CONTROL ENGINEERING VIVA & INTERVIEW QUESTIONS

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Q-1 **What is frequency response?**

Ans A frequency response is the steady state response of a system when the input to the system is a sinusoidal signal.

Q-2 **List out the different frequency domain specifications?**

Ans The frequency domain specification are

1. Resonant peak.
2. Resonant frequency.

Q-3 **Define –resonant Peak?**

Ans The maximum value of the magnitude of closed loop transfer function is called resonant peak.

Q-4 **Define –Resonant frequency?**

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

Q-5 **What is bandwidth?**

Ans The bandwidth is the range of frequencies for which the system gain Is more than 3 dbB. The bandwidth is a measure of the ability of a feedback system to reproduce the input signal, noise rejection characteristics and rise time.

Q-6 **Define Cut-off rate?**

Ans 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.

Q-7 **Define – Gain Margin?**

Ans The gain margin is defined as the reciprocal of the magnitude of the open loop transfer function at phase cross over frequency.

Q-8 **Define Phase cross over?**

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

Q-9 **What is phase margin?**

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

Q-10 **What are the main significances of root locus?**

Ans

1. The main root locus technique is used for stability analysis.
2. Using root locus technique the range of values of K, for as table system can be determined

Q-11 **Define Gain cross over?**

Ans The gain cross over frequency ω_{gc} is the frequency at which the magnitude of the open loop transfer function is unity.

Q-12 **What is Bode plot?**

Ans 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 ω. The other is a plot of the phase angle of a sinusoidal function versus log ω.

Q-13 **What are the main advantages of Bode plot?**

Ans The main advantages are:

1. Multiplication of magnitude can be in to addition.
2. A simple method for sketching an approximate log curve is available.
3. It is based on asymptotic approximation. Such approximation is sufficient if rough information on the frequency response characteristic is needed.

4. The phase angle curves can be easily drawn if a template for the phase angle curve of 1+ jω is available.

Q-14 **Define Corner frequency?**

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

Q-15 **Define Phase lag and phase lead?**

Ans A negative phase angle is called phase lag. A positive phase angle is called phase lead.

Q-16 **What are M circles?**

Ans The magnitude of closed loop transfer function with unit feedback can be shown to be in the for every value if M. These circles are called M circles.

Q-17 **What is Nichols chart?**

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

Q-18 **What are two contours of Nichols chart?**

Ans Nichols chart of M and N contours, superimposed on ordinary graph. The M contours are the magnitude of closed loop system in decibels and the N contours are the phase angle locus of closed loop system.

Q-19 **How is the Resonant Peak(M_r), resonant frequency(ω_r) , and band width determined from Nichols chart?**

Ans

1. The resonant peak is given by the value of contour which is tangent to G(jω) locus.
2. The resonant frequency is given by the frequency of G(jω) at the tangency point.
3. iii) The bandwidth is given by frequency corresponding to the intersection point of G(jω) and –3dB M-contour.

Q-20 **What are the advantages of Nichols chart?**

Ans The advantages are:

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

Q-21 **What are the two types of compensation?**

Ans

1. Cascade or series compensation
2. Feedback compensation or parallel compensation

Q-22 **What are the three types of compensators?**

Ans

1. Lag compensator
2. Lead compensator
3. Lag-Lead compensator

Q-23 **What are the uses of lead compensator?**

Ans

1. speeds up the transient response
2. increases the margin of stability of a system
3. Increases the system error constant to a limited extent.

Q-24 **What is the use of lag compensator?**

Ans Improve the steady state behaviour of a system, while nearly preserving its transient response.

Q-25 **When lag lead compensator is required?**

Ans The lag lead compensator is required when both the transient and steady state response of a system has to be improved

Q-26 **What is a compensator?**

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

Q-27 **What is Nyquist contour**

Ans The contour that encloses entire right half of S plane is called Nyquist contour.

Q-28 **State Nyquist stability criterion.**

Ans If the Nyquist plot of the open loop transfer function G(s) corresponding to the Nyquist control in the S-plane encircles the critical point –1+j0 in the counter clockwise direction as many times as the number of right half S-plane poles of G(s), the closed loop system is stable.

Q-29 **Define Relative stability**

Ans Relative stability is the degree of closeness of the system, it is indication of strength or degree of stability.

Q-30 **What are the two segments of Nyquist contour?**

Ans
1. A finite line segment C1 along the imaginary axis.
2. An arc C2 of infinite radius.

Q-31 **What are root loci?**

Ans The path taken by the roots of the open loop transfer function when the loop gain is varied from 0 to _ are called root loci.

