1. What is Control System?
a) Control system is a system in which the output is controlled by varying the input
b) Control system is a device that will not manage or regulate the behaviour of other devices using control loops
c) Control system is a feedback system that can be both positive and negative
d) Control System is a system in which the input is controlled by varying the output
View Answer
Answer: a

2. Which of the following is not the feature of a modern control system?
a) Correct power level
b) No oscillation
c) Quick response
d) Accuracy
View Answer
Answer: b

3. What is the characteristic of a good control system?
a) Insensitive to the parameter variation but sensitive to the input commands
b) Neither sensitive to parameter variations nor sensitive to input commands
c) Insensitive to the input command
d) Sensitive to parameter variation
View Answer
Answer: a

4. Which of the following element is not used in an automatic control system?
a) Final control element
b) Sensor
c) Oscillator
d) Error detector
View Answer
Answer: c

5. A control system working under unknown random actions is called _____
a) Adaptive control system
b) Stochastic control system
c) Computer control system
d) Digital data system
View Answer
Answer: b

6. Which of the following is an open loop control system?
a) Ward Leonard control
b) Metadyne
c) Stroboscope
d) Field controlled D.C. motor
View Answer
Answer: d

7. Which of the following statements is correct for any closed loop system?
a) Only one of the static error co-efficient has a finite non-zero value
b) All the co-efficient can have zero value
c) All the co-efficient are always non-zero
d) All of the mentioned
View Answer
Answer: a

8. What should be the nature of bandwidth for a good control system?
a) Small
b) Medium
c) Large
d) All of the mentioned
View Answer
Answer: c

9. The output of the feedback control system must be a function of _____
a) Output and feedback signal
b) Input and feedback signal
c) Reference input

d) Reference output
View Answer
Answer: b

10. Which of the following statement is true about Feedback control system?
a) Equally sensitive to forward feedback path parameter changes
b) Insensitive to both forward and feedback path parameter changes
c) Less sensitive to feedback path parameter changes than to forward path parameter changes
d) Less sensitive to forward path parameter changes than to feedback path parameter changes
View Answer
Answer: d

11. In a stable control system backlash can cause which of the following?
a) Overdamping
b) Low-level oscillations
c) Underdamping
d) Poor stability at reduced values of open loop gain
View Answer
Answer: b

12. In a control system the output of the controller is given to
a) Amplifier
b) Sensor
c) Final control element
d) Comparator
View Answer
Answer: c

13. A Control System with excessive noise, is likely to suffer from which of the following?
a) Oscillations
b) Saturation in amplifying stages
c) Loss of gain
d) Vibrations
View Answer
Answer: b

14. In a temperature control system, what conversion in signal takes place?
a) Error to Digital
b) Error to Analog
c) Digital to Analog
d) Analog to Digital
View Answer
Answer: d

15. Which of the following control systems have unpredictable & non-repeatable?
a) Stochastic control systems
b) Deterministic control systems
c) Static control systems
d) Dynamic control systems
View Answer
Answer: a

16. In pneumatic control systems the control valve used as the final control element converts
a) Position change to pressure signal
b) Electric signal to pressure signal
c) Pressure signal to electric signal
d) Pressure signal to position change
View Answer
Answer: d

17. Consider the following statements with respect to the feedback of the control systems.
i. Feedback can improve stability or be harmful to stability if it is not properly applied.
ii. Feedback can always improve stability
iii. In many situations the feedback can reduce the effect of noise and disturbance on system performance.
iv. In general the sensitivity of the system gain of a feedback system of a parameter variation depends on where the parameter is located.
a) i, ii, iii and iv only
b) i, ii and iii only
c) i, iii and iv only

d) i, ii and iv only
View Answer
Answer: c

18. In closed loop control system, what is the sensitivity of the gain of the overall system, M to the variation in G?
a) G/1GH
b) 1/1+GH
c) G/1+G
d) 1/1+G
View Answer
Answer: b

19. The input signals to control systems are not known fully ahead of time, the characteristics of control system which suddenly strain a control system are:
a) Constant velocity and acceleration
b) Sudden shock
c) Sudden change
d) All of the mentioned
View Answer
Answer: d

for the root loci?
a) 0°, 180°, 300°
b) 0°, 120°, 240°
c) 60°, 180°, 300°
d) 120°, 180°, 240°
View Answer
Answer: c

21. Feedback control system is basically _____
a) Band pass filter
b) Band stop filter
c) High pass filter
d) Low pass filter
View Answer
Answer: d

22. Which of the following is not a feature of a good control system?
a) Slow response
b) Sufficient power handling capacity
c) Good stability
d) Good accuracy
View Answer
Answer: a

23. A control system is generally met with the time response specifications:
a) Damping factor
b) Setting time
c) Steady state accuracy
d) All of the mentioned
View Answer
Answer: d

a) -4 and (-4,0)
b) 4 and (-4,0)
c) -3 and (-12,0)
d) 3 and (-12,0)
View Answer
Answer: b

25. With negative feedback in a closed loop control system, the system sensitivity to parameter variation:
a) Becomes infinite
b) Becomes zero
c) Decreases
d) Increases
View Answer
Answer: c

26. The open loop transfer function of a plant is given as, $G(s) = 1/s^2-1$. If the plant is operated in unity feedback configuration, then the lead compensator that can stabilize the control system is:

a) 10(s+4)/(s+2)
b) 10(s+2)/(s+10)
c) 10(s+2)/(s+10)
d) 10(s-1)/(s+2)
View Answer
Answer: d

27. Controllers play which of the following role in the control system?
a) They act on the error signal coming out of the summing junction and output a suitable to the actuator
b) They try to reduce steady state error optimizes overshoot
c) They amplify the signals going to the actuator
d) All of the mentioned
View Answer
Answer: c

28. In control system excessive bandwidth is not employed because
a) It leads to slower time response
b) Noise is proportional to bandwidth
c) Noise is proportional to the square of the bandwidth
d) It leads to low relative stability
View Answer
Answer: b

29. What is the relation between output response and input signal in closed loop system?
a) Nonlinear
b) Linear
c) Exponential
d) Parabolic
View Answer
Answer: b

30. Which of the following is the input of a controller?
a) Signal of fixed amplitude not dependent on desired variable value
b) Desired variable value
c) Sensed signal
d) Error signal
View Answer
Answer: d

31. Which of the following are the not characteristics of the closed loop systems?
a) It does not have the ability to control the system transient response
b) It does not involve I/O measurements
c) It reduces the sensitivity of plant-parameter variations
d) It does not compensate for disturbance
View Answer
Answer: a

32. A control system whose step response is $-0.5(1+e^{-2t})$ is cascaded to another control block whose impulse response is e^{-t}. What is the transfer function of the cascaded combination?
a) 1/(s+1)s
b) 0.5/(s+1)(s+2)
c) 1/(s+2)(s+1)
d) 1/(s+3)
View Answer
Answer: c

33. Effect of feedback on sensitivity is minimum in:
a) Closed loop control system
b) Open and closed loop control systems
c) Open loop control system
d) None of the mentioned
View Answer
Answer: a

34. A particular control system yielded a steady state error of 0.20 for unit step input. A unit integrator is cascaded to this system and unit ramp input is applied to this modified system. What is the value of steady-state error for this modified system?
a) 0.15
b) 0.20
c) 0.25

d) 0.10
View Answer
Answer: c

35. Sampling is necessary _____
a) Non automated control system
b) Automated control system
c) In complex control system
d) Where high accuracy is required
View Answer
Answer: d

36. Which of the motions in actuators are preferred?
a) Rotary
b) Stationary
c) Non-Stationary
d) Translator
View Answer

Answer: a

1. In an open loop control system

(a) Output is independent of control input
(b) Output is dependent on control input
(c) Only system parameters have effect on the control output
(d) None of the above

Ans: a

2. For open control system which of the following statements is incorrect ?

(a) Less expensive
(b) Recalibration is not required for maintaining the required quality of the output
(c) Construction is simple and maintenance easy
(d) Errors are caused by disturbances

Ans: b

3. A control system in which the control action is somehow dependent on the output is known as

(a) Closed loop system
(b) Semiclosed loop system
(c) Open system
(d) None of the above

Ans: a

4. In closed loop control system, with positive value of feedback gain the overall gain of the system will

(a) decrease (b) increase (c) remain unaffected (d) none of the above

Ans: a

5. Which of the following is an open loop control system ?

(a) Field controlled D.C. motor
(b) Ward leonard control
(c) Metadyne
(d) Stroboscope

Ans: a

6. Which of the following statements is not necessarily correct for open control system ?

(a) Input command is the sole factor responsible for providing the control action
(b) Presence of non-linearities causes malfunctioning
(c) Less expensive
(d) Generally free from problems of non-linearities

Ans: b

7. In open loop system

(a) the control action depends on the size of the system
(b) the control action depends on system variables
(c) the control action depends on the input signal
(d) the control action is independent of the output

Ans: d

8 . ___has tendency to oscillate.

(a) Open loop system
(b) Closed loop system
(c) Both (a) and (b)
(d) Neither (a) nor (b)

Ans: b

9. A good control system has all the following features except

(a) good stability
(b) slow response
(c) good accuracy
(d) sufficient power handling capacity

Ans: b

10. A car is moving at a constant speed of 50 km/h, which of the following is the feedback element for the driver ?

(a) Clutch
(b) Eyes
(c) Needle of the speedometer
(d) Steering wheel
(e) None of the above

Ans: c

11. The initial response when tune output is not equal to input is called

(a) Transient response
(b) Error response
(c) Dynamic response
(d) Either of the above

Ans: a

12. A control system working under unknown random actions is called

(a) computer control system
(b) digital data system
(c) stochastic control system
(d) adaptive control system

Ans: c

13. An automatic toaster is a _____ loop control system.

(a) open
(b) closed
(c) partially closed
(d) any of the above

Ans: a

14. Any externally introduced signal affecting the controlled output is called a

(a) feedback
(b) stimulus
(c) signal
(d) gain control

Ans: b

15. A closed loop system is distinguished from open loop system by which of the following ?

(a) Servomechanism
(b) Feedback
(c) Output pattern
(d) Input pattern

Ans: b

16. ___ is a part of the human temperature control system.

(a) Digestive system
(b) Perspiration system
(c) Ear
(d) Leg movement

Ans: b

17. By which of the following the control action is determined when a man walks along a path ?

(a) Brain
(b) Hands
(c) Legs
(d) Eyes

Ans: d

18. ___ is a closed loop system.

(a) Auto-pilot for an aircraft
(6) Direct current generator
(c) Car starter
(d) Electric switch

Ans: a

19. Which of the following devices are commonly used as error detectors in instruments ?

(a) Vernistats
(b) Microsyns
(c) Resolvers
(d) Any of the above

Ans: d

20. Which of the following should be done to make an unstable system stable ?

(a) The gain of the system should be decreased
(b) The gain of the system should be increased
(c) The number of poles to the loop transfer function should be increased
(d) The number of zeros to the loop transfer function should be increased

Ans: b

21. ___ increases the steady state accuracy.

(a) Integrator
(b) Differentiator
(c) Phase lead compensator
(d) Phase lag compensator

Ans: a

22. A.C. servomotor resembles

(a) two phase induction motor
(b) Three phase induction motor
(c) direct current series motor
(d) universal motor

Ans: a

23. As a result of introduction of negative feedback which of the following will not decrease ?

(a) Band width
(b) Overall gain
(c) Distortion
(d) Instability

Ans: a

24. Regenerative feedback implies feedback with

(a) oscillations
(b) step input
(c) negative sign
(d) positive sign

Ans: d

25. The output of a feedback control system must be a function of

(a) reference and output
(b) reference and input

(e) input and feedback signal
(d) output and feedback signal

Ans: a

Also Read : ***Open Loop and Closed Loop Animation***

26. ___ is an open loop control system.

