Laxminarayan Institute of Technology, Nagpur
Question Bank: Chemical Process Control (VI SEM CT)

1 Laplace transform of sinusoidal forcing function having input amplitude

A and w radian frequency is given as

A. $s/(s^2 + w^2)$
B. $Aw/(s^2 + w^2)$
C. $w/(s^2 + w^2)$
D. $A/(s^2 + w^2)$

2 The transfer function of a process is $1/(16s^2 + 8s + 4)$. If a step change is introduced into the system, then the response will be

A. Critically damped
B. Under damped
C. Over damped
D. None of these

3 The unit step response of the transfer function $1/(s^2 + 2s + 3)$

A. Has a non-zero slope at the origin
B. Is overdamped
C. Is unstable
D. Has a damped oscillatory characteristics

4 When the damping co-efficient (ξ) is unity, the system is

A. Critically damped
B. Overdamped
C. Underdamped
D. Highly fluctuating

5 The value of damping parameter increases the response becomes ------- and ------ in nature for the step response of second order control system

A. oscillatory, sluggish
B. Less oscillatory, with offset
C. Eliminates offset, oscillatory
D. Less oscillatory, sluggish

6 The impulse response equation for second order system is _______ in nature for underdamped system and ________ in nature for critically damped system and ________ for overdamped control system.

A. Oscillatory, Less Oscillatory, Sluggish
B. Less Oscillatory, Oscillatory, Sluggish

C. Sluggish, Less Oscillatory, Oscillatory
D. Sluggish, Oscillatory, Less Oscillatory

7 For underdamped second order system if the overshoot increases the maximum value of output

A. Increase
B. Decrease
C. Can’t be predicted
D. Zero

8 Response time is the time needed for response

A. To reach its final steady state value within +/- 5 percent
B. To reach its final steady state value for the first time
C. To reach its final steady state value
D. To reach its final steady state value at steady state

9 Calculate the time constant for the manometer. Density 1000 kg/m m m, viscosity 0.001 N-s/m m, length of manometer 60 cm and length of fluid in manometer 30 cm.

A. 0.54 sec
B. 0.21 sec
C. 0.12 sec
D. 0.45 sec

10 Calculate the damping coefficient for the manometer. Density 1000 kg/m m m, viscosity 0.001 N-s/m m, tube diameter is 6.3 mm, time constant is 0.124 sec, length of manometer 60 cm and length of fluid in manometer 30 cm.

A. 0.05 sec
B. 0.50 sec
C. 0.005 sec
D. 5.00 sec

11 Calculate the overshoot for the manometer. Density 1000 kg/m m m, viscosity 0.001 N-s/m m, tube diameter is 6.3 mm, time constant is 0.124 sec, damping parameter is 0.05, length of manometer 60 cm and length of fluid in manometer 30 cm.

A. 0.50
B. 0.85
C. 0.005
D. 5.00

12 If the overshoot for the testing manometer is 0.85. The ultimate value of response is 0.18 m. Calculate the theoretical length of manometer tube for both limbs, if the manometer contains 60 cm of fluid.

A. 126.6 cm
B. 96.6 cm
C. 33 cm
D. None of these

13 Calculate the period of oscillation for the second order system with time constant as 0.5 sec and damping parameter as 0.4.

A. 4.32 time/cycle
B. 3.42 rad/sec
C. 4.32 rad/sec
D. 3.42 time/cycle

14 Calculate the natural period of oscillation for the second order system with time constant as 0.5 sec and damping parameter as 0.4.

A. 3.42 time/cycle
B. 3.14 rad/sec
C. 3.14 time/cycle
D. 3.42 rad/sec

15 The signal from the comparator obtained by adding set point and measured value of the controlled variable the control system is known as

A. Positive feedback
B. Negative feedback
C. Feed forward
D. Adaptive

16 The signal from the comparator obtained is the difference between set point and measured value of the controlled variable the control system is known as

A. Positive feedback
B. Feed forward
C. Negative feedback
D. Adaptive

17 Signal input, signal output control system is known as

A. SISO
B. MIMO

C. Transfer function
D. None of these

18 Multiple input, multiple output control system is known as

A. SISO
B. MIMO
C. Transfer function
D. None of these

19 The offset introduced by proportional controller with gain Kc in response of first order system can be reduced by

A. Introducing integral control
B. Reducing value of Kc
C. Introducing derivative control
D. None of the above

20 On-off controllers are normally used for

A. flow rate changes
B. low loads
C. temperature changes
D. none of these

21 The offset for P controller is

A. maximum
B. minimum
C. zero
D. all of these

22 The period of oscillation of PI controller is

A. Longer
B. Moderate
C. Minimum
D. Shorter

23 The period of oscillation of PD controller is

A. Longer
B. Moderate
C. Minimum
D. Shorter

24 Flapper nozzle is used in a/an __________ controller.

A. pneumatic
B. hydraulic
C. electronic
D. none of these

25 Suppose that the gain, time constant and dead time of a process with the following transfer function: Gc(s) = 10 exp(- 0.1s)/(0.5s + 1) are known with a possible error of ± 20% of their values. The largest permissible gain Kc of a proportional controller needs to be calculated below taking the values of process gain, time constant and dead time as

