



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.TECH/ECE(NEW)/SEM-5/EC-503/2012-13**

**2012**

### **CONTROL SYSTEM**

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.*

#### **GROUP – A**

#### **( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any *ten* of the following :

10 × 1 = 10

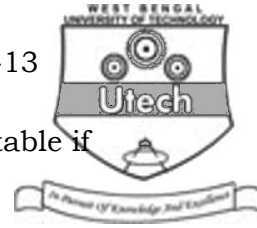
- i) A system is stable
  - a) if bounded inputs produce bounded outputs
  - b) if bounded inputs produce unbounded outputs
  - c) if bounded inputs produce unbounded outputs
  - d) if all bounded inputs produce bounded outputs.
- ii) The characteristics of a second order system is  $S^2 + 6s + 25 = 0$ , the system is
 

a) Underdamped	b) Overdamped
c) Undamped	d) Critically Damped.

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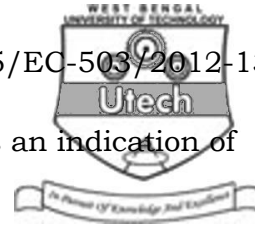
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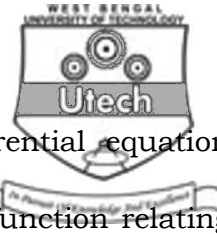
- iii) In terms of Bode Plot, the system is stable if
- a) PM = GM
  - b) PM & GM both are positive
  - c) PM & GM both are negative
  - d) PM negative but GM positive.
- iv) The response of control system, having damping factor as unity will be
- a) Oscillatory
  - b) Underdamped
  - c) Critically damped
  - d) none of these.
- v) A second order control system with  $\xi = 0$  is always
- a) marginally stable
  - b) stable
  - c) unstable
  - d) none of these.
- vi) The Routh Hurwitz criterion gives
- a) Relative stability
  - b) Absolute stability
  - c) Gain margin
  - d) Phase margin.
- vii) For a stable system
- a) the gain crossover occurs before phase crossover
  - b) the gain crossover occurs after phase crossover
  - c) the gain crossover and phase crossover frequencies are very close to each other
  - d) the gain cross and phase crossover frequencies are same.

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- viii) The initial slope of the Bode Plot gives an indication of
- a) type of the system
  - b) nature of the system time response
  - c) system stability
  - d) gain margin.
- ix) If the root locus branches cross the imaginary axis, the system becomes
- a) Overdamped
  - b) Underdamped
  - c) Oscillatory
  - d) Sustained oscillation.
- x) The transfer function of a system is defined as
- a) the ratio of Laplace transform of output to Laplace transform of input considering initial conditions as zero
  - b) the ratio of output to input
  - c) both (a) and (b)
  - d) none of these.

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xi) A system is represented by the differential equation

$$M \frac{d^2x}{dt^2} + F \frac{dx}{dt} + Kx = u(t). \text{ The transfer function relating}$$

$X(s)$  and  $U(s)$  is

- a)  $\frac{M}{(Ms^2 + Fs + K)}$       b)  $\frac{M}{(Fs^2 + Ms + K)}$
- c)  $\frac{1}{(Ms^2 + Fs + K)}$       d)  $\frac{1}{(Fs^2 + Ms + K)}$

xii) Area under a unit impulse function is

- a) infinity      b) unity
- c) zero      d) none of these.

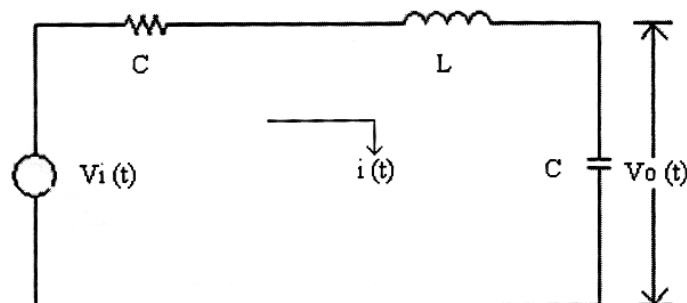
### GROUP – B

#### ( Short Answer Type Questions )

Answer any *three* of the following

$3 \times 5 = 15$

2. What are 'Analogous system' ? Explain 'Force-Voltage analogy' and 'Force-Current analogy' in brief. 1 + 4
3. Obtain the Transfer function of the given electrical system. The symbols have their usual meaning.



