Seventh Semester B.Tech. Degree Examination, November 2013
(2008 Scheme)
08.701 : CONTROL SYSTEMS (E)

Time : 3 Hours
Max. Marks : 100

PART - A

Answer all questions.

1. With sketches, compare input-output configuration of open-loop and closed-loop control systems.

2. Define transfer function. What are the properties of systems whose responses can be defined by transfer function?

3. Explain the construction and operation of tachometer.

4. Describe various standard test signals commonly used in control system design. Give time-domain and s-domain representation of the signals.

5. The transfer function of a first order process is given by \( G(s) = \frac{K}{\tau S + 1} \). Find
   a) impulse response to an impulse of strength 'A'
   b) step response to a step of strength 'A'
   c) Response to a sinusoidal input \( A \sin \omega t \).

6. Show with examples that introduction of derivative mode of control in a feedback system with proportional control makes it less oscillatory. What is the effect on steady state accuracy?

7. Explain the effect of adding poles and zeros to a root locus plot.

8. Define the terms resonance peak '\( M_r \)' and band width '\( W_b \)' of closed-loop control system.

9. Roughly sketch the polar plot a system described by the transfer function
   \[
   G(s) = \frac{1}{(1 + S\tau_1)(1 + S\tau_2)}.
   \]

10. State Nyquist stability criterion.

(10x4 = 40 Marks)
PART – B

Answer **one** full question from **each** Module.

**MODULE – I**

11. a) Obtain the transfer function $\frac{X(s)}{F(s)}$ for the mechanical system and draw its electric analog.

![Mechanical System Diagram]

b) Derive the expression for transfer function of a field controlled dc servomotor. State clearly the assumptions made.

12. a) Block diagram of a typical system is shown below. Draw its equivalent signal flow graph and find the transfer function $\frac{Y}{R}$.

![Block Diagram]

b) Describe the construction and working of a two-phase motor suitable for use in a.c. servo systems. Draw the torque-speed characteristics and derive the transfer function model based on linearised characteristics.
13. a) The characteristic equation of a system is given by

\[ S^4 + 3S^3 + 3S^2 + 2S + K = 0 \]

Determine the range of values of K for which the system is stable.

b) Determine the values of M, B and K for the mechanical system shown from the response curve.

14. a) The open-loop transfer function of a control system with positive feedback is

\[ G(s) = \frac{K}{s^2 + 4s + 5} \]

Sketch the Root-locus of the system as a function of K (0 < K < \( \alpha \)).

b) A unity feedback control system has open-loop transfer function, \( G(s) = \frac{10}{s(s + 2)} \).

Find the rise time, \% overshoot, peak time, delay time and settling time for a step input of 12 units.
15. Sketch the Bode plot for the system having the transfer function

\[ G(s) = \frac{3}{s(1+0.05s)(1+0.2s)} , \quad H(s) = 1. \]

Determine:

1) Gain cross over frequency and corresponding phase margin.

2) Phase cross over frequency and corresponding gain-margin.

Comment on system stability.

16. Sketch the Nyquist plot and find the positive values of K for which the closed-loop operation is stable, for the system given by

\[ G(s) H(s) = \frac{K}{s(1+s)(2+s)} . \]