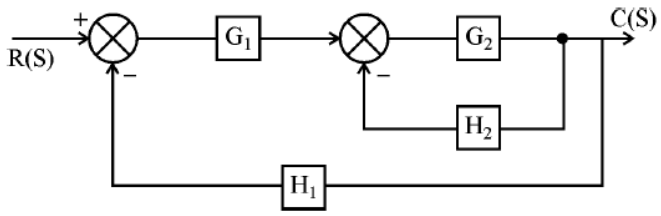
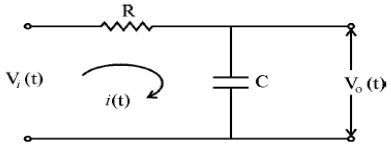
Subject: Control System and PLC (22531)

SYLLABUS

Chapter No.	Name of chapter	Marks With Option
1	Basics of control system	16
2	Time domain stability analysis	24
3	Process controllers	21
4	Fundamentals of PLC	18
5	PLC Hardware and Programming	21
	Total Marks :-	100

BOARD THEORY PAPER PATTERN FOR CSP (22531)

Q.1		**Attempt any FIVE** **5*2=10**
	a)	Draw the block diagram of DC servo system.
	b)	Give any four applications of PLC.
	c)	Name any two I/P devices each used with PLC.
	d)	Draw the block diagram of process control system.
	e)	Draw block diagram of AC output module.
	f)	Write any four block diagram reduction rules.
	g)	Draw the block diagram of PLC.
Q.2		**Attempt any THREE** **3*4=12**
	a)	For a unity feedback system, the TF is given by: $\frac{C(s)}{R(s)} = \frac{25}{s^2+6s+25}$ Find (i) rise time (ii) peak time (iii) peak overshoot (iv) settling time.
	b)	An unity feedback system has G(S), $G(S) = \frac{10(S+1)}{S^2(S+2)(S+10)}$ Find, (i) Type of system(ii) Error coefficient kp, kv&ka. (iii) Steady state error for I/P,r (t) = 1 + 4t + $t^2/2$.
	c)	Write function of CPU block in PLC.
	d)	Draw ladder diagram for 2 motor operation for following condition : (i) Start push button start motor M1 & M2. (ii) Stop push button stop motor M1 first & after 10 seconds motor M2.
Q.3		**Attempt any THREE** **3*4=12**
	a)	Draw block diagram of process control system & describe the need ofcontroller.

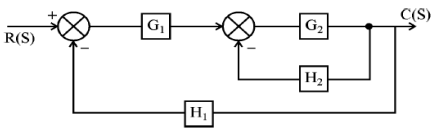
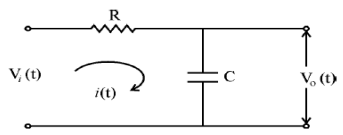
	b)	List any four specification of discrete DC input module.
	c)	List different output devices used in PLC.
	d)	For a control system, characteristics equation is given by: $S^5 + S^4 + 3S^3 + 9S^2 + 16S + 10 = 0$. Determine stability using Routh criteria.
Q.4		**Attempt any FOUR** **3*4=12**
	a)	Describe sourcing & sinking concept in DC input module in PLC.
	b)	A system has $G(S) = \frac{K(5 + 13)}{S(S + 3)(S + 7)}$ where K is positive. Determine the range of K value for system stability.
	c)	A unity feedback control system has $G(S) = \frac{26}{S(S + 5)}$ if step input is given to the system. Calculate :(i) Rise time (ii) Damping ratio (iii) Peak overshoot (iv) Settling time
	d)	Compare P control action with PID control action. (any four)
	e)	State advantages & disadvantages of Routh's Stability criteria.
Q.5		**Attempt any TWO** **2*6=12**
	a)	**i)**Draw block diagram of AC input module.
		ii) Develop ladder diagram for 8:1 Mux.
	b)	Derive the transfer function of the following block diagram: 
	c)	List the timer instruction of PLC. Explain any one of them in details.
Q.6		**Attempt any FOUR** **2*6=12**
	a)	Derive transfer function of given electric network. 
	b)	Explain PI control action. State its equation. State advantages of PIcontrol. (Any two).
	c)	Explain CPU & Memory related to CPU used in PLC.