A. 12, 0.4, 0.08
B. 8, 0.6, 0.
C. 8, 0.6, 0.12
D. 12, 0.6, 0.12

26 The dynamics of a pneumatic control valve with considerable mass of stem can be described by

A. First order system
B. Second order system
C. Third order system
D. Transfer lag

27 The dynamics of a pneumatic control valve with negligible mass of stem can be described by

A. Second order system
B. Third order system
C. First order system
D. Transfer lag

28 A part of the pneumatic control valve used to convert the controller signal to valve opening is known as

A. Actuator
B. Stem
C. Plug
D. Cylinder

29 The transducer in a control system used to convert mechanical position into electrical voltage is

A. Strain gauge
B. Thermistor
C. Potentiometer
D. All of these

30 The transducer in a control system used to convert pressure signal into electrical signal is

A. Strain gauge
B. Potentiometer
C. Thermistor
D. All of these

31 System is said to be stable if ------------------------

A. All the elements of first column of the Routh array are positive and non zero
B. All the elements of first column of the Routh array are negative
C. All the elements of second column of the Routh array are only positive
D. All of these

32 In the Routh array if some of the elements are negative for this condition the roots of the characteristic equation have

A. Negative real part
B. Stable
C. Constant
D. Positive real part

33 The Routh array test for determining the stability of a control system is limited to the system which have

A. Polynomial characteristic equation
B. Least square method
C. Taylor's series expansion
D. Linear equation

34 The Routh array test is a algebraic method used to determine from the characteristic equation of control system

A. Location of roots on the real axis
B. Exact location of all roots in the complex plane
C. Location of roots with positive real part
D. Location of roots only to the right of the complex

35 Identify the first order control system

A. Single stage absorption column
B. Pendulum
C. Steam injected into a water tank
D. Solid discharging through a screw conveyor

36 Identify the Pure capacity element.

A. Single stage absorption column
B. Pendulum
C. Steam injected into a water tank
D. Evaporator

37 The transfer function of a first order system is

A. S/(Ts + 1)
B. 1/Ts
C. 1/(Ts + 1)
D. None of these

38 In a liquid level single tank system, the transfer function relating the output flow rate with the input flow rate is

A. 1/(TS + 1)
B. R/TS
C. L(TS + l)
D. 1/TS

39 In a liquid level single tank system, the transfer function relating the liquid height with the inlet flow rate is

A. R/TS
B. L(TS + l)
C. R/(TS + 1)
D. 1/TS

40 A first order system with unity gain and time constant τ is subjected to a sinusoidal input of frequency w = 1/τ. The amplitude ratio for this system is

A. 1
B. 0.5
C. 1/√2
D. 0.25

41 The transfer function of a pure dead time system with dead time τd is

A. 1/(τds + 1)
B. E-τds
C. Tds + 1
D. Eτds

42 Response of a system to a sinusoidal input is called __________ response.

A. none of these
B. unit step
C. impluse
D. Frequency

43 The amplitude ratio for the sinusoidal response of a __________ is 1.

A. Transportation lag
B. First order system
C. Second order system
D. None of these

44 The amplitude ratio for the sinusoidal response of __________ is < 1.

A. Second order system
B. Transportation lag
C. First order system
D. None of these

45 What is the ratio of output amplitude to input amplitude for a sinusoidal forcing function in a first order system?

A. Equals to 1
B. Greater than 1
C. None of these
D. Less than 1

46 A bare thermocouple initially at 30^0C is moved at time t = 0 in an air stream maintained at 50^0C. The thermocouple reads 42.64^0C at the end of 10 s. Assume steady state gain to be unity. This thermocouple is used to measure the temperature of the same air stream flowing at the same rate when its temperature is increasing at the rate of 3^0C per minute. What is the lag shown by the thermocouple?

A. 0.167 min
B. 0.5 degree
C. 0.9 degree
D. 0.267 min

47 A thermometer having time constant 5 second is at steady state temperature of 30 ^oC and is suddenly immersed in a bath of 60 ^oC. Determine the time to attain 55 ^oC by the thermometer.

A. 8.96 sec
B. 9.86 sec
C. 6.98 sec
D. None of these

48 A temperature alarm unit exhibit the first order dynamics having time constant 90 sec is subjected to 90 K rise because of fire. The increase of 30 K is needed to respond the alarm. Calculate the time needed for signaling the temperature change.

A. 5.36 sec
B. 63.5 sec
C. 36.5 sec
D. 6.53 sec

49 A thermometer is observed to exhibit the first order dynamics. The thermometer reading at temperature of 55^0C was put into a bath whose temperature was varied sinusoidally between 50^0C and 60^0C with 60 sec/cycle period of oscillation. Calculate the radian frequency.

A. 0.401 rad/sec
B. 0.104 rad/sec
C. 1.04 rad/sec
D. 4.01 rad/sec

50 A thermometer is observed to exhibit the first order dynamics. The thermometer reading at temperature of 55^0C was put into a bath whose temperature was varied sinusoidally between 50^0C and 60^0C with radian frequency of 0.104 rad/sec. The time constant of thermometer is 6 sec. Calculate the amplitude ratio.

A. 1.6
B. 2.44
C. 0.8
D. 4.24