SNS COLLEGE OF TECHNOLOGY, COIMBATORE-35

(An Autonomous Institution)

DEPARTMENT OF BIOMEDICAL ENGINEERING

19BMT301 – BIOCONTROL SYSTEMS

TWO MARKS QUESTIONS AND ANSWERS

UNIT I

1. **What are the basic elements used for modeling mechanical translational system.**

   Mass, spring and dashpot

2. **What are the basic elements used for modeling mechanical rotational system?**

   Moment of inertia J, dashpot with rotational frictional coefficient B and Rotations spring with stiffness K.

3. **Name two types of electrical analogous for mechanical system.**

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

4. **What is block diagram?**

   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 block, branch point and summing point.

5. **What is the basis for framing the rules of block diagram reduction technique?**

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

6. **What is a signal flow graph?**

   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.

7. **What is transmittance?**

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

8. **What is sink and source?**

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

9. **Define non touching loop.**

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

10. **Write Masons Gain formula.**

    Masons Gain formula states that the overall gain of the system is $T = 1/\sum P_k\text{-}\Delta_k$

    k- No.of forward paths in the signal flow graph.

    Pk- Forward path gain of kth forward path

_ = 1-[sum of individual loop gains] + [sum of gain products of all possible combinations of two non touching loops]-[sum of gain products of all possible combinations of three non touching loops] +..._k - _ for that part of the graph which is not touching k^{th} forward path.

11. Write the analogous electrical elements in force voltage analogy for the elements of mechanical translational system.

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

12. Write the analogous electrical elements in force current analogy for the elements of mechanical translational system.

Force-current I	Velocity v-voltage v
Displacement x-flux_	Frictional coeff B-conductance 1/R
Mass M- capacitance C	Stiffness K-Inverse of inductance 1/L

13. Write the force balance equation ohm ideal mass element.

F = M d2x /dt2

14. Write the force balance equation of ideal dashpot element.

F = B dx /dt

15. Write the force balance equation of ideal spring element.

F = Kx Great efforts are needed to design a stable system

16. What is servomechanism?

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

17. What is servomotor?

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

18. What is system?

When a number of elements or components are connected in a sequence to perform a specific function, the group thus formed is called a system.

19. What are the major types of control system?

i. open loop system

ii closed loop system

20. Distinguish between open loop and closed loop system.

Open loop system	**Closed loop system**
In accurate and un reliable	Accurate and reliable
Simple and economical	Complex and costlier
The changes in output due to external disturbance are not corrected automatically	The changes in output due to external disturbances are corrected

Stable system	Unstable system

21. What is block diagram? What are the basic components of block diagram?

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 block, branch point, summing point.

UNIT II

1. What are the main advantages of generalized error co-efficient?

i) Steady state is function of time.

ii) Steady state can be determined from any type of input

2. What are the effects of adding a zero to a system?

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

3. State-Magnitude criterion.

The magnitude criterion states that s=sa will be a point on root locus if for that value of s,

| D(s) | = |G(s) H(s) | =1

4. State – Angle criterion.

The Angle criterion states that s=sa will be a point on root locus for that value of s,

_D(s)

= _G(s) H(s) =odd multiple of 180°

5. What is a dominant pole?

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

8. Name the test signals used in control system

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

9. Define BIBO stability.

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

10. What is the necessary condition for stability?

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

11. What is the necessary and sufficient condition for stability?

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

12. What is quadrant symmetry?

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

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.

15. What is steady state error?

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

16. What are static error constants?

The Kp Kv and Ka are called static error constants.

17. What is the disadvantage in proportional controller?

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

error.

18. 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.

19. Why derivative controller is not used in control system?

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

20. 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.

21. What is an order of a system?

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.

