



# SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

AN AUTONOMOUS INSTITUTION

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Chennai



## 23EET206 CONTROL SYSTEMS AND INSTRUMENTATION

### Two Mark Question & Answers

#### UNIT – II TIME RESPONSE ANALYSIS AND FREQUENCY RESPONSE

##### 1. What is transient response & steady state response of a system?

The transient response is the response of the system when the system changes from one state to another.

The steady state response is the response of the system when it approaches infinity.

##### 2. What is the difference between type & order of a system?

Type number of a system indicates the number of poles at the origin whereas order of a system is the order of the differential equation governing the system. The order of the system can be obtained from the transfer function of the given system.

##### 3. Define Damping ratio.

Damping ratio is defined as the ratio of actual damping to critical damping.

##### 4. List the time domain specifications (or) what are the time domain specifications?

The time domain specifications are

- ✓ Delay time
- ✓ Rise time
- ✓ Peak time
- ✓ Peak overshoot

##### 5. Define Delay time, Rise time, Peak time.

**Delay time:** The time taken for response to reach 50% of final value for the very first time is delay time.

**Rise time:** The time taken for response to rise from 0% to 100% for the very first time is rise time.

**Peak time:** The time taken for the response to reach the peak value for the very first time is peak time.

##### 6. Define peak overshoot.

Peak overshoot is defined as the ratio of maximum peak value to the final value, where the maximum peak value is measured from the final value.

##### 7. Define Settling time.

Settling time is defined as the time taken by the response to reach and stay within specified error.

**8. What is the significance of integral controller and derivative controller in a PID controller?**

- ✓ The Proportional controller stabilizes the gain but produces a steady state error.
- ✓ The Integral control reduces or eliminates the steady state error.

**9. Why derivative controller is not used in control systems?**

- ✓ The derivative controller produces a control action based on the rate of change of error signal and it does not produce corrective measures for any constant error.
- ✓ It is sensitive to noise signal and amplifies the noise.

**10. What is the drawback of static coefficients?**

The main drawback of static coefficient is that it does not show the variation of error with time and input should be standard input.

**11. What are the main advantages of generalized error coefficients?**

- ✓ Steady state is function of time.
- ✓ Steady state can be determined from any type of input.

**12. What are the standard test signals used in control systems?**

The commonly used test input signals in control system are impulse, step, ramp, parabolic and sinusoidal signals.

**13. What are the advantages & disadvantages of proportional controller?**

The disadvantage in proportional controller is that it produces a constant steady state error.

**Advantage:**

- Improves disturbance signal rejection
- Improves stability of the system
- Increases the loop gain of the system

**14 What is the effect of PD controller on system performance?**

The effect of PD controller is to increase the damping ratio of the system and so the peak overshoot is reduced.

**15. What is the effect of PI controller on the system performance?**

The PI controller increases the order of the system by one, which results in reducing the steady state error. But the system becomes less stable than the original system.

**16. How a control system is classified depending on the value of damping?**

- $\xi=0$ ; Undamped system
- $0 < \xi < 1$ ; Under damped system
- $\xi=1$ ; Critically damped system

$\xi > 1$ ; Over damped system

**17. What is steady state error?**

It is the difference between desired output & actual output of the system as t tends to infinity.

**18. List out the different frequency domain specifications.**

The frequency domain specifications are

Resonant peak, Resonant frequency, Bandwidth, Cut-off rate, Gain Margin, Phase Margin

**19. Define resonant Peak ( $M_r$ ) & resonant frequency ( $\omega_r$ )**

The maximum value of the magnitude of closed loop transfer function is called Resonant Peak.

The frequency at which resonant peak occurs is called resonant frequency.

**20. What is Bandwidth?**

The Bandwidth is the range of frequencies for which the system gain is more than 3 dB.

The bandwidth is a measure of the ability of a feedback system to reproduce the input signal noise rejection characteristics and rise time.

**21. Define Cut off rate.**

The slope of the log-magnitude curve near the cut-off is called cut-off rate. The cut off rate indicates the ability to distinguish the signal from noise.

**22. Define Gain Margin.**

The Gain Margin,  $K_g$  is defined as the reciprocal of the magnitude of the open loop transfer function at phase cross over frequency.

$$\text{Gain margin, } K_g = \frac{1}{|G(j\omega_{pc})|}$$

**23. Define Phase cross over frequency.**

The frequency at which, the phase of open loop transfer functions is called phase cross over frequency,  $\omega_{pc}$ .

**24. What is Phase margin?**

The Phase margin is the amount of additional phase lag at the gain cross over frequency required to bring system to the verge of instability.

$$\text{Phase margin, } \gamma = 180^\circ + \phi_{gc}$$

**25. Define Gain cross over frequency.**

The Gain cross over frequency,  $\omega_{gc}$ , is the frequency at which the magnitude of the open loop transfer function is unity.

**26. What is Bode plot?**

The Bode plot is the frequency response plot of the transfer function of a system. A Bode plot consists of two graphs. One is the plot of magnitude of sinusoidal transfer function versus  $\log \Delta$ . The other is a plot of the phase angle of a sinusoidal function versus  $\log \omega$ .

**27. Define Corner frequency.**

The frequency at which the two asymptotic meet in a magnitude plot is called Corner frequency.

**28. What is Nichols chart?**

The chart consisting of M & N loci in the log magnitude versus phase diagram is called Nichols chart.

**29. What are the advantages of Nichols chart?**

The advantages are:

- It is used to find the closed loop frequency response from open loop frequency response.
- Frequency domain specifications can be determined from Nichols chart.
- The gain of the system can be adjusted to satisfy the given specification.

**30. How closed loop frequency response is determined from the open loop frequency using M & N circles?**

The  $G(j\omega)$  locus or polar plot of open loop system is sketched on the standard M and N circles chart. The meeting point of M circle with  $G(j\omega)$  locus gives the magnitude of closed loop system. The meeting point of  $G(j\omega)$  locus with N-circle gives the value of phase of closed loop system.

**31. What are the uses of lead compensator?**

- i. Speeds up the transient response
- ii. Increases the margin of stability of a system
- iii. Increases the system error constant to a limited extent.

**32. What is a compensator?**

A device inserted into the system for the purpose of satisfying the specifications is called as a compensator.