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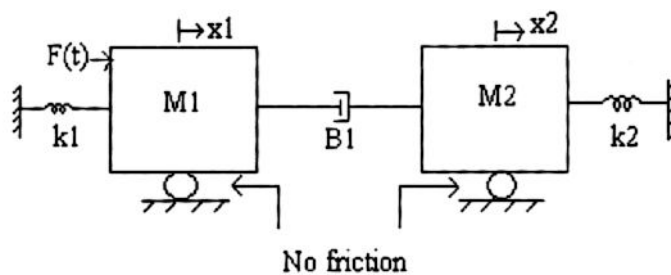
4. What do you mean by the term 'Transmittance' ? Differentiate between 'Self Loop' and 'Closed Loop'. Write down 'Mason's gain' formula and explain the meaning of each and every term. 1 + 2 + 2
5. What do you mean by 'Transient response' and 'Steady State response' of a system ? Obtain an expression for 'Unit impulse response' of first order system. 2 + 3
6. What is 'Damping ratio' ? Obtain an expression for 'Unit step response' of a second order system when the damping ratio is unity. 1 + 4

### GROUP – C

#### ( Long Answer Type Questions )

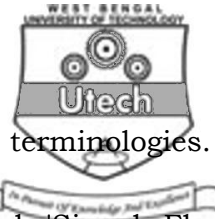
Answer any *three* of the following.  $3 \times 15 = 45$

7. a) Obtain the differential equation of the mechanical system.

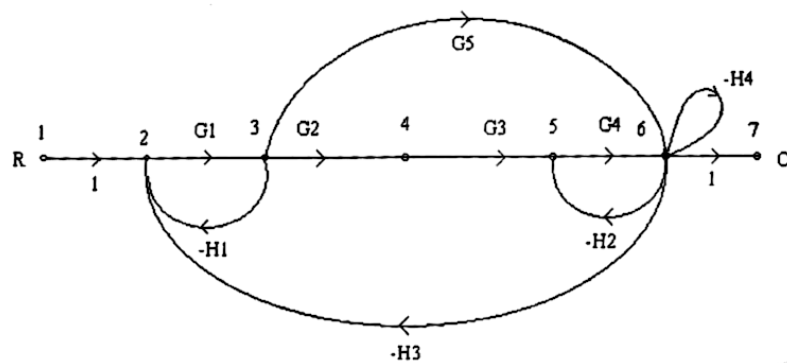


- b) Draw the Electrical analogous circuit based on 'force-current' analogy.  $7\frac{1}{2} + 7\frac{1}{2}$

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8. a) Explain the different 'Signal Flow Graph' terminologies.
- b) Compare between 'Block Diagram' and 'Signal Flow Graph' methods.
- c) For the given signal flow graph find the C/R ratio.



5 + 2 + 8

9. a) Write down the advantages and disadvantages of state space techniques.
- b) Obtain state transition matrix  $\phi(t)$  from non-homogeneous state equation of a linear time invariant control system and list the properties of it.
- c) Obtain the eigenvalues and eigenvectors for a

$$\text{system described by } \dot{X} = \begin{bmatrix} 0 & 6 & -5 \\ 1 & 0 & 2 \\ 3 & 2 & 4 \end{bmatrix} X + \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} U \text{ and}$$

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

3 + 6 + 6

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10. Write short notes on any *three* of the following :  $3 \times 5$

- a) PID Controller
- b) Type and Order of a system
- c) Analogous system
- d) Polar Plot
- e) Transient Response and Steady state response.

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