(a) Ward Leonard control
(b) Field controlled D.C. motor
(c) Stroboscope
(d) Metadyne

Ans: b

27. A control system with excessive noise, is likely to suffer from

(a) saturation in amplifying stages
(b) loss of gain
(c) vibrations
(d) oscillations

Ans: a

28. Zero initial condition for a system means

(a) input reference signal is zero
(b) zero stored energy
(c) ne initial movement of moving parts
(d) system is at rest and no energy is stored in any of its components

Ans: d

29. Transfer function of a system is used to calculate which of the following ?

(a) The order of the system
(b) The time constant
(c) The output for any given input
(d) The steady state gain

Ans: c

30. The band width, in a feedback amplifier.

(a) remains unaffected
(b) decreases by the same amount as the gain increase
(c) increases by the same amount as the gain decrease
(d) decreases by the same amount as the gain decrease

Ans: c

31. On which of the following factors does the sensitivity of a closed loop system to gain changes and load disturbances depend ?

(a) Frequency
(b) Loop gain
(c) Forward gain
(d) All of the above

Ans: d

32. The transient response, with feedback system,

(a) rises slowly
(b) rises quickly
(c) decays slowly
(d) decays quickly

Ans: d

33. The second derivative input signals modify which of the following ?

(a) The time constant of the system
(b) Damping of the system
(c) The gain of the system
(d) The time constant and suppress the oscillations
(e) None of the above

Ans: d

34. Which of the following statements is correct for any closed loop system ?

(a) All the co-efficients can have zero value
(6) All the co-efficients are always non-zero
(c) Only one of the static error co-efficients has a finite non-zero value
(d) None of the above

Ans: c

35. Which of the following statements is correct for a system with gain margin close to unity or a phase margin close to zero ?

(a) The system is relatively stable
(b) The system is highly stable
(c) The system is highly oscillatory
(d) None of the above

Ans: c

36. Due to which of the following reasons excessive bond width in control systems should be avoided ?

(a) It leads to slow speed of response
(b) It leads to low relative stability
(c) Noise is proportional to band width
(d) None of the above

Ans: c

37. In a stable control system backlash can cause which of the following ?

(a) Underdamping
(b) Overdamping
(c) Poor stability at reduced values of open loop gain
(d) Low-level oscillations

Ans: d

38. In an automatic control system which of the following elements is not used ?

(a) Error detector
(b) Final control element
(c) Sensor
(d) Oscillator

Ans: d

39. In a control system the output of the controller is given to

(a) final control element
(b) amplifier
(c) comparator
(d) sensor
(e) none of the above

Ans: a

40. A controller, essentially, is a

(a) sensor
(b) clipper
(c) comparator
(d) amplifier

Ans: c

41. Which of the following is the not the ideal input to a controller ?

(a) Servo signal
(b) Desired variable value
(c) Error signal
(d) Sensed signal

Ans: a

42. The on-off controller is a _____ system.

(a) digital
(b) linear

(c) non-linear
(d) discontinuous

Ans: d

43. The capacitance, in force-current analogy, is analogous to

(a) momentum
(b) velocity
(c) displacement
(d) mass

Ans: d

44. The temperature, under thermal and electrical system analogy, is considered analogous to

(a) voltage
(b) current
(c) capacitance
(d) charge
(e) none of the above

Ans: a

45. In electrical-pneumatic system analogy the current is considered analogous to

(a) velocity
(b) pressure
(c) air flow
(d) air flow rate

Ans: d

46. In liquid level and electrical system analogy, voltage is considered analogous to

(a) head
(b) liquid flow

(c) liquid flow rate
(d) none of the above

Ans: a

47. The viscous friction co-efficient, in force-voltage analogy, is analogous to

(a) charge
(b) resistance
(c) reciprocal of inductance
(d) reciprocal of conductance
(e) none of the above

Ans: b

48. In force-voltage analogy, velocity is analogous to

(a) current
(b) charge
(c) inductance
(d) capacitance

Ans: a

49. In thermal-electrical analogy charge is considered analogous to

(a) heat flow
(b) reciprocal of heat flow
(c) reciprocal of temperature
(d) temperature
(e) none of the above

Ans: d

50. Mass, in force-voltage analogy, is analogous to

(a) charge
(b) current
(c) inductance
(d) resistance

Ans: c

Also Read : Automation Interview Questions

51. The transient response of a system is mainly due to

(a) inertia forces
(b) internal forces
(c) stored energy
(d) friction

Ans: c

52. ___ Signal will become zero when the feedback signal and reference signs are equal.

(a) Input
(b) Actuating
(c) Feedback
(d) Reference

Ans: b

53. A signal other than the reference input that tends to affect the value of controlled variable is known as

(a) disturbance
(b) command
(c) control element
(d) reference input

Ans: a

54. The transfer function is applicable to which of the following ?

(a) Linear and time-in variant systems
(b) Linear and time-variant systems
(c) Linear systems
(d) Non-linear systems
(e) None of the above

Ans: a

55. From which of the following transfer function can be obtained ?

(a) Signal flow graph
(b) Analogous table
(c) Output-input ratio
(d) Standard block system
(e) None of the above

Ans: a

56. ___ is the reference input minus the primary feedback.

(a) Manipulated variable
(b) Zero sequence
(c) Actuating signal
(d) Primary feedback

Ans: c

57. The term backlash is associated with

(a) servomotors
(b) induction relays
(c) gear trains
(d) any of the above

Ans:

58. With feedback _____ increases.

(a) system stability
(b) sensitivity
(c) gain
(d) effects of disturbing signals

Ans: a

59. By which of the following the system response can be tested better ?

(a) Ramp input signal
(b) Sinusoidal input signal
(c) Unit impulse input signal
(d) Exponentially decaying signal

Ans: c

60. In a system zero initial condition means that

(a) The system is at rest and no energy is stored in any of its components
(b) The system is working with zero stored energy
(c) The system is working with zero reference signal

Ans: a

61. In a system low friction co-efficient facilitates

(a) reduced velocity lag error
(b) increased velocity lag error
(c) increased speed of response
(d) reduced time constant of the system

Ans: a

62. Hydraulic torque transmission system is analog of

(a) amplidyne set
(b) resistance-capacitance parallel circuit
(c) motor-generator set
(d) any of the above

Ans:

63. Spring constant in force-voltage analogy is analogous to

(a) capacitance
(b) reciprocal of capacitance
(c) current
(d) resistance

Ans: b

64. The frequency and time domain are related through which of the following?

(a) Laplace Transform and Fourier Integral
(b) Laplace Transform
(c) Fourier Integral
(d) Either (b) or (c)

Ans: a

65. An increase in gain, in most systems, leads to

(a) smaller damping ratio
(b) larger damping ratio
(c) constant damping ratio
(d) none of the above

Ans: a

66. Static error co-efficients are used as a measure of the effectiveness of closed loop systems for specified _____ input signal.

(a) acceleration
(b) velocity
(c) position
(d) all of the above

Ans: d

67. A conditionally stable system exhibits poor stability at

(a) low frequencies
(b) reduced values of open loop gain
(c) increased values of open loop gain
(d) none of the above

Ans: b

68. The type 0 system has _____ at the origin.

(a) no pole
(b) net pole
(c) simple pole
(d) two poles
(e) none of the above

Ans: a

69. The type 1 system has _____ at the origin.

(a) no pole
(b) net pole
(c) simple pole
(d) two poles

Ans: c

70. The type 2 system has at the origin.

(a) no net pole
(b) net pole
(c) simple pole
(d) two poles

Ans: d

71. The position and velocity errors of a type-2 system are

(a) constant, constant
(b) constant, infinity
(c) zero, constant
(d) zero, zero

Ans: c

72. Velocity error constant of a system is measured when the input to the system is unit _____ function.

(a) parabolic
(b) ramp

(c) impulse
(d) step

Ans: b

73. In case of type-1 system steady state acceleration is

(a) unity
(b) infinity
(c) zero
(d) 10

Ans: b

74. If a step function is applied to the input of a system and the output remains below a certain level for all the time, the system is

(a) not necessarily stable
(b) stable
(c) unstable
(d) always unstable
(e) any of the above

Ans: a

75. Which of the following is the best method for determining the stability and transient response ?

(a) Root locus
(b) Bode plot
(c) Nyquist plot
(d) None of the above

Ans: a

76. Phase margin of a system is used to specify which of the following ?

(a) Frequency response
(b) Absolute stability

(c) Relative stability
(d) Time response

Ans: c

77. Addition of zeros in transfer function causes which of the following ?

(a) Lead-compensation
(b) Lag-compensation
(c) Lead-lag compensation
(d) None of the above

Ans: b

78. ___ technique is not applicable to nonlinear system ?

(a) Nyquist Criterion
(b) Quasi linearization
(c) Functional analysis
(d) Phase-plane representation

Ans: a

79. In order to increase the damping of a badly underdamped system which of following compensators may be used ?

(a) Phase-lead
(b) Phase-lag
(c) Both (a) and (b)
(d) Either (a) and (b)
(e) None of the above

Ans: a

80. The phase lag produced by transportation relays

(a) is independent of frequency
(b) is inverseh'proportional to frequency
(c) increases linearly with frequency
(d) decreases linearly with frequency

Ans: c

Also Read : Programmable Logic Controller Questions

81. In a stable control system saturation can cause which of the following ?

(a) Low-level oscillations
(b) High-level oscillations
(c) Conditional stability
(d) Overdamping

Ans: a

82. Which of the following can be measured by the use of a tacho-generator ?

(a) Acceleration
(b) Speed
(c) Speed and acceleration
(d) Displacement
(e) None of the above

Ans: b

83. ___ is not a final control element.

(a) Control valve
(b) Potentiometer
(c) Electro-pneumatic converter
(d) Servomotor

Ans: b

84. Which of the following is the definition of proportional band of a controller ?

(a) The range of air output as measured variable varies from maximum to minimum
(b) The range of measured variables from set value
(c) The range of measured variables through which the air output chan¬ges from maximum to minimum

(d) Any of the above
(e) None of the above

Ans: c

85. In pneumatic control systems the control valve used as final control element converts

(a) pressure signal to electric signal
(b) pressure signal to position change
(c) electric signal to pressure signal
(d) position change to pressure signal
(e) none of the above

Ans: b

86. Pressure error can be measured by which of the following ?

(a) Differential bellows and straingauge
(b) Selsyn
(c) Strain gauge
(d) Strain gauge and potentiometer

Ans: a

87. Which of the following devices is used for conversion of co-ordinates ?

(a) Microsyn
(b) Selsyn
(c) Synchro-resolver
(d) Synchro-transformer

Ans: c

88. The effect of error damping is to

(a) provide larger settling lime
(b) delay the response
(c) reduce steady state error

(d) any of the above
(e) none of the above

Ans: c

89. ___ technique gives quick transient and stability response

(a) Root locus
(b) Bode
(c) Nyquist
(d) Nichols

Ans: a

90. A phase lag lead network introduces in the output

(a) lag at all frequencies
(b) lag at high frequencies and lead at low frequencies
(c) lag at low frequencies and lead at high frequencies
(d) none of the above

Ans: c

91. Which of the following is the non-linearity caused by servomotor ?

(a) Static friction
(b) Backlash
(c) Saturation
(d) None of the above

Ans: c

92. ___ can be extended to systems which are time-varying ?

