DEPARTMENT OF ELECTRICAL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

EXAMINATION: MAJOR (CONTROL SYSTEMS) DATE: 05TH July, 2013

SEMESTER: 4TH BRANCH: CSE

TIME ALLOWED: 2 hour (10:00 A.M. – 12:00 P.M.) Max. Marks: 50

Note: Attempt any four questions. Avoid unnecessary and irrelevant details.

Q. No. 1 a) A prototype second order system ($0 < \zeta < 1$) is subjected to a unit step input. Obtain an analytical expression for the response. Give a graphical interpretation.

b) The unit step response of a linear time-invariant system is $c(t) = 1 - e^{-2t}$. Obtain an expression for its ramp response. Plot the ramp response versus time. (8, 4.5)

Q. No. 2 a) Given a unity feedback system with

$$G(s) = K(s + 4)/s(s + 1)(s + 2)$$

Find the following:

i) The range of K that keeps the system stable

ii) The value of K that makes the system oscillate

iii) The frequency of oscillation when K is set to the value that makes the system oscillate

b) Under-damped second order systems have oscillatory transient response. Obtain an expression for their peak overshoot (M_p). Plot M_p versus ζ. (7, 5.5)

Q. No. 3 a) What are the advantages of frequency response analysis over time response analysis?

b) Derive an analytical expression for the frequency response of a linear time-invariant system.

c) Control systems should ideally have low-pass filter characteristics. Explain this statement.

(3, 6, 3.5)

Q. No. 4 a) Draw the Bode diagram for a unity-feedback system with forward path transfer function given as:

$$G(s) = 10(1 + \tfrac{s}{30})/s(1 + \tfrac{s}{10})(1 + \tfrac{s}{20})$$

Assess the closed loop stability from the Bode diagram.

b) Find analytical expressions for the magnitude and phase responses of

$$G(s) = \frac{1}{(s+2)(s+4)}$$

(8, 4.5)

Draw a polar plot of the frequency response.

Q. No. 5 a) State BIBO Stability criterion.

b) The transfer function of an LTI system is $G(s) = 1/s$. Find its step response. Comment upon the stability of this system.

c) Write down the important advantages of closed loop systems over open loop systems.

d) Distinguish between:

i. Regulator and Tracking Systems

ii. Static and Dynamic Systems

iii. Command Input and Reference Input

iv. Time-invariant and Time-varying systems

(2.5x3, 5)