Dr. Nigam

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
TEST - 2 EXAMINATION –OCTOBER 2019
B.TECH III SEMESTER (ECE)

COURSE CODE: 18B11EC311 **MAX. MARKS: 25**
COURSE NAME: AUTOMATIC CONTROL SYSTEMS
COURSE CREDITS: 04 **MAX. TIME: 1 $\frac{1}{2}$ Hr.**

Note: All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means.

1(a). The student - teacher learning process is inherently a feedback process intended to reduce the system error to a minimum. With the aid of Fig.1(a), construct a feed-back model of the learning process and identify each block of the system. [CO-1] 1

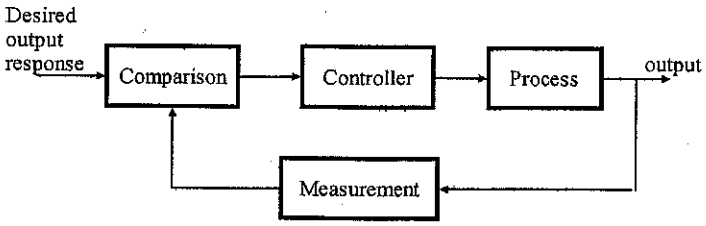

Fig 1(a)

(b). Apply Mason's gain formula to the signal flow graph of the canonical feedback system shown in Fig 1(b): [CO-1] 2

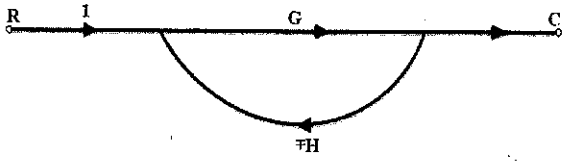

Fig 1(b)

(c). A closed-loop control system is subjected to a disturbance D(s) as shown in Fig 1(c). Show by the principle of superposition the effect on the output of the system. [CO-1] 2

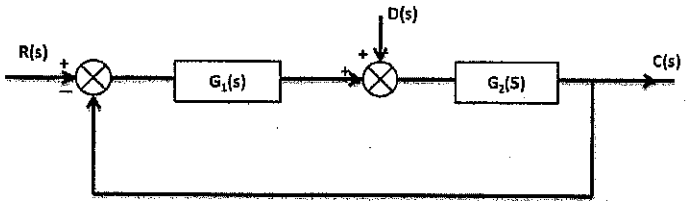

Fig 1(c)

2(a). Draw and explain the locus of equation $s^2 + 2\zeta\omega_n s + \omega_n^2 = 0$ when the damping ratio is varied from 0 to -∞ and 0 to ∞ and when ω_n is held constant. [CO-2] 2

(b). A unity negative feedback control system has the plant [CO-2] 2

$$G(s) = \frac{K}{s(s+\sqrt{2K})}$$

(i) Determine the percent overshoot and settling time (using a 2% settling criterion) due to a unit step input.
(ii) For what range of K is the settling time less than 1 second?

3(a). Explain quantitatively how the derivative control affects the damping ratio and steady state error of a second order unity feedback control system using using ramp input. [CO-3] 3

A unity feedback control system is shown in Fig 3(a). By using derivative control the damping ratio is to be made 0.8. Determine the value of T_d.

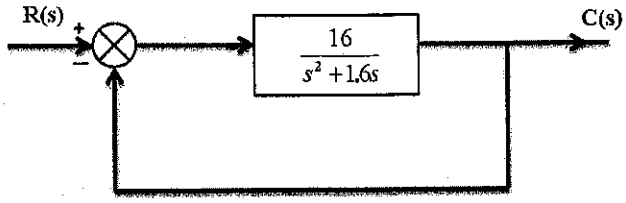

Fig 3(a)

(b). The block diagram representation of a control system is shown in Fig 3(b) [CO-3] 2

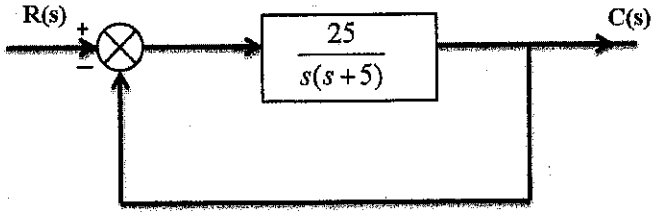

Fig 3(b)

Determine the natural frequency, damping ratio, damped natural frequency, rise time, percentage of overshoot and approximate 5% settling time.

4(a). A system has characteristic equation $s^3 + 3Ks^2 + (2+K)s + 4 = 0$. Determine the range of K for a stable system. [CO-3] 2

(b). For unity feedback system having [CO-3] 3

$$G(s) = \frac{K}{s^2(s+5)}$$

Find (i) K_p (ii) K_v (iii) K_a (iv) steady state error for unit step input, unit ramp and unit acceleration inputs.

5(a) List the rules of construction of Root Loci. [CO-5] 2

(b) Draw and explain the Loci of roots of $s^2 + 2s + K = 0$ as a function of K. [CO-5] 2

(c) A unity feedback system has [CO-5] 2

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

For the loop transfer function of this system, calculate the following when K is changed from $+\infty$ to $-\infty$.

(i) Number of finite poles and zeros

(ii) Number of separate root locus

(iii) The angles of asymptotes and the centroid in the pole and zero plot