(a) Bode-Nyquist stability methods
(b) Transfer functions
(c) Root locus design
(d) State model representatives

Ans: d

93. When the initial conditions of a system are specified to be zero it implies that the system is

(a) at rest without any energy stored in it
(b) working normally with reference input
(c) working normally with zero reference input
(d) at rest but stores energy

Ans: d

94. Which of the following is electromechanical device ?

(a) Induction relay
(b) Thermocouple
(c) LVDT
(d) Any of the above
(e) None of the above

Ans: c

95. A differentiator is usually not a part of a control system because it

(a) reduces damping
(b) reduces the gain margin
(c) increases input noise
(d) increases error

Ans: c

96. If the gain of the critical damped system is increased it will behave as

(a) oscillatory
(b) critically damped
(c) overdamped
(d) underdamped
(e) none of the above

Ans: d

97. In a control system integral error compensation _____ steady state error

(a) increases
(b) minimizes
(c) does not have any effect on
(d) any of the above

Ans: b

98. With feed back _____ reduces.

(a) system stability
(6) system gain
(c) system stability and gain
(d) none of the above

Ans: b

99. An amplidyne can give which of the following characteristics ?

(a) Constant current
(b) Constant voltage
(c) Constant current as well as constant voltage
(d) Constant current, constant voltage and constant power
(e) None of the above

Ans: d

100. Which of the following can be measured byLVDT?

(a) Displacement
(b) Velocity
(c) Acceleration
(d) Any of the above

Ans: d

101. ___ directly converts temperature into voltage.

(a) Thermocouple
(b) Potentiometer

(c) Gear train
(d) LVDT
(e) None of the above

Ans: a

102. The transfer function technique is considered as inadequate under which of the following conditions ?

(a) Systems having complexities and non-linearities
(b) Systems having stability problems
(c) Systems having multiple input dis¬turbances
(d) All of the above

Ans: d

103. Which of the following is the output of a thermocouple ?

(a) Alternating current
(b) Direct current
(c) A.C. voltage
(d) D.C. voltage
(e) None of the above

Ans: d

104. A.C. servomotor is basically a

(a) universal motor
(b) single phase induction motor
(c) two phase induction motor
(d) three phase induction motor

Ans: c

105. The first order control system, which is well designed, has a

(a) small bandwidth
(b) negative time constant
(c) large negative transfer function pole
(d) none of the above

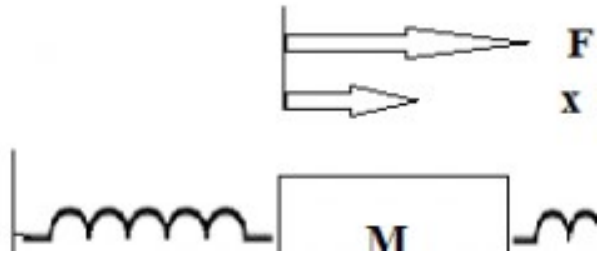
Ans: c

106. Which of the following is exhibited by Root locus diagrams ?

(a) The poles of the transfer function for a set of parameter values
(b) The bandwidth of the system
(c) The response of a system to a step input
(d) The frequency response of a system
(e) None of the above

Ans: a

1. Consider a simple mass spring friction system as given in the figure K1, K2 are spring constants f-friction, M-Mass, F-Force, x-Displacement. The transfer function X(s)/F(s) of the given system will be :



a) $1/(Ms^2+fs+K1.K2)$
b) $1/(Ms^2+fs+K1+K2)$
c) $1/(Ms^2+fs+K1.K2/K1+K2)$
d) $K2/(Ms^2+fs+K1)$
Answer: b
Explanation: Force balance equations are formed where force from both the springs will be balanced by the mass system.

2. The output of an first order hold between two consecutive sampling instants is:
a) Constant
b) Quadratic Function
c) Ramp Function
d) Exponential Function
Answer: c
Explanation: Inverse Laplace of the equation of first order hold gives the ramp function and hence the output of an first order hold between two consecutive sampling is ramp function.

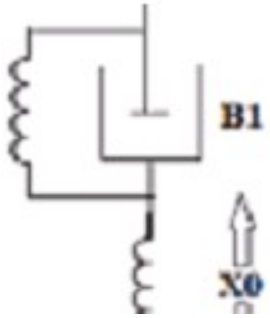
3. Which of the following is an example of an open loop system?
a) Household Refrigerator
b) Respiratory system of an animal
c) Stabilization of air pressure entering into the mask
d) Execution of program by computer

Answer: d
Explanation: Execution of a program by a computer is an example of an open loop system as the feedback mechanism is not taken by the computer program and set programs are used to get the set output.

4. A tachometer is added to servomechanism because:
a) It is easily adjustable
b) It can adjust damping
c) It reduces steady state error
d) It converts velocity of the shaft to a proportional Dc voltage
Answer: b
Explanation: A tachometer is a device to control the speed and adjust damping and it is used in servomechanism to adjust damping and mainly is used in AC servomotors.

5. A synchro Transmitter is used with control transformer for:
a) Feedback
b) Amplification
c) Error detection
d) Remote sensing
Answer: c
Explanation: Synchro transmitter is used as the error detector to get the desired speed and it is accompained with the synchro transformer which is used as an amplifier.

6. The below figure represents:



a) Lead network
b) Lag network
c) PI controller
d) PD controller
Answer: b
Explanation: The equations of performance are
B1(dX1/dt-dX2/dt)+k1(X1-X0)=k2X0
T=k1(1+B1s/K1)/k1+k2(1+sB1/k1+k2)
X0(s)/X1(s)=1/a(1+aTs/1+Ts).

7. Backlash in a stable control system may cause:
a) Under damping
b) Over damping

c) High level oscillations
d) Low level oscillations
Answer: d
Explanation: In a servo system, the gear backlash may cause sustained oscillations or chattering phenomenon and the system may even turn unstable for large backlash.

8. Tachometer feedback in a D.C. position control system enhances stability?
a) True
b) False
Answer: a
Explanation: Tachometer feedback is derivative feedback and hence increases the stability and speed of response, so tachometer adds zero at origin.

9. For a tachometer, if a(t) is the rotor displacement, e(t) is the output voltage and K is the tachometer constant, then the transfer function is given by:
a) Ks^2
b) K/s
c) K_s
d) K
Answer: c
Explanation: $e(t)=K_w$
$E(s)=K_{sa}(s)$
$E(s)/a(s)=K_s$.

10. Gear train in the motor is used to reduce the gear ratio?
a) True
b) False
Answer: b
Explanation: Gear ratio refers to the ratio of the number of teeths in the respective gears and gear train in the motor is specifically used to increase the gear ratio.

11. Assertion (A): Servomotors have heavier rotors and lower R/X ratio as compared to ordinary motors of similar ratings.
Reason (R): Servomotor should have smaller electrical and mechanical time constants for faster response.
a) Both A and R are true and R is the correct explanation of A
b) Both A and R are true but R is not correct explanation of A
c) A is true but R is false
d) A is false but R is true
Answer: d
Explanation: Ac servomotors are essentially induction motor with low X/R ratio for the rotor which has very low inertia.

12. Assertion (A): DC servomotors are more commonly used in armature controlled mode than field controlled mode.
Reason (R): Armature controlled Dc motors have higher starting torque than fiels

controlled motors.
a) Both A and R are true and R is the correct explanation of A
b) Both A and R are true but R is not correct explanation of A
c) A is true but R is false
d) A is false but R is true
Answer: a
Explanation: To get higher speed in field controlled dc motor, field current is decreased with decrease in torque.

13. In case of DC servomotor, the back emf is equivalent to an "electric friction" which tends to:
a) Slowly decrease the stability of the system
b) Improve stability of the system
c) Very rapidly decrease the stability of the system
d) Have no effect of stability
Answer: b
Explanation: As Back emf in dc servomotors provides necessary centrifugal force to control the speed of the motor that increases the stability of the system.

14. The lagrangian is defined as:
a. Sum of kinetic energy and hydraulic energy
b. Mechanical energy
c. Difference of kinetic and potential energy
d. None of these
Answer: c
Explanation: By definition lagrangian is defined as difference of kinetic and potential energy.
L=K-P.

15. A gantry robot consists of a manipulator mounted on an overhead system that allows movement only in _____ plane.
a) Horizontal
b) Inclined
c) Vertical
d) None of the mentioned
Answer: a
Explanation: Gantry robot allows motion only in horizontal plane and this is made in this geometry to fulfill the respective work.

16. An object stationary or moving in a uniform motion w.r.t A will appear to be traveling in a straight path w.r.t B. This apparent path is attributed to Coriolis acceleration.
a) True
b) False
Answer: b
Explanation: An object stationary or moving in a uniform motion w.r.t A will appear to be traveling in a curved path w.r.t B. This apparent path curvature is attributed to Coriolis

acceleration.”

Transfer Functions

1. Which of the following is not the feature of modern control system?
a) Quick response
b) Accuracy
c) Correct power level
d) No oscillation
Answer: d
Explanation: For a good control system the speed of response and stability must be high and for the slow and sluggish response is not used and undesirable.

2. The output of the feedback control system must be a function of:
a) Reference input
b) Reference output
c) Output and feedback signal
d) Input and feedback signal
Answer: d
Explanation: Feedback control system has the property of reducing the error and that is by differencing the output with the desired output and as the equation of the output of the system is C=GR/1+GH.

3. The principle of homogeneity and superposition are applied to:
a) Linear time invariant systems
b) Nonlinear time invariant systems
c) Linear time variant systems
d) Nonlinear time invariant systems
Answer: c
Explanation: Superposition theorem states that for two signals additivity and homogeneity property must be satisfied and that is applicable for the LTI systems.

4. In continuous data systems:
a) Data may be continuous function of time at all points in the system
b) Data is necessarily a continuous function of time at all points in the system
c) Data is continuous at the inputs and output parts of the system but not necessarily during intermediate processing of the data
d) Only the reference signal is continuous function of time
Answer: b
Explanation: Continuous signals are the signals having values for the continuous time and if impulse response decays to zero as time approaches infinity, the system is stable.

5. A linear system at rest is subject to an input signal $r(t)=1-e^{-t}$. The response of the system for t>0 is given by $c(t)=1-e^{-2t}$. The transfer function of the system is:
a) (s+2)/(s+1)
b) (s+1)/(s+2)

c) 2(s+1)/(s+2)
d) (s+1)/2(s+2)
Answer: c
Explanation: $c(t)=1-e^{-2t}$
R(s)=1/s-1/s+1
C(s)=1/s-1/s+2
Tf=2(s+1)/(s+2).

6. In regenerating the feedback, the transfer function is given by
a) C(s)/R(s)=G(s)/1+G(s)H(s)
b) C(s)/R(s)=G(s)H(s)/1-G(s)H(s)
c) C(s)/R(s)=G(s)/1+G(s)H(s)
d) C(s)/R(s)=G(s)/1-G(s)H(s)
Answer: d
Explanation: Regenerating feedback is positive feedback and it increases the infinitely and hence the speed of response of the system reduces.

7. A control system whose step response is $-0.5(1+e^{-2t})$ is cascaded to another control block whose impulse response is e^{-t}. What is the transfer function of the cascaded combination?
a) 1/(s+2)(s+1)
b) 1/(s+1)s
c) 1/(s+3)
d) 0.5/(s+1)(s+2)
Answer: a
Solution: Laplace transform is the transformation that transforms the time domain into frequency domain and of both the cascaded systems are 1/(s+1)(s+2).

8. A transfer function has two zeroes at infinity. Then the relation between the numerator(N) and the denominator degree(M) of the transfer function is:
a) N=M+2
b) N=M-2
c) N=M+1
d) N=M-1
Answer: b
Explanation: Zeroes at infinity implies two poles at origin hence the type of the system is two and degree of denominator is M=N+2.

