Control Systems Questions and Answers – Time Response of Second Order Systems – II

This set of Control Systems Questions and Answers for Experienced people focuses on " Time Response of Second Order Systems – II".

1. What will be the nature of time response if the roots of the characteristic equation are located on the s-plane imaginary axis?
a) Oscillations
b) Damped oscillations
c) No oscillations
d) Under damped oscilaations

View Answer

Answer: c
Explanation: complex conjugate (non-multiple): oscillatory (sustained oscillations)
Complex conjugate (multiple): unstable (growing oscillations).

2. Consider a system with transfer function $G(s) = s+6/Ks^2+s+6$. Its damping ratio will be 0.5 when the values of k is:
a) 2/6
b) 3
c) 1/6
d) 6

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Answer: c
Explanation: $s+6/K[s^2+s/K+6/K]$ Comparing with $s^2+2Gw+w^2$
w= √6/K
2Gw=1/K
2*0.5*√6/K =1/K
K=1/6.

3. The output in response to a unit step input for a particular continuous control system is $c(t)= 1-e^{-t}$. What is the delay time Td?
a) 0.36
b) 0.18
c) 0.693
d) 0.289

View Answer

Answer: c
Explanation: The output is given as a function of time. The final value of the output is $\lim_{n\to\infty} c(t)=1$; . Hence Td (at 50% of the final value) is the solution of $0.5=1-e^{-Td}$, and is equal to ln 2 or 0.693 sec.

4. Which one of the following is the most likely reason for large overshoot in a control system?
a) High gain in a system
b) Presence of dead time delay in a system
c) High positive correcting torque
d) High retarding torque

View Answer

Answer: c
Explanation: Large overshoot refers to the maximum peak in the response of the closed loop system and this is mainly due to the high positive correcting torque.

5. For the system 2/s+1, the approximate time taken for a step response to reach 98% of its final value is:
a) 1s
b) 2s
c) 4s
d) 8s

View Answer

Answer: c
Explanation: C(s)/R(s) = 2/s+1
R(s) = 1/s (step input)
C(s) = 2/s(s+1)
$c(t) = 2[1-e^{-t}]$ $1.96 = 2[1-e^{-T}]$ T= 4sec.

6. The unit step response of a second order system is $= 1-e^{-5t}-5te^{-5t}$. Consider the following statements:
1. The under damped natural frequency is 5 rad/s.
2. The damping ratio is 1.
3. The impulse response is $25te^{-5t}$.
Which of the statements given above are correct?
a) Only 1 and 2
b) Only 2 and 3
c) Only 1 and 3
d) 1,2 and 3

View Answer

Answer: d
Explanation: C(s) = 1/s-1/s+5-5/(s+5)^2
$C(s) = 25/s(s^2+10s+25)$
R(s) = 1/s
$G(s) = 25/(s^2+10s+25)$
w= √25
w = 5 rad/sec
G = 1.

7. The loop transfer function of controller Gc(s) is :
a) 1+0.1s/s
b) -1+0.1s/s
c) –s/s+1
d) s/s+1

View Answer

Answer: a
Explanation: The transfer function of the controller is 0.1s+1/s
Gc(s) = 0.1s+1/s.

8. The peak percentage overshoot of the closed loop system is :
a) 5.0%
b) 10.0%
c) 16.3%
d) 1.63%

View Answer

Answer: c
Explanation: $C(s)/R(s) = 1/s^2+s+1$
$C(s)/R(s) = w/ws^2+2Gws+w^2$
Compare both the equations,
w = 1 rad/sec
2Gw = 1
Mp = 16.3 %

9. Consider a second order all-pole transfer function model, if the desired settling time(5%) is 0.60 sec and the desired damping ratio 0.707, where should the poles be located in s-plane?
a) -5+j4√2
b) -5+j5
c) -4+j5√2
d) -4+j7

View Answer

Answer: b
Explanation: G = 1/√2
Gw = 5
s = -5+j5.

10. Which of the following quantities give a measure of the transient characteristics of a control system, when subjected to unit step excitation.
1. Maximum overshoot
2. Maximum undershoot
3. Overall gain
4. Delay time
5. Rise time
6. Fall time
a) 1,3 and 5
b) 2, 4 and 5
c) 2,4 and 6
d) 1,4 and 5

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Answer: d
Explanation: Maximum overshoot, rise time and delay time are the major factor of the transient behaviour of the system and determines the transient characteristics.

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Manish Bhojasia, a technology veteran with 20+ years @ Cisco & Wipro, is Founder and CTO at Sanfoundry. He is Linux Kernel Developer & SAN Architect and is passionate about competency developments in these areas. He lives in Bangalore and delivers focused training sessions to IT professionals in Linux Kernel, Linux Debugging, Linux Device Drivers, Linux Networking, Linux Storage, Advanced C Programming, SAN Storage Technologies, SCSI Internals & Storage Protocols such as iSCSI & Fiber Channel. Stay connected with him @ LinkedIn | Instagram | Facebook | Twitter