CLASS TEST - I

PAPER PATTERN

Syllabus:-

Unit No.	Name of the Unit	Course Outcome (CO)
1	**Basics of control system**	**CO-531.1**
2	**Time domain stability analysis**	**CO-531.2**
3	**Process controllers**	**CO-531.3**

Q.1	**Attempt any FOUR4*2=8Marks**	Course Outcome (CO)
a)	Define close loop control system.	**CO-329.1**
b)	Find poles and zeros for T.F. $\frac{C(s)}{R(s)} \quad \frac{10(s+8)}{s(s+4)(s^2+5s+6)}$	**CO-329.2**
c)	Classify different modes of process control system.	**CO-329.2**
d)	State any two block diagram reduction rules.	**CO-329.1**
e)	Define peak time tp and settling time ts.	**CO-329.3**
f)	Draw transient response for second order system.	**CO-329.1**
Q.2	**Attempt any THREE3*4=12 Marks**	
a)	Derive T.F. of following block diagram. 	**CO-531.1**
b)	For unity feedback s/m G(s)= 10(s+1)/ s^2(s+2)(s+10), find all error coefficient and steady state response output for r(t)=1+4t+t^2/2.	**CO-531.2**
c)	For C(s)/R(s)=100/(s2+15s+100), find Tp. Ts, Mp, Tr.	**CO-531.2**
d)	Derive transfer function of given electric network. 	**CO-531.1**

CLASS TEST - II

PAPER PATTERN

Syllabus:-

Unit No.	Name of the Unit	Course Outcome (CO)
3	**Process controllers**	CO-531.3
4	**Fundamentals of PLC**	CO-531.4
5	**PLC Hardware and Programming**	CO-531.5

Q.1	**Attempt any FOUR** 4*2=8Marks	Course Outcome (CO)
a)	Classify different modes of process control actions.	CO-531.3
b)	Draw ladder dia. for following expression: Y=A.B(C+D)	CO-531.5
c)	List various output modules of PLC.	CO-531.4
d)	Define UP counter instruction with diagram.	CO-531.5
e)	Define PID controller.	CO-531.3
f)	Give any four applications of PLC.	CO-531.4
Q.2	**Attempt any THREE** 3*4=12 Marks	
a)	Draw ladder diagram for 2 motor operation for following condition : (i) Start push button starts motor M1 immediately & M2 after 5sec. (ii) Stop push button stop motor M1 first & after 10 sec motor M2.	CO-531.5
b)	Draw block diagram of PLC and explain memory.	CO-531.4
c)	Draw PI controller and give its equation.	CO-531.3
d)	Draw ladder diagram for AND, OR, XOR, NOT gates.	CO-531.5

COURSE OUTCOME

(CO)

COURSE:- Control System and PLC (22531) **PROGRAMME: -E&TC**

CO.NO	Course Outcome
CO-531.1	Identify different types of control systems.
CO-531.2	Determine the stability of the control system.
CO-531.3	Test the performance of various types of controllers.
CO-531.4	Maintain various components of PLC based process control system.
CO-531.5	Maintain PLC based process control systems.

1. Introduction to Control System

Position in Question Paper **Total Marks-16**

Q.1. a) 2-Marks.
Q.1. c) 2-Marks.
Q.2. a) 4-Marks.
Q.3. a) 4-Marks.
Q.4. b) 4-Marks

Descriptive Questions:

1. State principle of DC servo mechanism with neat diagram
2. Define: open loop system and draw block diagram of open loop system
3. State any four block diagram reduction rules
4. Derive transfer function for given closed loop system
5. Compare open loop and closed loop control system
6. Define: linear, non-linear, time invariant and variant control system
7 .Derive transfer function for following electrical network
8. Derive transfer function for following block diagram
9. Define: control system and explain the part of control system
10. Give classification of control system
11. Derive the transfer function of block diagram using reduction rules.

MCQ Question

(Total number of Question=Marks*3=12*3=36)

Note: Correct answer is marked with **bold.**

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

2. In closed loop control system, with positive value of feedback gain the overall gain of the system will _____ .
   a) Increase
   b) decrease
   c) be unaffected
   d) any of the above

3. An automatic toaster is a _____ loop control system
   a) partially closed
   b) closed
   c) open
   d) any of the above

4. A closed loop system is distinguished from open loop system by which of the following?
   a) Servomechanism
   b) Input pattern
   c) Output pattern
   d) Feedback

5. Effect of feedback on the plant is to _____.
   a) Control system transient response
   b) Reduce the sensitivity to plant parameter variations
   c) Both (a) and (b)
   d) None of these

6. Output of the feedback control system should be a function of _____
   a) Input
   b) Reference and output
   c) Feedback signal
   d) None of these

7. _____ is a closed loop system.
   a) Auto-pilot for an aircraft
   b) Direct current generator
   c) Car starter
   d) Electric switch

8. Out of following which is not a part of block diagram of control system?
   a) Summing point
   b) Take off point
   c) Functional block
   d) Plant