9. When deriving the transfer function of a linear element
a) Both initial conditions and loading are taken into account
b) Initial conditions are taken into account but the element is assumed to be not loaded
c) Initial conditions are assumed to be zero but loading is taken into account
d) Initial conditions are assumed to be zero and the element is assumed to be not loaded
Answer: c
Explanation: When deriving the transfer function of a linear element only initial conditions are assumed to be zero, loading cannot be assumed to be zero.

10. If the initial conditions for a system are inherently zero, what does it physically mean?

a) The system is at rest but stores energy

b) The system is working but does not store energy

c) The system is at rest or no energy is stored in any of its part

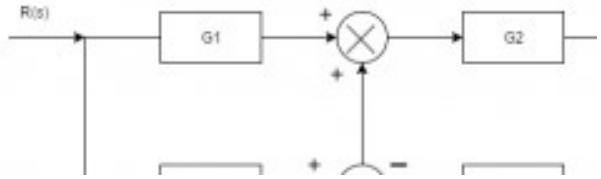
d) The system is working with zero reference input

Answer: c

Explanation: A system with zero initial condition is said to be at rest since there is no stored energy.

Block diagram Algebra

1. Consider the block diagram shown below:



If the transfer function of the system is given by T(s)=G1G2+G2G3/1+X. Then X is:

a) G2G3G4

b) G2G4

c) G1G2G4

d) G3G4

Answer: b

Explanation: Use the technique of making two different block diagram by dividing two summers and use the approaches of shifting take off point and blocks.

2. For the block diagram given in the following figure, the expression of C/R is:

a) G1G2G3/1-G2G1

b) G1G2/1-G1G2G3

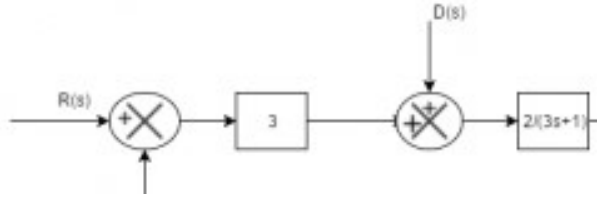
c) G1G2G3/1-G1G2G3

d) G1G2/G3(1-G1G2)

Answer: a

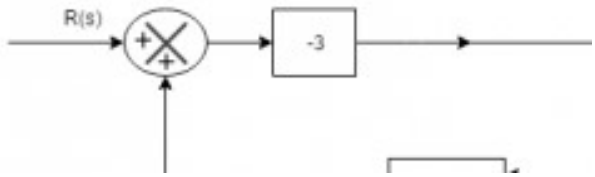
Explanation: Block diagram is being converted into signal flow graphs by considering each take off point as a node and each forward transfer function as forward gain.

3. The transfer function from D(s) to Y(s) is :



a) 2/3s+7
b) 2/3s+1
c) 6/3s+7
d) 2/3s+6
Answer: a
Explanation: Y(s)/D(s)=2/3s+1/1+3*(2/3s+1)=2/3s+7.

4. The closed loop gain of the system shown in the given figure is :



a) -9/5
b) -6/5
c) 6/5
d) 9/5
Answer: b
Explanation: C(s)/R(s)=-3/1+3/2=-6/5.

5. The advantage of block diagram representation is that it is possible to evaluate the contribution of each component to the overall performance of the system.
a) True
b) False
Answer: a
Explanation: The advantage of the block diagram is that it is possible to get the contribution of each block to the overall performance of the system.

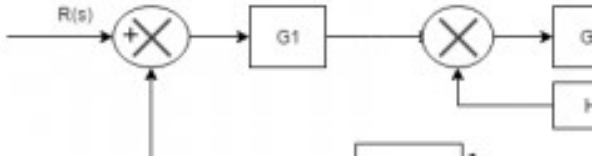
6. The overall transfer function from block diagram reduction for cascaded blocks is :
a) Sum of individual gain
b) Product of individual gain
c) Difference of individual gain
d) Division of individual gain
Answer: b
Explanation: Gain of block get multiplied when they are cascaded where cascaded means that the blocks are in series combination with no summer in between.

7. The overall transfer function of two blocks in parallel are :
a) Sum of individual gain
b) Product of individual gain
c) Difference of individual gain
d) Division of individual gain
Answer: a
Explanation: The gains get added as the blocks are connected in parallel with the summer in between and they are connected with the same sign.

8. Transfer function of the system is defined as the ratio of Laplace output to Laplace input considering initial conditions_____

a) 1
b) 2
c) 0
d) infinite
Answer: c
Explanation: By definition transfer function is the ratio of the laplace output to the input but the initial conditions mainly the stored energy is zero.

9. In the following block diagram, G1=10/s G2=10/s+1 H1=s+3, H2=1. The overall transfer function is given by :



a) $10/11s^2+31s+10$
b) $100/11s^2+31s+100$
c) $100/11s^2+31s+10$
d) $100/11s^2+31s$
Answer: b
Explanation: C/R=G2G1/1+G2H2+G1G2H2
C/R=$100/11s^2+31s+100$.

10. Oscillations in output response is due to :
a) Positive feedback
b) Negative feedback
c) No feedback
d) None of the mentioned
Answer: a
Explanation: Oscillations are the unwanted sinuoidal signals with high gain in positive feedback and s the damping factor is absent in the positive feedback system entirely oscillations are present.

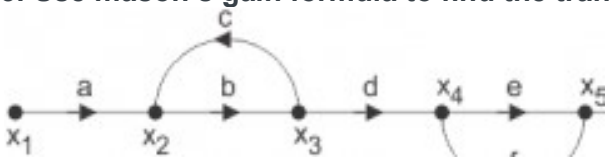
Signal Flow Graphs

1. A signal flow graph is the graphical representation of the relationships between the variables of set linear algebraic equations.
a) True
b) False
Answer: a
Explanation: By definition signal flow graphs are the graphical representation of the relationships between the variables of set linear algebraic equations.

2. A node having only outgoing branches.
a) Input node

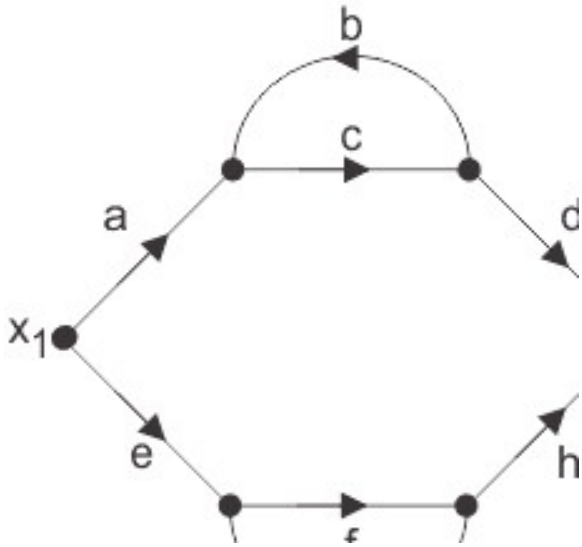
b) Output node
c) Incoming node
d) Outgoing node
Answer: a
Explanation: Nodes are the point by which the branches are outgoing or ingoing and this can be input or output node and input node is the node having only outgoing branches.

3. Use mason's gain formula to find the transfer function of the given signal flow graph:



a) abd/1-(ac)
b) abdeg/1-(bc+ef)+bcef
c) abd/1-(bc+ef)+bcef
d) adcdef/1-(bc+ef)+bcef
Answer: b
Explanation: Using mason's gain formula transfer function from signal flow graph can be calculated which relates the forward path gain to the various paths and loops.

4. Use mason's gain formula to find the transfer function of the following signal flow graph:



a) abcd+efg/1-cd-fg-cdfg
b) acdfg+bcefg/1-cd-fg-cdfg
c) abef+bcd/1-cd-fg-cdfg
d) adcdefg/1-cd-fg-cdfg
Answer: b
Explanation: Using mason's gain formula transfer function from signal flow graph can be calculated which relates the forward path gain to the various paths and loops.

5. Loop which do not possess any common node are said to be _____ loops.

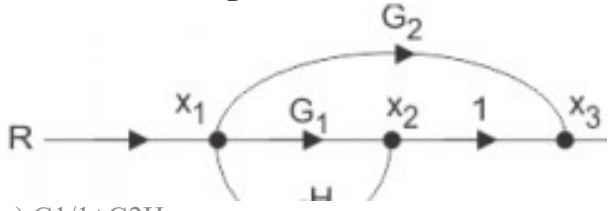
a) Forward gain
b) Touching loops
c) Non touching loops
d) Feedback gain
Answer: c
Explanation: Loop is the part of the network in which the branch starts from the node and comes back to the same node and non touching loop must not have any node in common.

6. Signal flow graphs:
a) They apply to linear systems
b) The equation obtained may or may not be in the form of cause or effect
c) Arrows are not important in the graph
d) They cannot be converted back to block diagram
Answer: a
Explanation: Signal flow graphs are used to find the transfer function of control system by converting the block diagrams into signal flow graphs or directly but cannot be used for nonlinear systems.

7. Signal flow graphs are reliable to find transfer function than block diagram reduction technique.
a) True
b) False
Answer: a
Explanation: As one set technique and formula is used here but in block diagram technique various methods are involved which increases complexity.

8. The relationship between an input and output variable of a signal flow graph is given by the net gain between the input and output node is known as the overall_____
a) Overall gain of the system
b) Stability
c) Bandwidth
d) Speed
Answer: a
Explanation: The relationship between input and output variable of a signal flow graph is the overall gain of the system.

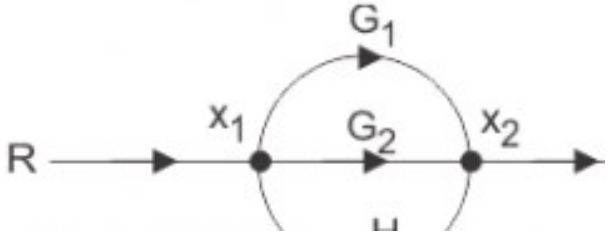
9. Use mason's gain formula to calculate the transfer function of given figure:



a) G1/1+G2H
b) G1+G2/1+G1H

c) G2/1+G1H
d) None of the mentioned
Answer: b
Explanation: Use mason's gain formula to solve the signal flow graph and by using mason's gain formula transfer function from signal flow graph can be calculated which relates the forward path gain to the various paths and loops.

10. Use mason's gain formula to find the transfer function of the given figure:



a) G1+G2
b) G1+G1/1-G1H+G2H
c) G1+G2/1+G1H+G2H
d) G1-G2
Answer: c

1) A major part of the automatic control theory applies to the:

a. Casual systems
b. Linear Time invariant systems
c. Time variant systems
d. Non-linear systems

Hide Answer Workspace

Answer: (b) Linear Time invariant systems

Explanation: A linear time invariant (LTI) system provides the same output for the same input irrespective of when input is given. LTI systems are also used to predict the system's long term behavior.

Hence the correct answer is an option (b).

---

2) Traffic light system is the example of:

a. Open-loop system
b. Closed-loop system
c. Both (a) and (b)
d. None of these

Hide Answer Workspace

Answer: (a) Open-loop system

Explanation: The traffic lamp will glow according to the set timing and sequence and is time-dependent. The sequence and time are controlled by relays that work on the pre-programmed time. It does not depend upon the rush of the road.

Hence the correct answer is an option (a).

