



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech(CSE/IT)/SEM-5/EE-503/2009-10**

**2009**

**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.*

*Graph paper(s) and Semi log paper(s) will be provided by the institution.*

**GROUP – A**

**( Multiple Choice Type Questions )**

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

10 × 1 = 10

i) Feedback control system is basically

- |                     |                      |
|---------------------|----------------------|
| a) high pass filter | b) band pass filter  |
| c) low pass filter  | d) band stop filter. |

ii)

**Dia.**

The value of  $x_3 / x_1$  is

- |       |       |
|-------|-------|
| a) 8  | b) 2  |
| c) 12 | d) 5. |



- iii) If the gain  $K$  of the system increases, the steady state error of the system
  - a) decreases
  - b) increases
  - c) may increase or decrease
  - d) remains unaltered.
- iv) If some pole of a system lies on the imaginary axis, the system is
  - a) absolutely stable      b) conditionally stable
  - c) marginally stable      d) unstable.
- v) The root locus of a system has four separate loci. The system can have
  - a) four poles or four zeros
  - b) four poles & four zeros
  - c) six poles & two zeros
  - d) two poles & two zeros.
- vi) A system has 14 poles & 2 zeros. The slope of its highest frequency asymptote in its magnitude plot is
  - a)  $-40$  dB/decade      b)  $-240$  dB/decade
  - c)  $-280$  dB/decade      d)  $-320$  dB/decade.
- vii) The disadvantage (s) of polar plot is ( are )
  - a) plot is cramped of high frequencies
  - b) the calculations are time consuming for exact plot
  - c) it is very difficult to calculate gain & phase margin
  - d) all of these.



viii) The number of points encircled by X & Y is

**Fig.**

- a) 2, 1                                      b) 1, 2
- c) 1, 1                                      d) 2, 2.
- ix) The proportional error device has output as function of
- a) derivative of error    b) integral of error
- c) error                                      d) none of these.
- x) The system response can be tested better with
- a) sinusoidal input signal
- b) ramp input signal
- c) unit impulse damping signal
- d) exponentially decaying signal.
- xi) The input-output relationship of a linear system is given by
- a)  $y = a_0 x^2 + a_1 x + a_0$
- b)  $y = a_1 x + a_0$
- c)  $y = a_1 x$
- d)  $y = a_0$ .



xii) Regenerative feedback means the output is feedback with

- a) positive sign                      b) negative sign
- c) step input                         d) oscillation.

### GROUP – B

#### ( Short Answer Type Questions )

Answer any *three* of the following.                       $3 \times 5 = 15$

2. Determine the transfer function of the system having the following graph.

#### Graph

3. Calculate the transfer function of the electrical network shown in the figure.

#### Fig.

4. A system has  $G(s) = \frac{20}{s^2 + 5s + 5}$  & unity feedback. Find

- i)  $W_n$                                       ii)  $\xi$
- iii)  $W_d$                                     iv)  $M_p$
- v)  $T_s$  .



5. A unity feedback system has

$$G(s) = \frac{180}{s(s+6)} \quad \& \quad r(t) = 4t.$$

Determine,

- i) the steady state error
  - ii) the value of  $k$  to reduce the error by 6%.
6. Find the stability of a system having characteristic equation  $s^6 + 2s^5 + 7s^4 + 10s^3 + 14s^2 + 8s + 8 = 0$ .

### GROUP – C

#### ( Long Answer Type Questions )

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

7. The open loop transfer function of an unity feedback system is given by  $G(s) = \frac{k}{s(1 + 0.02s)(1 + 0.04s)}$ .

Draw the Bode plot. Find gain margin & phase margin. Hence find the value of open loop gain so that the system has a phase margin of  $45^\circ$ .

8. The transfer function of an open loop control system is  $G(s) = \frac{k}{s(s^2 + 4s + 8)}$ .

- a) Sketch the root loci of the system on a graph paper, touching the following points :

- i) Number of the root loci



- ii) Number of asymptotes
  - ii) Angle of asymptotes & their real axis intercept.
  - iv) Angle of departure
  - v) Imaginary axis intercepts
  - vi) Real axis part of root locus.
- b) Find from your sketch, the value of gain  $k$  at which dominant pole will have a damping ratio,  $\xi = 0.5$ . Also find the corresponding transient frequency of oscillation.
9. By applying Nyquist criterion, state whether the closed loop system having the following open loop transfer function is stable or not.
- $$G(s)H(s) = \frac{s+3}{(s+1)(s-1)}$$
10. a) What is a polar plot ?
- b) Draw the polar plot of a first order system.
- c) What is the effect on the polar plot if a non-zero pole is added to the transfer function.
- d) What is Nichols chart ?
- e) What is the application of Nichols chart ?

3 + 5 + 2 + 3 + 2



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

- a) PID controller
- b) Lead-lag compensator
- c) AC tachometers
- d) Effect of adding poles & zeros to a second order linear system.

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