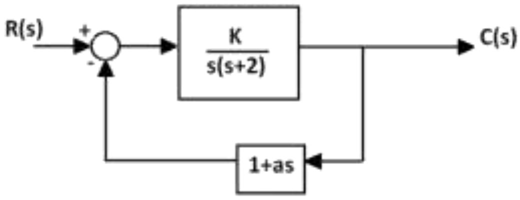
Type 4: Time Response Analysis

For Concept, refer to Control Systems K-Notes,Time Response Analysis

Sample Problem 4:

For the system shown in figure, with a damping ratio ξ of .7 and an un-damped natural frequency ω_0 of 4 rad/sec, the values of 'K' and 'a' are



(A)K=4,a=.35 (B)K=8,a=.455

(C)K=16,a=.225 (D)K=64,a=.9

Solution: (C) is correct option

Characteristic equation

$$1+G(s)H(s)=0$$

$$1+\frac{K(1+as)}{(s+2)}=0$$

$$S^2+2s+Kas+K=0$$

$$S^2+s(Ka+2)+K=0$$

Compare with standard equation

$$S^2+2\xi\omega_n s+\omega_n^2=0$$

$$\therefore \omega_n^2=K=4^2=16$$

$$K=16$$

$$Ka+2=2\xi\omega_n$$

$$=2(.7)(4)$$

$$a=\frac{2(.7)(4)-2}{16}=.225$$

$$a=.225$$

Unsolved Problems:

Q.1 A controller of the form $G_c(s)=\frac{K(s+a)}{(s+b)}$ is designed for a plant with transfer function $G(s)=\frac{1}{s(s+3)}$ such that the un-damped natural frequency and the damping ratio of the closed loop 2nd order system are 2 rad/sec and 0.5 respectively. When the steady state error to a unit step input is zero, then the controller parameters are

(A) k = 4, a = 3, b = 2 (B) k = 1, a = 3, b = 2

(C) k = 4, a = 2, b = 3 (D) k = 1, a = 2, b = 3

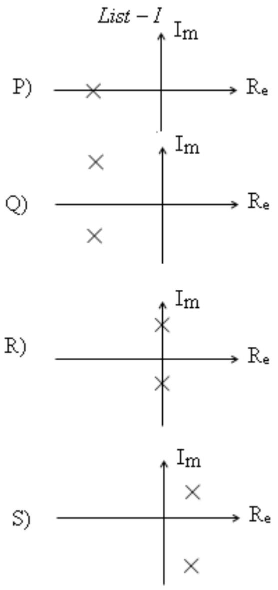
Q.2 A feedback system has un-damped frequency of 10 rad/sec and the damping ratio is 0.4 the transfer function is?

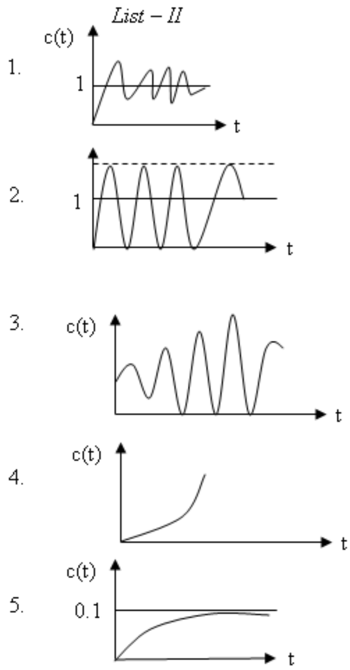
(A) $\dfrac{100}{(s^2+8s+100)}$ (B) $\dfrac{10}{(s^2+8s+10)}$ (C) $\dfrac{100}{(s^2+4s+100)}$ (D) $\dfrac{10}{(s^2+8s+100)}$

Q.3 A system is required to have a peak overshoot of 4.32 % and a natural frequency of 5 rad/sec. The required location of the dominant pole is:
(A)– 3.535 + j 5.535 (B)– 2.535 + j 2.525 (C)– 2.535 + j 3.535 (D)– 3.535 + j 3.535

Q.4 Match List – I (Location of roots) with List – II (Step response) and select the correct answer using the codes given below the lists:

	P	Q	R	S
(A)	4	1	2	3
(B)	5	1	2	3
(C)	4	2	1	3
(D)	5	2	3	4

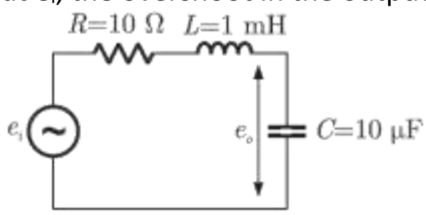




Q.5 The open loop transfer function of a system is $G(s)=\dfrac{100}{(s+1)(s+100)}$ for a unit step input to the system, the approximate settling time for 2% criterion is

(A) 100 sec (B) 4 sec (C) 1 sec (D) none

Q.6 Consider the R-L-C circuit shown in figure For a step-input e_i, the overshoot in the output e_o will be



(A) 0 (B) 5 %

(C) 16 % (D) 48 %