Department of Electrical Engineering
National Institute of Technology Srinagar

Major Exam

Course: Control Systems
Course Code: ELE-407
Time: 3 Hour

Semester: B.Tech 4th (IT Deptt)
Maximum Marks: 60
Date: 03-07-2018

CO1: Introduction to continuous control systems open/closed loop, Automatic/manual.
CO2: Mathematical modeling transfer functions, block diagrams and signal flow graphs.
CO3: To determine the time response analysis of first and second order systems to various standard test inputs.
CO4: Stability studies of control systems, absolute and relative stability analysis.
CO5: Study of PID controllers, lead-lag Compensators, Modeling of dynamic systems in state space.

Attempt any four questions

Q1 a) Derive the time response of a standard critically damped second order control system for unit step input. **CO3 (8)**

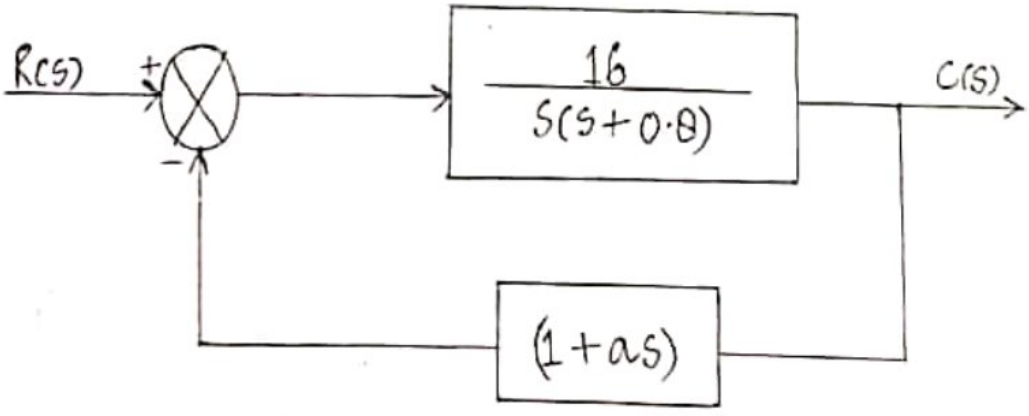
b) The open loop transfer function of a unity feedback system is given by

$$G(s) = \frac{108}{S^2(S+4)(S^2+3S+12)}$$

Find the static error coefficients and steady state error of the system when subjected to an input given by $r(t)=2+5t+2t^2$. **CO3 (7)**

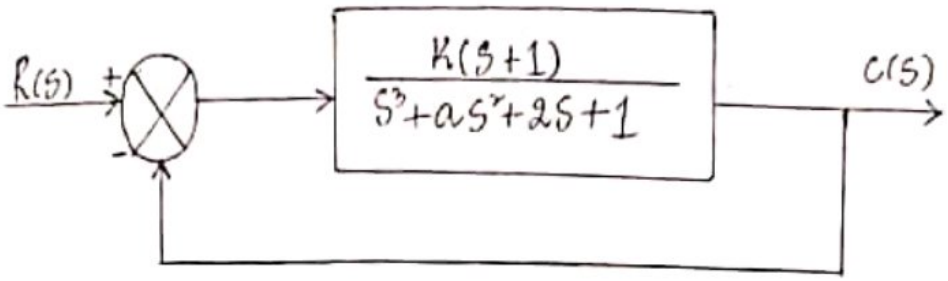
Q2 a) With respect to second order system define the following by drawing neat response curve and expressions:(i) Delay time (ii) Rise time (iii) Peak time (iv) Maximum overshoot and (v) Settling time. **CO3 (8)**

b) For the system shown in figure, find the value of 'a' such that the damping ratio is 0.5.Determine the rise time, peak time, maximum overshoot, and settling time, in the unit step response.



CO3 (7)

Q3 a) A system oscillates with frequency w, if it has poles at s=±jw, and no poles in the right half of s-plane. By applying the Routh Hurwitz Criteria determine the value of 'k' and 'a' so that the system shown, oscillates at a frequency of 2 radian/second. **CO4 (7)**



b) The open loop function of a system is given by:

$$G(s) = \frac{20(S+0.5)}{S(S+3)(S+1)}$$

Draw the polar plot. **CO4 (8)**

Q4 a) The forward transfer function of a unity feedback control system is given by:

$$G(s) = \frac{K}{S(S+6)(S^2+4S+13)}$$

Sketch the root locus as k varies from zero to infinity. **CO4 (10)**

b) Explain about the effects of P, I and PID control action on the performance of second order control system. **CO5 (5)**

Q5 a) Sketch the Nyquist plot for a unity feedback control system having given

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

And determine the stability condition. **CO4 (5)**

b) Write short notes on:
(i) Controllability and Observability
(ii) Lag-Lead compensator
(iii) State space model
(iv) Static error coefficients **CO5 (2.5×4)**