $\dot{x} = \begin{bmatrix} -7 & 1 & 0 \\ 0 & -8 & 1 \\ 0 & 0 & -9 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$; $y = [-1 \;\; 1 \;\; 0]\,\underline{x}$, to yield 20% OS and settling time of 2 seconds ii) Obtain state space model of the system with controller and verify the design specifications iv) design an observer which is 5times faster than the control loop v) draw the state diagram of the system with controller and observer. (10)

3A. For the system shown in Fig.Q3A, the describing function is $N = k + \frac{4u}{\pi X}$, predict the range of K (linear system) for which limit cycle exist iii) determine the amplitude and frequency of the limit cycle for K=10. Also specify whether it is stable or unstable limit cycle. Why? (08)

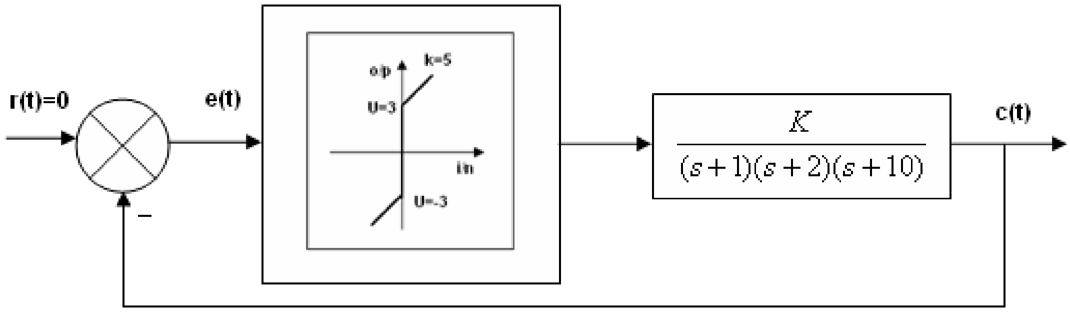

Fig.Q3A

3B. Explain limit cycle of Non-linear systems (02)

4A. Explain any one practical control system highlighting the significance of controllers for energy management applications. (05)

4B. For the system shown in Fig.4B, obtain $c^*(t)$ when unit step input is applied to the system

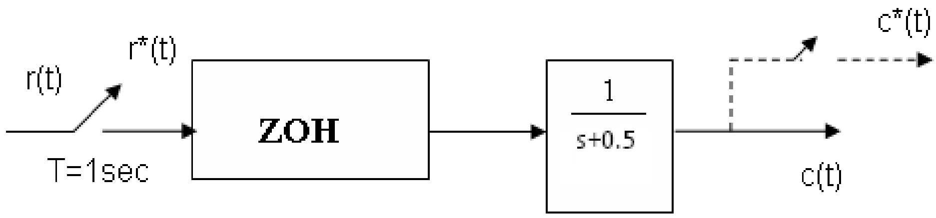

Fig.4B (05)

5. Design lag-lead compensator for the unity feedback system with feed forward transfer function $G(s) = \dfrac{K}{s(s+5)(s+11)}$ to satisfy the following specifications. The system operates with a damping ratio of 0.5, reduce the peak time by a factor of 2 and reduce the % overshoot by a factor of 2 and to improve the steady state error by a factor of 8. (10)

6A. For the unity feedback system with $G(s) = \dfrac{K}{(s+1)(s+2)(s+4)}$, design a PID controller to yield a peak time of 1.047 sec and a damping ratio of 0.6, with zero error for a step input. Also design a stable controller using Zeigler – Nichols tuning method. (08)

6B. State and explain asymptotic Stability. (02)