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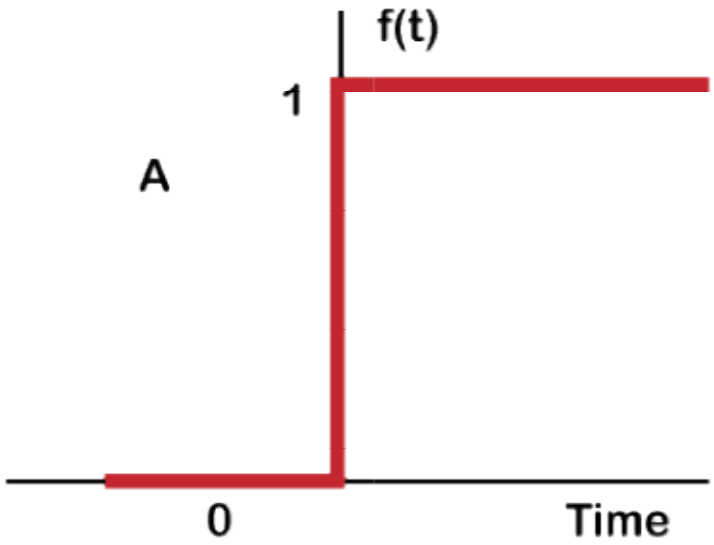
3) Laplace transform of a step function shown below is:



a. 1
b. 1/s^2
c. 0
d. 1/s

Hide Answer Workspace

Answer: (d) 1/s

Explanation: The abrupt change in input of a step function takes place at t=0, and the step's size is1 unit.

Let the size of the step function be A, where A=1.

The Laplace transform of a function is given by:

$L[f(t)] = F(s) = \int_0^{\infty} f(t)\, e^{-st}\, dt$

$F(s) = \int_0^{\infty} Af(t)\, e^{-st}\, dt$

$F(s) = -A/s\ (e^{-\infty} - e^{-0})$

$F(s) = A/s$

We know, A =1

$F(s) = 1/s$

Hence the correct answer is an option (d).

---

4) The negative feedback closed-loop system was subjected to 15V. The system has a forward gain of 2 and a feedback gain of 0.5. Determine the output voltage and the error voltage.

a. 15V, 10V
b. 6V, 5V
c. 15V, 7.5V
d. 5V, 10V

Hide Answer Workspace

Answer: (c) 15V, 7.5V

Explanation:

Given:

G(s) = 2

H(s) = 0.5 and R(s) = 10V

Output voltage: $\frac{G(s)}{1+G(s)H(s)} R($

= (2/1+2x 0.5) x 15 = 15V

Error voltage: $\frac{1}{1+G(s)H(s)} R($

= (1/1+2x 0.5) x 15 = 7.5V

Hence the correct answer is option (c).

5) The Static system can be defined as:

a. Output of a system depends on the present as well as past input.
b. Output of a system depends only on the received inputs.
c. Output of the system depends on future inputs.
d. Output of the system depends only on the present input.

Hide Answer Workspace

Answer: (d) Output of the system depends only on the present input

Explanation: Static systems do not have any feedback system. Hence, the output depends only on the present input.

Hence, the correct answer is an option (d).

---

6) Find the function f(t) for the following function F(s):

$$F(s) = \frac{1}{s(s+1)(s}$$

a. $0.25e^{-t}+0.05e^{-5t}$
b. $-0.2-0.25e^{-t}+0.05e^{-5t}$
c. $-0.2+0.25e^{-t}+0.05e^{-5t}$
d. $0.25e^{-5t}+0.05e^{-t}$

Hide Answer Workspace

Answer: (b) $-0.2-0.25e^{-t}+0.05e^{-5t}$

Explanation: The given function can be written as:

$$F(s) = \frac{1}{s(s+1)(s} = A/s + B/ (s+1) + C/(s+5)$$

$1 = A(s+1)(s+5) + Bs(s+5) + Cs(s+1)$

To calculate the value of A, put s= 0, we get:

$1 = A(1)(5)$

$A = 1/5 = 0.2$

Now, to calculate the value of B, put s=-1, we get:

1 = B (-1)(4)

B = -1/4 = -0.25

Similarly, put s=-5, we get:

1 = C (-5) (-4)

C = 1/20 = 0.05

Substituting the value of A, B, and C in F(s), we get:

F(s) = A/s + B/ (s+1) + C/(s+5)

F(s) = 0.2/s - 0.25/ (s+1) + 0.05/(s+5)

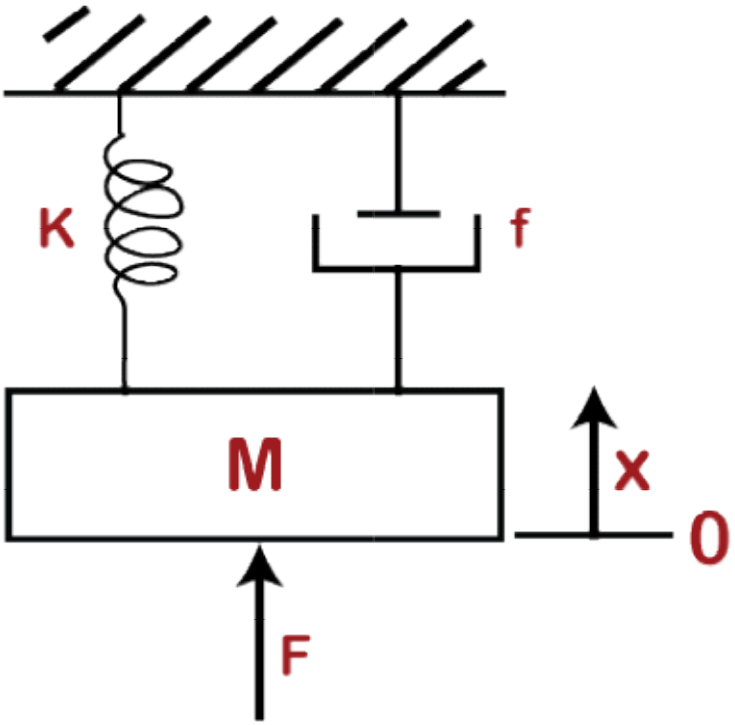
We know, Laplace transform of $1/(s + a) = e^{-at}$ and $1/s = 1$.

$f(t) = -0.2-0.25e^{-t}+0.05e^{-5t}$

Hence the correct answer is option (b).

---

7) The force equation of the given system is:



a. $F = K\frac{d^2x}{dt^2} + f\frac{dx}{dt} + Mx$

b. $F = f\frac{d^2x}{dt^2} + K\frac{dx}{dt} + Mx$

c. $F = M\frac{d^2x}{dt^2} + f\frac{dx}{dt} + Kx$

d. $F = K\frac{d^2x}{dt^2} + M\frac{dx}{dt} + fx$

Hide Answer Workspace

Answer: (c) $F = M\frac{d^2x}{dt^2} + f\frac{dx}{dt} + Kx$

Explanation:

Given: x is the displacement in the above diagram. The Laplace transform of x is X(s). The differential equations governing the system are the balanced force equation at these nodes.

Here,

F is the opposite force due to mass.

F = $M\frac{d^2x}{dt^2}$

f is the opposite force due to friction

F = $f\frac{dx}{dt}$

k is the ideal elastic spring element that has negligible mass and friction. The force generated by the spring is directly proportional to the displacement of the body.

F = Kx

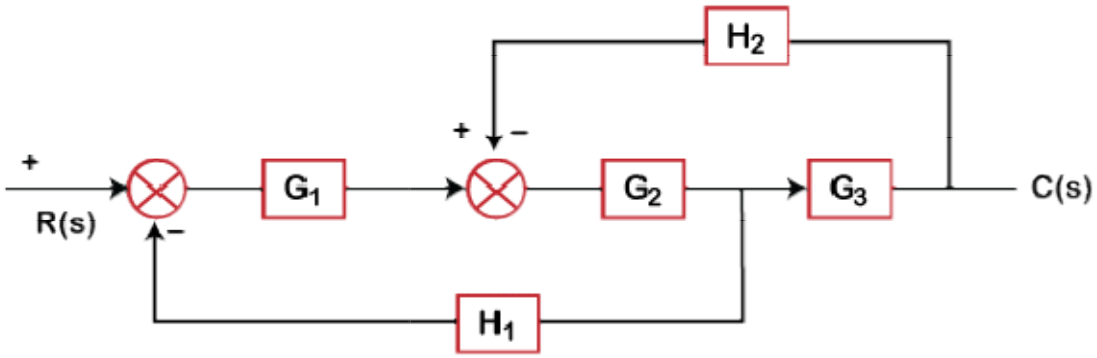
So, the force equation can be represented as:

$$F = M\frac{d^2x}{dt^2} + f\frac{dx}{dt} + Kx$$

Hence, the correct answer is an option (c).

---

8) Determine the transfer function of the given system:



a. G1G2G3/ (1 + H2G2G3 + G2G1H1)

b. G1 G2G3/ (1 + G1G2G3H2H1)

c. G1G2G3 / (1 + G1G2G3H1 + G1G2G3H2)

d. G1G2G3 / (1 + G1G2G3H1)

Hide Answer Workspace

Answer: (a)

Explanation: We will first shift the H1 block after G3

The shifting of a take-off point will make the block as: H1/ G3

Block G2 and G3 are in cascade. The equivalent block will be the product of these two (G2G3).

The gain for that block will be:

G2G3/ (1 + H2G2G3)

As shown, G1 is in cascade, the transfer function of the above system will be:

C(s)/R(s) = [G1G2G3/ (1 + H2G2G3)]/ [1 + G1G2G3/ (1 + H2G2G3) x H1/G3

C(s)/R(s) = G1G2G3/ (1 + H2G2G3 + G2G1H1)

Hence, the correct answer is an option (a).

---

9) Loop gain is equal to:

a. Product of all branch gains in a loop
b. Product of all branch gains while traversing the forward path
c. Summation of all branch gains in a loop
d. Sum of all branch gains while traversing the forward path

Hide Answer Workspace

Answer: (b) Product of all branch gains while traversing the forward path

Explanation: According to Mason's Gain formula, the transfer function can be calculated as:

T(s) = C(s)/R(s)

$$T(s)= \frac{\sum_{i=1}^{K} P_k \Delta}{\Delta}$$

Where,

Pk is the forward path gain

Δistheloopgain, which is calculated as:

Δ=1-∑(Allloopgain) + ∑(Gainproductoftwonon-touchingloops)-∑(Gainproductofthreenon-touchingloops)

Δ_k iscalculatedbyeliminatingallloopstouchingPk

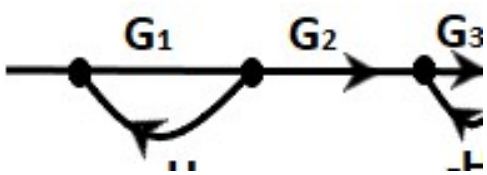
Here, the loop gain is defined as the product of the branch gain that is traversing a forward path.

Hence, the correct answer is an option (b).

The Mason's gain formula is used to find the overall transfer function of a signal graph.

---

10) Find the overall transfer function of the given signal flow graph.



a. G1G2G3/ (1 + G1H1 + G3H2 + G3G1H1H2)
b. G1G3/ (1 + G1H1 + G3H2 + G3G1)
c. (G1G2G3 + G1H1)/ (1 + G1H1 + G3H2 + G3G1H1H2)
d. (G1G2G3 + G1H1 + G3H2) / (1 + G1H1 + G3H2 + G3G1H1H2)

Hide Answer Workspace

Answer: (a) G1G2G3/ (1 + G1H1 + G3H2 + G3G1H1H2)

Explanation: Here, we will calculate the transfer function using mason's gain formula:

$$T(s)=\frac{\sum_{i=1}^{K} P_k \Delta}{\Delta}$$

Where,

Pk is the forward path gain

Δistheloopgain, which is calculated as:

Δ=1-∑(Allloopgain) + ∑(Gainproductoftwonon-touchingloops)-∑(Gainproductofthreenon-touchingloops)

Δ_k iscalculatedbyeliminatingallloopstouchingPk

Now,

Step 1: From the figure, let's identify the forward path,

P1 = G1G2G3

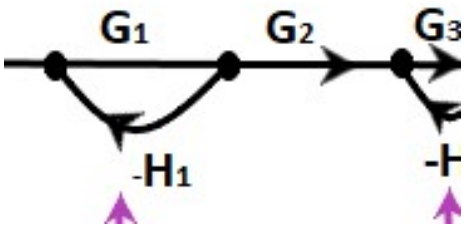
There is only one forward path in the above figure.