Q-32 **What is a dominant pole?**

Ans The dominant pole is a pair of complex conjugate pair which decides the transient response of the system.

Q-33 **What are the effect of adding a zero to a system?**

Ans Adding a zero to a system increases peak overshoot appreciably.

Q-34 **What is control system?**

Ans A system consists of a number of components connected together to perform a specific function. In a system when the output quantity is controlled by varying the input quantity then the system is called control system.

Q-35 **What are the two major types of control system?**

Ans The two major types of control system are open loop and closed loop

Q-36 **Define open loop control system.**

Ans The control system in which the output quantity has no effect upon the input quantity are called open loop control system. This means that the output is not feedback to the input for correction.

Q-37 **Define closed loop control system.**

Ans The control system in which the output has an effect upon the input quantity so as to maintain the desired output value are called closed loop control system.

Q-38 **What are the components of feedback control system?**

Ans The components of feedback control system are plant, feedback path elements, error detector and controller.

Q-39 **Define transfer function.**

Ans The T.F of a system is defined as the ratio of the Laplace transform of output to Laplace transform of input with zero initial conditions.

Q-40 **What are the basic elements used for modelling mechanical translational system.**

Ans Mass, spring and dashpot

Q-41 **What are the basic elements used for modelling mechanical rotational system?**

Ans Moment of inertia J, dashpot with rotational frictional coefficient B and torsional spring with stiffness K

Q-42 **Name two types of electrical analogous for mechanical system.**

Ans The two types of analogies for the mechanical system are Force voltage and force current analogy

Q-43 **What is block diagram?**

Ans A block diagram of a system is a pictorial representation of the functions performed by each component of the system and shows the flow of signals. The basic elements of block diagram are blocks, branch point and summing point.

Q-44 **What is the basis for framing the rules of block diagram reduction technique?**

Ans The rules for block diagram reduction technique are framed such that any modification made on the diagram does not alter the input output relation.

Q-45 **What is a signal flow graph?**

Ans A signal flow graph is a diagram that represents a set of simultaneous algebraic equations .By taking L.T the time domain differential equations governing a control system can be transferred to a set of algebraic equations in s-domain.

Q-46 **What is transmittance?**

Ans The transmittance is the gain acquired by the signal when it travels from one node to another node in signal flow graph.

Q-47 **What is sink and source?**

Ans Source is the input node in the signal flow graph and it has only outgoing branches. Sink is a output node in the signal flow graph and it has only incoming branches.

Q-48 **Define non touching loop.**

Ans The loops are said to be non-touching if they do not have common nodes.

Q-49 **Write the analogous electrical elements in force voltage analogy for the elements of mechanical translational system.**

Ans

Force-voltage

Velocity v-current i
Displacement x-charge q
Frictional co-efficient B-Resistance R
Mass M- Inductance L
Stiffness K-Inverse of capacitance 1/C

Q-50 **Write the analogous electrical elements in force current analogy for the elements of mechanical translational system.**

Ans

Force-current

Velocity v-voltage v
Displacement x-flux
Frictional co-efficient B-conductance 1/R
Mass M- capacitance C
Stiffness K-Inverse of inductance 1/L

Q-51 **Distinguish between open loop and closed loop system**

Ans

Open loop Closed loop

1. 1.Innaccurate

2. Simple and economical
3. The changes in output due to external disturbance are not corrected Accurate Complex and costlier The changes in output due to external disturbances are corrected automatically
4. They are generally stable Great efforts are needed to design a stable system

Q-52 **What is servomechanism?**

Ans The servomechanism is a feedback control system in which the output is mechanical position (or time derivatives of position velocity and acceleration)

Q-53 **Why negative feedback is invariably preferred in closed loop system?**

Ans The negative feedback results in better stability in steady state and rejects any disturbance signals.

Q-54 **What is transient response?**

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

Q-55 **What is steady state response?**

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

Q-56 **What is an order of a system?**

Ans The 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.

Q-57 **Define Damping ratio.**

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

Q-58 **List the time domain specifications.**

Ans The time domain specifications are

1. Delay time
2. Rise time
3. Peak time
4. Peak overshoot

Q-59 **Define Delay time.**

Ans The time taken for response to reach 50percent of final value for the very first time is delay time.

Q-60 **Define Rise time.**

Ans The time taken for response to raise from 0percent to 100percent for the very first time is rise time.

Q-61 **Define peak time.**

Ans The time taken for the response to reach the peak value for the first time is peak time.

