B.E./B.Tech (Full Time) ARREAR EXAMINATIONS, Nov/Dec 2012
VIII Semester
Electrical and Electronics Engineering
EE 9048 – ADVANCED CONTROL SYSTEM

Time: Three hours **Max: 100 marks**

Answer ALL Questions

PART-A **(10 x2 = 20 Marks)**

1. With reference to time domain response of a system, explain the parameters percentage overshoot and peak time?
2. Explain how the parameters of PID are determined from process reaction curve using Zeigler-Nichols method?
3. State the advantages of state space design.
4. Explain how integral control helps in robust tracking with the help of state model of system.
5. Explain the fundamental concepts associated with functional and function in optimal control theory.
6. Briefly discuss the stability issues of linear time-invariant regulator.
7. How can the effect of quantization in an A/D converter be studied? Explain.
8. Give two advantages for selecting a digital processor rather than analog circuitry to implement a controller.
9. Draw a flow chart describing the system identification procedure.
10. State the properties of least square estimation.

PART-B **(5 x 16 = 80 Marks)**

11.(a) With suitable assumption, obtain the closed-loop, unconstrained, optimal control for the system

$$\dot{x}_1(t) = x_2(t)$$

$$\dot{x}_2(t) = -2x_1(t) - 3x_2(t) + u(t)$$

and the performace index

$$J = \int_0^{\infty} [x_1^2(t) + x_2^2(t) + u^2(t)]dt$$

12.(a) Given a unity feedback system where $G(s)=K/[s(s+1)(s+4)]$, design a passive lag-lead compensator using Bode diagrams to yield a 13.25% overshoot, a peak time of 2 seconds and $K_v = 12$.

(OR)

12(b) Given a unity feedback system where $G(s)=K(s+8)/[(s+3)(s+6)(s+10)]$, design a PID controller so that the system can operate with a peak time that is two-thirds that of the uncompensated system at 20% overshoot and with zero steady-state error for a step input.

13(a) Consider a simple pendulum with frequency ω_0 and a state-space description given by

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -\omega_0^2 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

Find the control law using state feedback to place the closed-loop poles of the system at the desired location in order to double the natural frequency and increase the damping ratio from 0 to 1. Also compute the estimator gain matrix that will place both the estimator error poles at $-10\omega_0$.

(OR)

13(b) Explain the step by step procedure for designing the Full order and Reduced order estimator.

14(a) Consider a closed loop system with controlled process, digital controller and zoh. The transfer function of the controlled process of the system is given as $G(s)=5/[(s^2+s+10)]$. The sampling period is 0.5 s. Design a Digital PID controller to satisfy the following performance requirements:

i. Ramp-error constant $K_v=10$

ii. Maximum overshoot ≤ 15 %

(OR)

14(b) A unity feedback system has an open loop transfer function given by $G(s)=250/s[(s/10)+1]$. The following lag compensator added in series with the plant yields a phase margin of 50 degrees:
$D(s)= [(s/1.25)+1]/(50s+1)$. Using the matched pole-zero approximation, determine an equivalent digital realization of this compensator.

15(a) Describe in detail the various non-parametric methods of system identification.

(OR)

15(b) Write notes on Least Squares Estimation algorithm and Maximum Likelihood estimation methods.