Step 2: Now, let's find the loop gain. There are two loops:

L1 = -G1H1

L2 = -G3H2

Step 3: Two non-touching loops. There is only one combination of two non-touching loops, as shown below:



L1 L2 = G3G1H1H2

Step 4: Since there are no three non-touching loops, we will directly find the system's determinant.

Δ= 1 - (L1+ L2) + (L1L2)

= 1 + G1H1 + G3H2 + G3G1H1H2

Step 5: Here, we will find Δ_1 because there is only one forward path.

For Δ_1, we will eliminate L1 and L2 because both loop gains are touching the forward path.

L1 = L2 = 0

Δ_1=1-0=1

Now, the transfer function is obtained as: C/R = G1G2G3/ (1 + G1H1 + G3H2 + G3G1H1H2)

Hence the correct answer is an option (a).

---

11) The block diagram representation of a closed-loop system. Write the time response equation for the given system with a unit step input, assuming zero initial conditions.

a. $1-e^{-t/5}$
b. $1-e^{t/10}$
c. $1-e^{-t/10}$
d. $1+e^{-t/10}$

Hide Answer Workspace

Answer: (c) $1-e^{-t/10}$

Explanation:

The transfer function of a loop is G/ (1+GH)

We will first simplify the above block diagram into the simple system. Let's calculate the transfer function of the first loop.

TF = [1/ (40s+2)] / [1 + 2/ (40s+2)] = 1/ (40s +4)

Now, two blocks are left in cascade. The equivalent block is the product of these two blocks, as given below:

C(s)/R(s) = 4. (1/ (40s +4)) = 1/ (10s + 1)

The Laplace transform of the step input is 1/s. It means R(s) = 1/s.

C(s) = [1/ (10s + 1)]. R(s)

C(s) = [1/ s (10s + 1)

Taking the inverse Laplace of the above equation, we get:

$1-e^{-t/10}$

---

12) If the characteristic equation of the closed loop system is s^2 + 2s + 2 = 0, then the system is:

a. Over damped
b. Critically damped
c. Undamped
d. Underdamped

Hide Answer Workspace

Answer: (d) Underdamped

Explanation: The given equation is: s^2 + 2s + 2 = 0

It is a second-order differential equation. The Laplace transform of a standard form of a second-order differential equation is:

$$s^2 + 2\omega_n \delta s$$

Comparing the values, we get:

$$\omega_n = \sqrt{}$$

$$2\omega_n \delta =$$

$$\delta = \frac{1}{\sqrt{}}$$

Thus, the system is underdamped.

Hence, the correct answer is an option (d).

---

13) The transfer function of a system is given as 81/ (s^2 + 16s + 81). Find the undamped natural frequency, damping ratio, and peak time for a unit step input.

a. 9, 0.889, 0.762
b. 9, 0.559, 0.762
c. 9, 0.889, 0.187
d. 9, 0.667, 0.187

Hide Answer Workspace

Answer: (a) 9, 0.889, 0.762

Explanation: The standard transfer function can be written as:

$$\frac{Y(s)}{X(s)} = K\,\omega_n^2/(s|2 + 2\omega_n \zeta$$

The given equation is: 81/ (s^2 + 16s + 81)

Comparing the values, we get:

K= 1

$\omega_n^2 = 81$

$\omega_n = 9$ Radians / s

$$2\omega_n\delta = 16$$

Thus, the undamped natural frequency is 9, and the damping ratio is 0.889.

The Peak time can be calculated as:

$$Tp = \frac{\pi}{\omega_d}$$

$$\omega_d = \omega_n\sqrt{(1 - \zeta}$$

$$\omega_d = 4.12$$

$$Tp = \frac{\pi}{4.12}$$

Hence, the correct answer is an option (a).

---

14) The closed loop transfer function for a second order system is: T(s) = 4/ (s^2 + 4s + 4). Calculate the settling time for a 2 percent and 5 percent band.

a. 5, 2.0
b. 0, 10.0
c. 0, 1.5
d. 0, 2.0

Hide Answer Workspace

Answer: (c) 2.0, 1.5

Explanation: The standard transfer function can be written as:

$$\frac{Y(s)}{X(s)} = K\,\omega_n^2/(s|2 + 2\omega_n\delta s$$

The given equation is: 4/ (s^2 + 4s + 4)

Comparing the values, we get:

K= 1

$$\omega_n^2 = 4$$

$$\omega_n = 2 \text{ Radian}$$

$$2\omega_n\delta = 4$$

The settling time for a 2 percent band is calculated as:

$$Ts = \frac{}{\delta}$$

$$Ts =$$

Settling time = 2 seconds

The settling time for a 5 percent band is calculated as:

$$Ts = \frac{}{\delta}$$

$$Ts =$$

Settling time = 1.5 seconds

Hence, the correct answer is an option (c).

---

15) Consider a system with transfer function G(s) = (s + 4)/ (ks^2 + s + 4). The value of damping ratio will be 0.5 when the value of k is:

a. ½
b. ¼

c. 8
d. 4

Hide Answer Workspace

Answer: (b) ¼

Explanation: The given transfer function is:

G(s) = (s + 4)/ (ks^2 + s + 4)

The characteristic equation ks^2 + s + 4 = 0

Dividing the equation by k, we get:

S^2 +s/k + 4/k = 0

$$\omega_n^2 = 4/k$$

$$2\omega_n\delta = \frac{1}{k}$$

$$2 \times 0.5 \times \sqrt{\left(\frac{4}{k}\right)} =$$

Hence, the correct answer is an option (b).

---

16) The step error coefficient of a system G(s) = 1/ (s+2)(s+3) with unity feedback is:

a. 0
b. Infinite
c. 1
d. 1/6

Hide Answer Workspace

Answer: (d) 1/6

Explanation: The step error can be calculated as:

ess = sR(s)/ (1 + G(s))

R(s) = 1/s (in case of unity feedback)

G(s) = 1/ (s+2)(s+3)

ess = (s x 1/s)/ (1 + (1/ (s+2)(s+3)))

ess = 1/(1 + kp)

Where, kp is the step error coefficient

Kp can be calculated as:

$$Kp = \lim_{s \to 0} \frac{1}{(s+2)(s}$$

$$Kp = \frac{1}{2.3}$$

$$Kp = \frac{1}{}$$

Hence, the correct answer is an option (d).

---

17) The transfer function of a control system is given by G(s) = 25/ (s^2 + 6s + 25). The first maximum value of the response occurs at t, which is given by:

a. π/2
b. π/8
c. π/4
d. π

Hide Answer Workspace

Answer: (c) π/4

Explanation: The given transfer function is: G(s) = 25/ (s^2 + 6s + 25)

Comparing the value of the given transfer function with the standard equation

$$G(s) = K\,\omega_n^2/(s|2 + 2\omega_n\delta s +$$

We get:

$$\omega_n^2 = 25$$

$$\omega_n = 5$$

$$2\omega_n\delta = 6$$

$$\delta = 0.6$$

$$\omega_d = \omega_n\sqrt{(1-\delta^2)}$$

$$\omega_d = 5\sqrt{(1-0.6^2)}$$

$$\omega_d = 5\sqrt{(1-0.36)}$$

$$\omega_d = 5\sqrt{(0.64)}$$

$$\omega_d = 5 \times 0.8$$

$$\omega_d = 4$$

We know

Hence, the correct answer is option (c).

---

18) The impulse response of an RL circuit is:

a. Parabolic function
b. Step function
c. Rising exponential function
d. Decaying exponential function

Hide Answer Workspace

Answer: (d) Decaying exponential function

Explanation: The RL circuit comprises of the resistor and inductor connected in series.

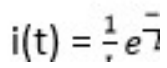
The equation can be written as:

1 = RI(s) + sLI(s)

1 = I(s) [R + sL]

I(s) = 1 / (R +sL)

Taking the inverse Laplace, we get:



The equation clearly depicts that the impulse response is a decaying exponential function.

Hence, the correct answer is option (d).

---

19) Calculate the poles and zeroes for the given transfer function G(s) = 5 (s + 2)/ (s^2 + 3s + 2)

a. -2, (-1, -2)
b. 2, (-1, 2)
c. 2, (1, 2)
d. -2, (1, -2)

Hide Answer Workspace

Answer: (a) -2, (-1, -2)

Explanation: The zeroes can be calculated by equating the numerator to zero:

5 (s + 2) = 0

5s + 10 = 0

5s = -10

s = -2

The poles can be calculated by equating the denominator to zero:

s^2 + 3s + 2 = 0

s^2 + 2s + s + 2 = 0

s (s + 2) + 1 (s + 2) = 0

(s + 1) (s + 2) = 0

s = -1, -2

Hence, the correct answer is an option (a).

---

20) The number of roots in the left half of the s-plane of the given equation s^3 + 3s^2 + 4s + 1 = 0 is:

a. One
b. Three
c. Two
d. Zero

Hide Answer Workspace

Answer: (b) Three

Explanation: The given characteristic equation is: s^3 + 3s^2 + 4s + 1 = 0.

To find the number of roots, we need to create a Routh table, as shown below:

s^3	1	4
s^2	3	1
s^1	11/3	0
s^0	1	

There are no roots and no significant changes in the RHS plane, as shown in the above table. Hence, all three roots lie in the LHS plane.

Hence, the correct answer is an option (b).

---

21) A system with the polynomial s^4 + 5s^3 + 3s^2 + 6s + 5 = 0 is:

a. Unstable
b. Marginally stable
c. In equilibrium
d. Stable

Hide Answer Workspace

Answer: (a) Unstable

Explanation: The given characteristic equation is: s^4 + 5s^3 + 3s^2 + 6s + 5 = 0. We first need to find the roots by creating the Routh's array table.

Routh's array table is shown below:

s^4	1	3	5
s^3	5	6	0
s^2	9/5	5	
s^1	-71/9	0	

In the first column of the above table, we have two sign changes. It means that two roots are in the RHS plane. Hence, the system is unstable.

Hence the correct answer is an option (a).

---

22) If s^3 + Ks^2 + 5s + 10 = 0, the root of the feedback system's characteristic equation is said to be critically stable. Then, the value of K will be:

a. 1
b. 2
c. 3
d. 4

Hide Answer Workspace

Answer: (b) 2

Explanation: For the above equation, we need to find the roots by creating the Routh's array table. The given equation is: s^3 + Ks^2 + 5s + 10

The table is given below:

s^3	1	5
s^2	K	10
s^1	(5K -10)/K	0

For the system to be critically stable, we will put (5K -10)/K = 0

5K - 10 = 0

5K = 10

K = 2

The value of K for which the system is said to be critically stable is 2.

Hence, the correct answer is an option (b).

---

23) If s^3 + 3s^2 + 4s + A = 0, the roots of the characteristic equation lie in the left half of the s-plane. The value of the A is said to be:

a. 0 < A < 12
b. 5< A < 12
c. A > 12
d. A < 12

Hide Answer Workspace

Answer: (a) 0 < A < 12

Explanation: For the above equation, we need to find the roots by creating the Routh's array table. The given equation is: s^3 + 3s^2 + 4s + A = 0

The table is given below:

s^3	1	4
s^2	3	A
s^1	(12 – A)/3	0
s^0	A	

There is no change in sign in the first column of the Routh table. It means that all roots lies in the left half of the s-plane.

