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 < ζ < 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:

- 1) The range of K that keeps the system stable
- The value of K that makes the system oscillate
- 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
 - 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:

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

Assess the closed loop stability from the Bode diagram.

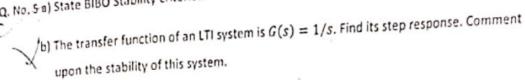
b) Find analytical expressions for the magnitude and phase responses of

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

Draw a polar plot of the frequency response.

(8, 4.5)

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



- 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)