Q-62 **Define peak overshoot.**

Ans Peak overshoot is defined as the ratio of maximum peak value measured from the Maximum value to final value

Q-63 **Define Settling time.**

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

Q-64 **What is the need for a controller?**

Ans The controller is provided to modify the error signal for better control action

Q-65 **What are the different types of controllers?**

Ans Proportional controller
PI controller
PD controller
PID controller

Q-66 What is proportional controller?

Ans It is device that produces a control signal which is proportional to the input error signal.

Q-67 What is PI controller?

Ans It is device that produces a control signal consisting of two terms –one proportional to error signal and the other proportional to the integral of error signal.

Q-68 What is PD controller?

Ans PD controller is a proportional plus derivative controller which produces an output signal consisting of two time -one proportional to error signal and other proportional to the derivative of the signal.

Q-69 What is the significance of integral controller and derivative controller in a PID controller?

Ans The proportional controller stabilizes the gain but produces a steady state error. The integral control reduces or eliminates the steady state error.

Q-70 Why derivative controller is not used in control systems?

Ans 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.

Q-71 Define Steady state error.

Ans The steady state error is defined as the value of error as time tends to infinity.

Q-72 What is the drawback of static coefficients?

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

Q-73 What is step signal?

Ans The step signal is a signal whose value changes from zero to A at t= 0 and remains constant at A for t>0.

Q-74 What is ramp signal?

Ans The ramp signal is a signal whose value increases linearly with time from an initial value of zero at t=0.the ramp signal resembles a constant velocity.

Q-75 What is a parabolic signal?

Ans The parabolic signal is a signal whose value varies as a square of time from an initial value of zero at t=0.This parabolic signal represents constant acceleration input to the signal.

Q-76 What are the three constants associated with a steady state error?

Ans Positional error constant
Velocity error constant
Acceleration error constant

Q-77 What are the main advantages of generalized error coefficients?

Ans
1. Steady state is function of time.
2. Steady state can be determined from any type of input

Q-78 What are the effects of adding a zero to a system?

Ans Adding a zero to a system results in pronounced early peak to system response thereby the peak overshoot increases appreciably.

Q-79 State-Magnitude criterion.

Ans The magnitude criterion states that $s=s_a$ will be a point on root locus if for that value of s , | D(s) | = |G(s)H(s) | =1

Q-80 **What is a dominant pole?**

Ans The dominant pole is a pair of complex conjugate pair which decides the transient response of the system.

Q-81 **What is stepper motor?**

Ans A stepper motor is a device which transforms electrical pulses into equal increments of rotary shaft motion called steps.

Q-82 **What is servomotor?**

Ans The motors used in automatic control systems or in servomechanism are called servomotors. They are used to convert electrical signal into angular motion.

Q-83 **Name the test signals used in control system**

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

Q-84 **Define BIBO stability.**

Ans A linear relaxed system is said to have BIBIO stability if every bounded input results in a bounded output.

Q-85 **What is the necessary condition for stability?**

Ans The necessary condition for stability is that all the coefficients of the characteristic polynomial be positive.

Q-86 **What is the necessary and sufficient condition for stability?**

Ans The necessary and sufficient condition for stability is that all of the elements in the first column of the routh array should be positive.

Q-87 **What is quadrantal symmetry?**

Ans The symmetry of roots with respect to both real and imaginary axis called quadrantal symmetry.

Q-88 **What is limitedly stable system?**

Ans For a bounded input signal if the output has constant amplitude oscillations Then the system may be stable or unstable under some limited constraints such a system is called limitedly stable system.

Q-89 **What is synchros?**

Ans A synchros is a device used to convert an angular motion to an electrical signal or vice versa.

Q-90 **What is steady state error?**

Ans The steady state error is the value of error signal e(t) when t tends to infinity.

Q-91 **What are static error constants.**

Ans The Kp Kv and Ka are called static error constants.

Q-92 **What is the disadvantage in proportional controller?**

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

Q-93 **What is the effect of PD controller on system performance?**

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

Q-94 **Why derivative controller is not used in control system?**

Ans The derivative controller produces a control action based on rare of change of error signal and it does not produce corrective measures for any constant error. Hence derivative controller is not used in control system.

Q-95 **What is the effect of PI controller on the system performance?**

Ans 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.

Q-96 **What is Order of the system?**

Ans Order of the system is defined as the order of the differential equation governing the system. Order of the system can be determined from the transfer function of the system. Also the order of the system helps in understanding the number of poles of the transfer function. For nth order system for a particular transfer function contains (n) number of poles.