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

a) Feedback
c) Signal
b) Stimulus
d) gain control

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

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

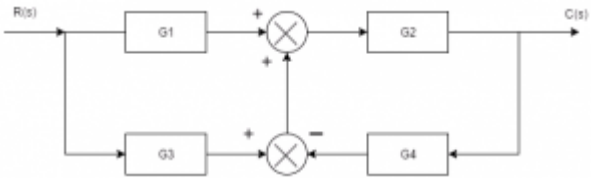
11. Automatic control system in which output is a variable is called

a) Closed loop system
c) Automatic regulating system
b) Servomechanism
d) Process control system

12. Output of the feedback control system should be a function of

a) Input
c) Feedback signal
b) Reference and output
d) None of these

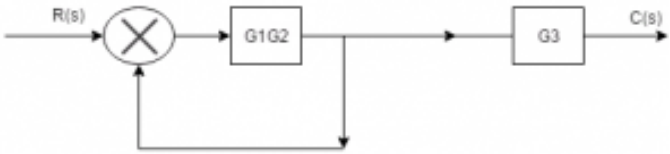
13. Consider the block diagram shown below:



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

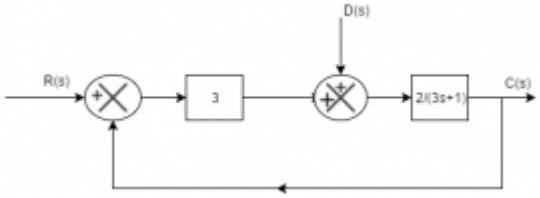
a) G2G3G4
c) G1G2G4
b) G2G4
d) G3G4

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



a) G1G2G3/1-G2G1
c) G1G2G3/1-G1G2G3
b) G1G2/1-G1G2G3
d) G1G2/G3(1-G1G2)

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



a) 2/3s+7
c) 6/3s+7
b) 2/3s+1
d) 2/3s+6

16. 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

c) Cannot say
d) None of the above

17. The overall transfer function of two blocks in parallel are:

a) Sum of individual gain
c) Difference of individual gain
b) Product of individual gain
d) Division of individual gain

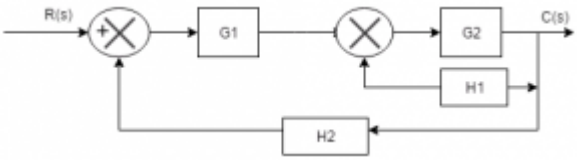
18. The overall transfer function from block diagram reduction for cascaded blocks is:

a) Sum of individual gain
c) Difference of individual gain
b) Product of individual gain
d) Division of individual gain

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

a) 1
c) 0
b) 2
d) infinite

21. 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) $10/11s^2+31s+10$
c) $100/11s^2+31s+10$
b) $100/11s^2+31s+100$
d) $100/11s^2+31s$

22. At summing point, more than one signal can be added or _____

a) Subtracted
c) Both a and b
b) Multiplied
d) None of the above

23. In block diagram representation, what do the lines connecting the blocks, known as?

a) Branches
c) Datums
b) Nodes
d) Sources

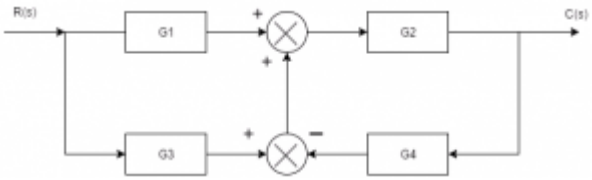
24. For the elimination of feedback loops, the derivation based on transfer function of _____ loop is used.

a) Open
c) Both a and b
b) Closed
d) None of the above

25. Effect of feedback on the plant is to

a) Control system transient response
b) Reduce the sensitivity to plant parameter variations
c) Both (a) and (b)
d) None of these

26. Consider the block diagram shown below:



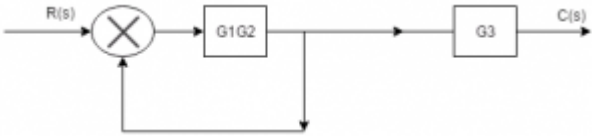
If the transfer function of the system is given by T(s)=G1G2+G2G3/1+X. Then X is:

a) G2G3G4 d) G3G4

b) G2G4

c) G1G2G4

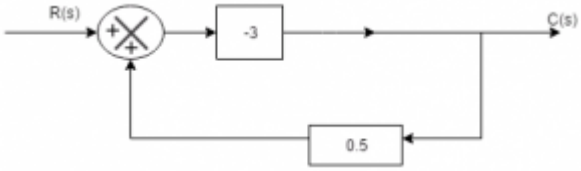
27. For the block diagram given in the following figure, the expression of C/R is:



a) G1G2G3/1-G2G1 c) G1G2G3/1-G1G2G3

b) G1G2/1-G1G2G3 d) G1G2/G3(1-G1G2)