Putting A and (12 - A)/3 > 0, we get:

A > 0 (or 0 < A)

(12 - A)/3 > 0

12 - A > 0

12 > A (or A < 12)

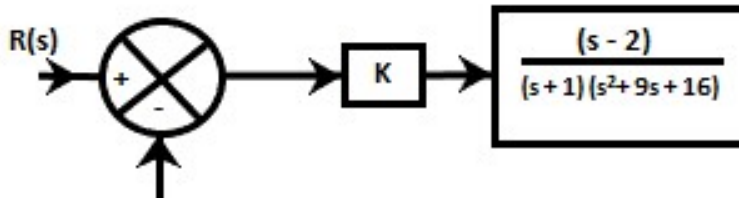
From the above equations, we get two values of A, i.e., A > 0 and A < 12. It means that A lies between 0 and 12, as shown below:

0 < A < 12

Hence, the correct answer is an option (a).

---

24) For the given closed-loop system, the ranges of the values of K for stability is:



a. K > -19.5
b. k > 8
c. -19.5 < k < 8
d. K > 0

Hide Answer Workspace

Answer: (c) -19.5 < k < 8

Explanation: The two blocks in the above diagram are in cascade. So, the equivalent block will be the product of these two blocks.

G(s) = k (s - 2) /(s +1) (s^2 + 9s + 16)

Now, H(s) = 1, as shown in the above block diagram. The characteristic equation will be: 1 + G(s) H(s)

C(s) = 1 + [k (s - 2) / (s + 1) (s^2 + 9s + 16)] = 0

= s^3 + 10s^2 + 25s + 16 + ks - 2k

= s^3 + 10s^2 + s (25 + k) + 16 - 2k

For the above equation, we need to find the roots by creating the Routh's array table.

The table is given below:

s^3	1	(25 + k
s^2	10	16 - 2k
s^1	[10 (25 + k) – (16 -2k)] /10	0
s^0	16 - 2k	

For stability,

16 - 2k > 0

16 > 2k

8 > k or k < 8

10 (25 + k) - (16 -2k) /10 > 0

250 + 10k -16 + 2k > 0

12k + 234 > 0

12k > -234

k > -19.5

From the two values of k, we can say that it lies between -19.5 < k < 8

Hence, the correct answer is an option (c).

---

25) Find the number of asymptotes for the given open-loop transfer function of a unity feedback system:

G(s) = ((s + 2) (s+3) (s + 4)) / ((s + 5) (s+6) (s + 1))

a. 1
b. 0
c. 2
d. 3

Hide Answer Workspace

Answer: (b) 0

Explanation: The number of asymptotes in a given system is equal to the number of branches approaching infinity. So, the formula to calculate the number of asymptotes is P -Z. Here, P and Z represent the poles and zeroes.

We know that poles and zeroes are calculated by equating the denominator and numerator to zero. So, for the given open-loop transfer function, we get:

P = 3

Z = 3

So, the number of zeroes at infinity = 3 - 3 = 0

Hence, the correct answer is an option (b).

---

26) An open loop transfer function is given by G(s) = K (s + 1) / (s + 4)(s^2 + 3s + 2). It has:

a. One zero at infinity
b. Three zeroes at infinity
c. Two zeroes at infinity
d. None of the above

Hide Answer Workspace

Answer: (c) Two zeroes at infinity

Explanation: The formula to calculate a number of zeroes at infinity is P - Z. Here, P and Z are the number of poles and zeroes in a given transfer function.

We know that poles are calculated by equating the denominator to zero, and zeroes are calculated by equating the numerator to zero. So, for the above given transfer function, we get:

P = 3

Z = 1

So, the number of zeroes at infinity = 3 - 1 = 2

Hence, the correct answer is an option (c).

---

27) The centroid in the root locus is a point where

a. The branches of the root locus intersect with the imaginary axis.
b. The branches of the root locus tend to infinity.
c. The asymptotes cross the real axis.
d. The branches of the root locus terminate on the real axis.

Hide Answer Workspace

Answer: (c) The asymptotes cross the real axis.

Explanation: Centroid is defined as a common point where all the asymptotes intersect on the real axis. The value of centroid is always real. But, it can be located either on the positive or negative real axis.

---

28) Calculate the centroid for the given system:

G(s) = K / [(s + 1) (s + 4 + 4j) (s + 4 - 4j)]

a. - 1.47
b. -2
c. -2.66
d. -3

Hide Answer Workspace

Answer: (d) -3

Explanation:

We will first calculate the number of branches approaching infinity and then the asymptotes. With the help of asymptotes, we will calculate the value of centroid.

The given transfer function of the system is G(s) = K / [(s + 1) (s + 4 + 4j) (s + 4 - 4j)].

The number of asymptotes is equal to the number of branches approaching infinity. There are no zeroes but three poles.

So, P - Z = 3

Let's calculate the value of the poles by equating the denominator equal to zero. We get:

Poles located at: -1,

The angle of asymptotes is calculated by:

Θ = (2q + 1) 180 / (P - Z)

Here, q = 0, 1, 2...

The number of asymptotes is equal to the number of branches approaching infinity.

So, we will calculate the asymptotes at value 0, 1, and 2.

For q = 0,

Θ=180⁄3=60degrees

For q = 1,

Θ=(2+1) 180⁄3=180degrees

For q = 2,

Θ=(4+1) 180⁄3=300degrees

Centroid is defined as a common point where all the asymptotes intersect on the real axis.

σ= / (P - Z)

σ= (- 1 - 4 - 4 - 0) / 3

σ=(-9)⁄3

σ=-3

Hence, the correct answer is an option (d).

---

29) The characteristic equation of the feedback control system is given as: s^3 + 4s^2 + (K + 5)s + K = 0

Here, K is a scalable variable parameter. In the root loci diagram of the system, the asymptotes of the root locus for large values of K meet at a point in the s-plane whose coordinate is:

a. (-1.5, 0)

b. (-2, 0)

c. (-1, 0)

d. (2, 0)

Hide Answer Workspace

Answer: (b) (-2, 0)

Explanation:

The given equation for the feedback control system is s^3 + 5s^2 + (K + 6)s + K = 0.

The above equation can also be written as:

s^3 + 5s^2 + Ks + 6s + K = 0

s^3 + 5s^2 + 6s + K(s + 1) = 0

s (s^2 + 5s + 6) + K(s + 1) = 0

1 + K(s + 1) / [s (s^2 + 5s + 6)] = 0

1 + K(s + 1) / s (s^2 + 2s + 3s + 6) = 0

1 + K(s + 1) / s (s + 2)(s + 3) = 0

Now, we will calculate the value of centroid, which is equal to:

σ= / (P - Z)

Here, the number of poles and zeroes are 3 and 1.

σ= [(0 - 2 - 3) + 1] / (3 - 1)

σ=(-4)/2

σ=-2

Hence, the correct answer is option (b).

---

30) In a bode-plot of a unity feedback control system, the value of phase of G(jw) at the gain cross over frequency is -115 degrees. The phase margin of the system is:

a. 115 degrees

b. -57.5 degrees

c. -65 degrees
d. 65 degrees

Hide Answer Workspace

Answer: (d) 65 degrees

Explanation: The phase margin can be calculated as 180 +

Where,

Ø is the phase of G(jw) at the gain cross over frequency.

So, phase margin = 180 + (-115)

= 180 - 115

= 65 degrees

Hence, the correct answer is an option (d).

---

31) The gain margin of a second-order system is:

a. Zero
b. Infinite
c. One
d. Two

Hide Answer Workspace

Answer: (b) Infinite

Explanation: The gain margin indicates the additional gain provided to the system without affecting its stability.

The total phase shift of a second-order system is approximately equal to 180 degrees, which leads to the infinite frequency. Thus, the gain margin is also infinite.

Hence, the correct answer is an option (b).

---

32) Determine the phase cross-over frequency of the given open-loop transfer function:

G(s) = 1 / s(s + 1) (2s + 1)

a. 606 Radians / second

b. - 1. 707 Radians / second
c. 707 Radians / second
d. - 0. 707 Radians / second

Hide Answer Workspace

Answer: (c) 0. 707 Radians / second

Explanation: The given open-loop transfer function is: G(s) = 1 / s(s + 1) (2s + 1)

Let s = $j\omega$

$$G(j\omega) = \frac{1}{j\omega(j\omega + 1)(2j\omega}$$

$$G(j\omega) = \frac{1}{j\omega(1 + j\omega + 2j\omega}$$

$j^2 = -1$

$$G(j\omega) = \frac{1}{j\omega(1 + 3j\omega - 2}$$

The imaginary part of the system at phase cross over frequency is zero. Hence, we will equate the imaginary part to zero, as shown below:

$$\omega(1 - 2\omega^2) =$$

We get two values of ω

$$\omega = 0 \wedge \omega =$$

1

It means that the phase cross-over frequency to the system is 0.707 Radians/s.

Hence, the correct answer is an option (c).

---

33) Determine the gain margin of the given open-loop feedback control system: G(s)H(s) = 1 / [(s + 1) ^3]

a. 2
b. 4
c. 8
d. 32

Hide Answer Workspace

Answer: (c) 8

Explanation: The given open-loop feedback control system is: G(s)H(s) = 1 / [(s + 1) ^3]

The phase angle for the cross-over frequency can be calculated by:

$-3 \tan^{-1} \omega = -180°$

We get the value of $\omega = \sqrt{3}$

Now, the gain margin is the magnitude of the transfer function, as shown below:

$= 1 / |G(s)H(s)| = |(j\sqrt{3}+1^3|$

= 8

Hence, the correct answer is an option (c).

---

34) The phase margin of the given system G(s) = 1 / [(s + 1) ^3] is:

a. Π
b. -Π
c. 0
d. Π/2

Hide Answer Workspace

Answer: (a) Π

Explanation: The phase margin can be calculated as: 180 + ø

Where,

ø is the phase of G(jω) at the gain cross over frequency.

We will first find the magnitude of the given system, as shown below:

$$\frac{1}{\left(\sqrt{\omega^2+1}\right)^3} = 1$$

$$\omega^2 + 1 = 1$$

$$\omega = 0\, rad/sec$$

$$\emptyset = -3tan^{-1}\omega = 0 \text{ degree}$$

Hence, the correct answer is an option (a).

---

35) The corner frequency in the Bode plot is:

a. The frequency at which bode plot slope is 0 dB /decade.
b. The frequency at which bode plot slope is -10 dB /decade.
c. The frequency at which the two asymptotes intersect.
d. The frequency at which the two asymptotes meet.

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Answer: (d) The frequency at which the two asymptotes meet.

Explanation: The frequency at which the two asymptotes in the Bode plot meet is termed as corner frequency.

Hence, the correct answer is an option (d).

---

36) Which of the following statements are correct?

1. Bode plot is in the frequency domain.

2. Root locus is in the time domain.

3. Nyquist criteria are in the frequency domain.

4. Routh Hurwitz's criteria are in the time domain.

a. 1 and 2
b. 1 and 3
c. 1, 3, and 4
d. 2 and 3

Hide Answer Workspace

Answer: (b) 1 and 3

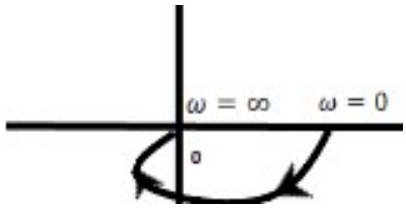
Explanation: The Bode plot is defined as the frequency response plot of the sinusoidal transfer function of a system. The two graphs of the Bode plot are the plot of magnitude and phase angle. Thus, it is in the frequency domain.