22. Define Damping ratio.

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

23. List the time domain

specifications. The time domain

specifications are i.Delay time

ii.Rise time

iii.Peak time iv.Peak overshoot

24. Define Delay time.

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

25. Define Rise time.

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

26. Define peak time.

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

27. Define peak overshoot.

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

28. Define Settling time.

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

29. What is the need for a controller?

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

30. What are the different types of controllers? Proportional controller

PI controller

PD controller PID

Proportional controller P

31. What is proportional controller?

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

32. What is PD controller?

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

3**3 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.

34. 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.

35. Define Steady state error.

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

36. What is the drawback of static coefficients?

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

37. What is step signal?

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

38. What is ramp signal?

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 constant velocity.

39. What is a parabolic signal?

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.

40. What are the three constants associated with a steady state error.

Positional error constant Velocity error constant Acceleration error constan

UNIT III

1. What is frequency response?

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

2. List out the different frequency domain specifications?

The frequency domain specifications are

i) Resonant peak.

ii) Resonant frequency.

3. Define –resonant Peak

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

4. Define –Resonant frequency

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

5. What is bandwidth?

The bandwidth is the range of frequencies for which the system gains 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.

6. 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.

7. Define –Gain Margin?

The gain margin, kg is defined as the reciprocal of the magnitude of the open loop transfer function at phase cross over frequency. Gain margin Kg = 1 / □□G(j□pc) □.

8. Define Phase cross over?

The frequency at which, the phase of open loop transfer functions is called phase cross over frequency □pc.

9. What is phase margin?

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

11. Define Gain cross over?

The gain cross over frequency □gc is the frequency at which the magnitude of the open loop transfer function is unity.

12. 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 □.The other is a plot of the phase angle of a sinusoidal function versus log □.

13. What are the main advantages of Bode plot?

The main advantages are:

i) Multiplication of magnitude can be in to addition.

ii) A simple method for sketching an approximate log curves available.

iii) It is based on asymptotic approximation. Such approximation is sufficient if rough information on the frequency response characteristic is needed.

iv) The phase angle curves can be easily drawn if templates for the phase angle curve of 1+ j□is available.

14. Define Corner frequency?

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

15. Define Phase lag and phase lead?

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

16. What are M circles?

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

17. What is Nichols chart?

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

18. What are two contours of Nichols chart?

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.

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

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

20. What are the advantages of Nichols chart?

The advantages are:

i) It is used to find the closed loop frequency response from open loop frequency response.

ii) Frequency domain specifications can be determined from Nichols chart.

iii) The gain of the system can be adjusted to satisfy the given specification.

21. What are root loci?

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

22. What is a dominant pole?

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

23. What are the main significances of root locus?

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

24. What are the effects of adding a zero to a system?

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

25. Define Relative stability

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

26. What is phase margin?

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

27. Define Gain cross over?

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

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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.

32. 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.

33. How will you find root locus on real axis.

To find the root locus on real axis, choose a test point on real axis. If the total number of poles and zeros on the real axis to the right of this rest point is odd number then the rest point lies on the root locus. If it is even then the test point does not lie on the root locus.

34. What are the asymptotes?

Asymptotes are straight lines which are parallel to root locus going to infinity and meet the root locus at infinity.

35. How will you find the angle of asymptotes?

i. Asymptotes= 180(2q+1)/n-m q=0,1,2……(n-m)

36. What is centroid?

The meeting point of asymptotes with real axis is called centroid.

37. How the centroid is calculated?

Centroid= sum of poles- sum of zeros /n-m

38. How to find the crossing point of root locus in imaginary axis.

Method (i) by Routh Hurwitz criterion

Method (ii) by letting s=jw in the characteristics equation.

39. What is break away point?

At break away point the root locus breaks from the real axis to enter into the complex

40. plane.

41. What is break in point?

At break in point the root locus enters from the real axis to from the complex plane.

42. How the break away point & break in point to determine them.

To find the break away or break in points, form an equation for K from the characteristics equation and differentiated the equation the equation of K with respect to s. Then find the roots of equation dK/ds=0. The root of dK/ds=0 are breakaway or break-in points provided for this value of root the gain K should be positive and real.