Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.TECH(EE)/SEM-1/MCI-101/2012-13

2012

ADVANCED CONTROL SYSTEMS

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* questions. 5 × 14 = 70

1. a) Define *Z*-transfer function.

   b) Compute the response of the system $y(n) = 0 \cdot 7y(n-1) - 0 \cdot 12y(n-2) + x(n-1) + x(n-2)$ to input $x(n) = nu(n)$. Also identify whether the system is stable or not. 2 + (10 + 2)

2. a) Find out the *Z*-transform and ROC of the signal

   i) $x(n) = na^n u(n)$

   ii) $x(n) = \cos(\omega_0 n)u(n)$.

   b) Determine the inverse *Z*-transform of

   $$X(z) = \frac{1}{1 - 1 \cdot 5z^{-1} + 0 \cdot 5z^{-2}}$$ if

   i) $ROC : |z| > 1$

   ii) $ROC : |z| < 0 \cdot 5$. 6 + 8

3. a) Write down the output waveform showing idealized characteristics of non-linearity having dead-zone and saturation with sinusoidal input. Hence find the corresponding describing function. Find also the describing function with saturation non-linearity.

   b) Discuss the stability conditions with describing function. 10 + 4

4. a) Explain the following systems with suitable examples :

      i) Causal and non-causal

      ii) Linear and non-linear.

   b) Describe the stability conditions in its simplest form by Liapunov's method. 8 + 6

5. a) Define state, state variables and state vector.

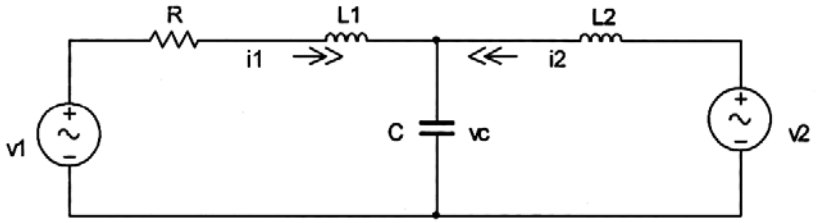
   b) A system is described by the following differential equation. Represent the system in state space.

$$\frac{d^3x}{dt^3} + 3\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 4x = u_1(t) + 3u_2(t) + 4u_3(t)$$

   And the outputs are $y_1 = 4\frac{dx}{dt} + 3u_1$, $y_2 = \frac{d^2x}{dt^2} + 4u_2 + u_3$.

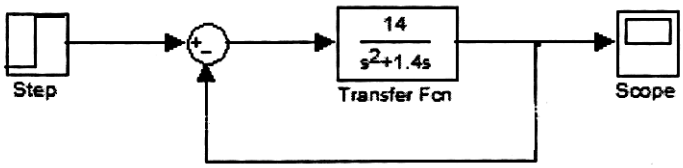
   6 + 8

6. Develop a state model for the electrical network shown in the figure below.



   Find out an expression of i_1 and verify the same using any network theorem.

7. A closed loop control system with unity feedback is shown in figure below. By using derivative control the damping ratio is to be made 0·7. Determine the value of T_d, also determine the rise time, peak time and maximum overshoot without derivative control and with derivative control. The input to the system is unit step.



8. Write short notes on any *two* of the following : 2 × 7

   a) PID

   b) PI

   c) PD.

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