The Nyquist plot is considered as the extension of the polar plot. The variation of frequency from infinity to -infinity results in the plot, known as the Nyquist plot. Hence, the Nyquist criterion is in the frequency domain.

Hence, the correct answer is an option (b).

---

37) Determine the type and order of the given Nyquist plot:



a. 1, 2
b. 0, 1
c. 2, 1
d. 0, 2

Hide Answer Workspace

Answer: (d) 0, 2

Explanation: The given plot is of the type 1/ (ST1 + 1)(ST2 + 1)

The above transfer function has order 2 and type 0.

Hence, the correct answer is an option (d).

---

38) Calculate the damping ratio of the system whose phase margin is 45 degrees.

a. 1
b. 42
c. 5
d. 0

Hide Answer Workspace

Answer: (b) 0.42

Explanation: The formula to calculate the damping ratio using the phase margin is:

Damping Ratio = tanØ√cos Ø⁄2

= ((tan45√cos45))⁄2

= 0. 42

Hence, the correct answer is an option (b).

---

39) The GM of a unity feedback system with the transfer function 1/ (s + 5)^3 is:

a. 10 dB
b. 30 dB
c. 60 dB
d. 40 dB

Hide Answer Workspace

Answer: (c) 60 dB

Explanation: The Phase margin can be calculated as:

$$Ø = -3tan^{-1}\omega$$

$$Ø = -3tan^{-1}\left(\frac{\omega}{5}\right) = -180 \text{ deg}$$

$$tan^{-1}\left(\frac{\omega}{5}\right) = 60$$

$$\frac{\omega}{5} = \sqrt{3}$$

The gain margin (GM) = 20 log (1 / |G(s)H(s)|)

At, s = jω

We get: (GM) = 60dB

Hence, the correct answer is an option (c).

40) The most powerful controller is:

a. PD controller
b. PI Controller
c. PID Controller
d. None of the above

Hide Answer Workspace

Answer: (c) PID Controller

Explanation: The PID is the combination of proportional, integral, and derivate control modes. Such a combination makes it the most powerful controller.

Hence, the correct answer is an option (c).

---

41) What will be the controller output for PD controller at t = 2s, if the error begins to change from 0 at the rate of 1.2% /s? The given parameters are Po = 50%, Kp = 4, and KD = 0.4.

a. 61.52%
b. 61.92%
c. 51.52%
d. 51.92%

Hide Answer Workspace

Answer: (a) 61. 52%

Explanation: The error the rate of 1.2% per second c neb calculated as:

e = 1.2% x 2 = 1.2/100 x 2 = 2.4%

Now, let's calculate the Pout (controller output) = 4 (2.4%+ KD x 1.2%) + Po

= 4 (2.4 / 100 + 0.4 x 1.2 /100) + 50/100

= 4 x 2.88/100 + 50/100

= 11.52/100 + 50/100

= 61.52/100

= 61.52%

Hence, the correct answer is an option (a).

---

42) The controller required to handle fast process load changes is:

a. PD controller
b. PI Controller
c. PID Controller
d. None of the above

Hide Answer Workspace

Answer: (a) PD controller

Explanation: The Proportional Derivative controller is preferred to handle fast process load changes.

Hence, the correct answer is an option (a).

---

43) Consider the following statements:

1. Lead compensator increases the bandwidth of the system.

2. Lag compensator suppresses steady-state performance.

3. Lead compensator improves the dynamic response and provides faster response.

4. Lag compensator acts as a low-pass filter.

Of these above statements, which of the following are true?

a. 1 and 2
b. 1, 2, and 3
c. 1, 2, and 4
d. 3 and 4

Hide Answer Workspace

Answer: (c)

Explanation: Lag compensator does not suppress steady state performance. Instead, it improves steady state performance.

Hence, the correct answer is an option (c).

44) The transfer function of a compensating network is in the form of (1 +aTs) / (1 + Ts). Find the value of 'a' if the given network is the phase-lag network.

a. Between 0 and 1.
b. 0
c. 1
d. Greater than 1

Hide Answer Workspace

Answer: (a) Between 0 and 1

Explanation: The given transfer function is:

(1 +aTs) / (1 + Ts)

We will first calculate the poles and zeroes of the given transfer function.

Here,

Zero = -1/aT

Pole = -1/T

The pole in the given system is nearer to the jω axis (origin). The 0 will be far from the axis, such that the value of a < 1. It means that the value lies between 0 and 1.

Hence, the correct answer is an option (a).

---

45) Consider the following statements:

Phase lead:

1) Increases the bandwidth of the system

2) Improves the damping

3) Reduces steady-state error

4) Increases gain at high frequency

Which of the following statements are true?

a. 1 and 2

b. 2 and 4
c. 1, 2, and 3
d. 1 and 4

Hide Answer Workspace

Answer: (d)

Explanation: Phase lead is responsible for improving the damping and reducing the system's steady-state error.

Hence, the correct answer is an option (d).

---

46) Find the phase shift provided by the lead compensator for a given transfer function G(s) = (1 + 6s)/ (1 + 2s)

a. 15 degrees
b. 30 degrees
c. 45 degrees
d. 60 degrees

Hide Answer Workspace

Answer: (b) 30 degrees

Explanation: The phase shift provided by the lead compensator can be calculated using the formula:

$$\emptyset = 90° - 2tan^{-1}\sqrt{}$$

The standard transfer function of a lead compensator is represented as:

(s +1/aT) / (s + 1/bT)

Comparing the value of the given transfer function to the standard transfer function, we get:

a = 1/6

b = 1/2

Putting the values of a and b in the phase shift formula:

$$\emptyset = 90° - 2tan^{-1}\sqrt{\left(\frac{1}{6}\right)}/$$

Hence, the correct answer is an option (b).

---

47) The following set of differential equations describes a linear second-order single input continuous-time system.

X1'(t) = -2X1(t) + 4X2(t)
X2'(t) = 2X1(t) - X2(t) + u(t)

Here, X1(t) and X2(t) are the state variables, and u(t) is the control variable. Check for the system, if it is:

a. Uncontrollable and unstable
b. Controllable but unstable
c. Controllable and stable
d. Uncontrollable and stable

Hide Answer Workspace

Answer: (b) Controllable but unstable

Explanation:

We know,

$$\dot{x} = Ax + B$$

Here,

$$A = \begin{bmatrix} -2 & 4 \\ 2 & -1 \end{bmatrix},\ B$$

The product of matrix A and B is,

$$AB = \begin{matrix} 4 \\ -1 \end{matrix}$$

$$B: AB = \begin{bmatrix} 0 \\ \end{bmatrix}$$

Thus, the rank of the system is 2.

The determinant of the system is non-zero. Hence, the system is controllable.

Now, we will check for stability.

SI - A = 0

$$\begin{bmatrix} s+2 & -4 \\ -2 & s+1 \end{bmatrix}$$

The above matrix can be written in the form of an equation:

s^2 + 3s -6 = 0

Now, we will find the roots using Routh's array table, as shown below:

s^2	1	-6
s^1	3	0
s^0	-6	

There are two sign changes in the first column. Thus, the system is unstable.

Hence, the correct answer is an option (b).

---

48) The sum of the Eigenvalues in the given matrix is:

a. The sum of all non-zero components in the matrix
b. Sum of the elements of any row
c. Sum of the elements of any column
d. Sum of the principal diagonal elements

Hide Answer Workspace

Answer: (d) Sum of the principal diagonal elements

Explanation: The sum of Eigenvalue of a given matrix is generally called the trace of that matrix. The trace of a matrix is the sum of the diagonal elements of a matrix.

Hence, the correct answer is an option (d).

---

49) Consider a LTI system described by the given differential equation:

d^2 a(t)/dt^2 + 3da(t)/dt + 2a(t) = r(t)

Where a(t) is the output. The Eigenvalues of the given characteristic equation are:

a. 2, 1
b. 2, -1
c. -2, 1
d. -2, -1

Hide Answer Workspace

Answer: (d)

Explanation: Let x1(t) = a(t) and x2(t) = ẋ1

Thus, the given characteristic equation can be written as:

ẋ2 +3x2 + 2x1 = r(t)

The matrix representation will be:

$$\begin{matrix}\dot{x}1(t)\\ \dot{x}2(t)\end{matrix} = \begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{matrix}x1(t)\\ x2(t)\end{matrix} +$$

Where, A is the matrix:

$$A = \begin{bmatrix}0\\ -2\end{bmatrix} \quad -$$

We know the characteristic equation to calculate Eigenvalue is |SI - A| = 0

The equation thus formed is:

s (s + 3) + 2 = 0

s^2 + 3s + 2 = 0

s^2 + 2s + s + 2 = 0 (factorization to find Eigenvalues)

(s + 2)(s + 1) = 0

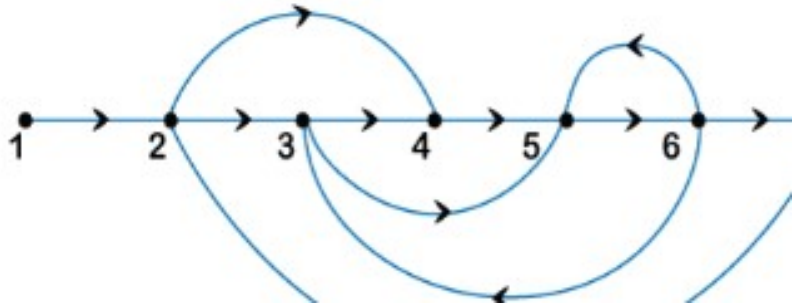
S = -2, -1

Thus, the required Eigenvalues are -2 and -1.

Hence, the correct answer is an option (d).

---

50) The signal flow graph shown in the figure has:



a. forward path = 2, loops = 4, and non-touching loops = 0

b. forward path = 3, loops = 4, and non-touching loops = 0

c. forward path = 3, loops = 3, and non-touching loops = 0

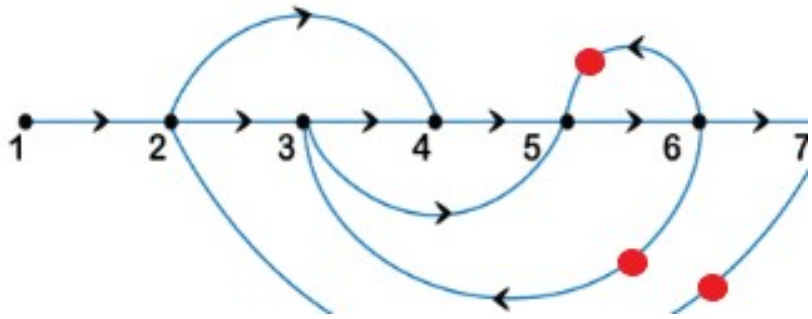
d. forward path = 2, loops = 4, and non-touching loops = 2

Hide Answer Workspace

Answer: (c) forward path = 3, loops = 3, and non-touching loops = 0

Explanation: Forward path is the path from the input to the output node in the given signal flow graph. Here, there are three forward paths.

The number of loops in the given signal flow graph is three, as shown in the below image:



The non-touching loops are considered as non-touching when there are no common nodes between them. There are no non-touching loops in the given signal flow graph. It is because all the loops touch each other.

Hence, the correct answer is an option (c).

---

51) Arrange the following set of statements in order.

The free-body diagram is obtained,

1. By marking all the forces acting on the node
2. Drawing each mass separately.
3. Take Laplace transform of differential equations and rearrange the equations in the s-domain.
4. Find the transfer function as the ratio between output and input variable.
5. Write one differential equation for each of the free body diagram.

a. 1, 2, 3, 4, 5
b. 2, 1, 5, 3, 4
c. 1, 3, 2, 5, 4
d. 2, 1, 4, 3, 5

Hide Answer Workspace

Answer: (b) 2, 1, 5, 3, 4