Q-97 **What is Time response of the control system?**

Ans Time response of the control system is defined as the output of the closed loop system as a function of time. Time response of the system can be obtained by solving the differential equations governing the system or time response of the system can also be obtained by transfer function of the system.

Q-98 **How Time response of the system is divided?**

Ans Time response of the system consists of two parts: 1.Transient state response 2. Steady state response. Transient response of the system explains about the response of the system when the input changes from one state to the other. Steady state response of the system shows the response as the time t, approaches infinity

Q-99 **What are Test signals and their significance?**

Ans The knowledge of the input signal is required to predict the response of the system. In most of the systems input signals are not known ahead of the time and it is also difficult to express the input signals mathematically by simple equations. In such cases determining the performance of the system is not possible. Test signals helps in predicting the performance of the system as the input signals which we give are known hence we can see the output response of the system for a given input and can understand the behaviour of the control system. The commonly used test signals are impulse, ramp, step signals and sinusoidal signals.

Q-100 **What is Pole of the system?**

Ans Pole of a function F(s) is the value at which the function F(s) becomes infinite, where F(s) is a function of the complex variable s.

Q-101 **What is Zero of the system?**

Ans Zero of a function F(s) is a value at which the function F(s) becomes zero, where F(s) is a function of complex variable s.

Q-102 **What is Signal Flow Graph?**

Ans A Signal Flow Graph is a diagram that represents a set of simultaneous linear algebraic equations. By taking Laplace transform the time domain differential equations governing a control system can be transferred to a set of algebraic equations in s-domain. The signal Flow graph of the system can be constructed using these equations.

Q-103 **What is S-domain and its significance?**

Ans By taking Laplace transform for differential equation in the time domain equations in S-domain can be obtained. L[F(t)]=F(s) S domain is used for solving the time

domain differential equations easily by applying the Laplace for the differential equations.

Q-104 What are the basic properties of Signal Flow Graph?

Ans The basic properties of the signal flow graph are:

1. Signal Flow Graphs are applicable to linear systems
2. It consists of nodes and branches. A node is a point representing a variable or signal. A branch indicates the functional dependence of one signal on another
3. A node adds the signals of all incoming branches and transmits this sum to all outgoing branches
4. Signals travel along branches only in a marked direction and is multiplied by the gain of the branch
5. The algebraic equations must be in the form of cause and effect relationship

Q-105 What is mathematical model of a control system?

Ans Control system is a collection of physical elements connected together to serve an objective. The output and input relations of various physical system are governed by differential equations. Mathematical model of a control system constitutes set of differential equations. The response of the output of the system can be studied by solving the differential equations for various input conditions.

Q-106 Explain Mechanical Translational System?

Ans Model of mechanical translational system can be obtained by using three basic elements Mass, Spring and Dash-pot.

1. Weight the mechanical system is represented by mass and is assumed to be concentrated at the centre of body
2. The elastic deformation of the body can be represented by the spring
3. Friction existing in a mechanical system can be represented by dash-pot.

Q-107 What is a System?

Ans When a number of elements or components are connected in a sequence to perform a specific function, the group of elements that all constitute a System

Q-108 What is Control System?

Ans In a System the output and inputs are interrelated in such a manner that the output quantity or variable is controlled by input quantity, then such a system is called Control System. The output quantity is called controlled variable or response and the input quantity is called command signal or excitation.

Q-109 What are different types of Control Systems?

Ans Two major types of Control Systems are

1. Open loop Control Systems: The Open loop Control System is one in which the Output Quantity has no effect on the Input Quantity. No feedback is present from the output quantity to the input quantity for correction.
2. Closed Loop Control System: The Closed loop Control System is one in which the feedback is provided from the Output quantity to the input quantity for the correction so as to maintain the desired output of the system.

Q-110 What is a feedback in Control System?

Ans The Feedback in Control System in one in which the output is sampled and proportional signal is fed back to the input for automatic correction of the error (any change in desired output) for further processing to get back the desired output.

Q-111 Why Negative Feedback is preferred in the Control System?

Ans The role of Feedback in control system is to take the sampled output back to the input and compare output signal with input signal for error (deviation from the desired result). Negative Feedback results in the better stability of the system and rejects any disturbance signals and is less sensitive to the parameter variations. Hence in control systems negative feedback is considered.

Q-112 What is the effect of positive feedback on stability of the system?

Ans Positive feedback is not used generally in the control system because it increases the error signal and drives the system to instability. But positive feedbacks are used in minor loop control systems to amplify certain internal signals and parameters