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



a) -9/5 c) 6/5

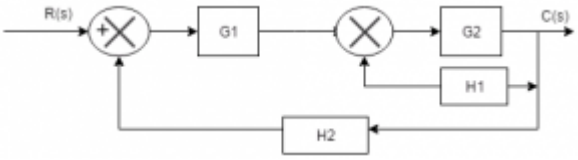
b) -6/5 d) 9/5

29. The overall transfer function of two blocks in parallel are :

a) Sum of individual gain c) Difference of individual gain

b) Product of individual gain d) Division of individual gain

30. 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) $10/11s^2+31s+10$ c) $100/11s^2+31s+10$

b) $100/11s^2+31s+100$ d) $100/11s^2+31s$

31. Oscillations in output response is due to:

a) Positive feedback c) No feedback

b) Negative feedback d) None of the mentioned

32. Consider the assertions related to block diagram. Which among them represents the precise condition?

A. Block diagram is used for analysis & design of control system.
B. Block diagram also provides the information regarding the physical construction of the system.

a) A is true, B is false
c) Both A & B are true
b) A is false, B is true
d) Both A & B are false

33. At summing point, more than one signal can be added or _____

a) Subtracted
c) Both a and b
b) Multiplied
d) None of the above

34. Which terminology deals with the excitation or stimulus applied to the system from an external source for the generation of an output?

a) Input signal
c) Error signal
b) Output signal
d) Feedback signal

35. Which among the following is not an advantage of an open loop system?

a) Simplicity in construction & design
b) Easy maintenance
c) Rare problems of stability
d) Requirement of system recalibration from time to time

36. Which among the following represents an illustration of closed loop system?

a) Automatic washing machine
c) Bread toaster
b) Automatic electric iron
d) Electric hand drier

2. Time Domain Analysis

Position in Question Paper **Total Marks-24**

Q.1. b) 2-Marks.
Q.1. d) 2-Marks
Q.2. c) 4-Marks.
Q.3. b) 4-Marks.
Q.4. c) 4-Marks.
Q.5. b) 4-Marks.
Q.6. b) 4-Marks

Descriptive Questions:

1. Define poles and zeros

2. Draw time response of second order system

3. What are the different standard test input and give their Laplace transform

4. Define steady state and transient response of system

5. For a system given by $\frac{C(S)}{R(S)} = \frac{25}{S^2+6S+25}$ find TP,TR,TD,MT,TS

6. A unity feedback control system has $G(S) = \frac{40(S+2)}{S(S+1)(S+4)}$

Find the type of system and all error coefficient

7. For a given system $\frac{d2y}{dt2} + 4\frac{dy}{dt} + 8y(t) = 8x(t)$

where y= output & x=input find TP,TR,TD,MT,TS

8. Define TP,TR,TD,MP,TS

9. For a given transfer function T.F=$\frac{K(S+6)}{S(S+2)(S+5)(S^2+7S+12)}$

Find poles zeros characteristics equation pole zero plot

10. For unity feedback system G(S)=$\frac{4}{S(S+2)(1+0.5S)}$Find ess for R(t)=3t

11. For a system having transfer function$\frac{C(S)}{R(S)} = \frac{100}{S^2+8S+100}$Find TP, TR, TD, MP, TS.

12. Define stability and give type of system

13. Find the stability of system given by $S^4+2S^3+8S^2+4S+3=0$

14. A unity feedback system given by $G(S) = \frac{K(S+13)}{S(S+3)(S+7)}$ calculate the range of value of k for system to be stable

15. Define stable unstable critical stable and conditional stable system

16. Determine the stability of system given by $S^5+S^4+2S^3+2S^2+3S+5=0$

17. Give the advantages of route's stability criteria

MCQ Question

(Total number of Question=Marks*3=16*3=48)

Note: Correct answer is marked with **bold.**

1. Out of following which is not standard test input for control system?
   a) Parabola
   c) Step
   b) Hyperbola
   d) Ramp
2. The system with the open loop transfer function 1/s(1+s) is:
   a) Type 2 and order 1
   c) Type 0 and order 0
   b) Type 1 and order 1
   d) Type 1 and order 2
3. A system has a single pole at origin. Its impulse response will be:
   a) Constant
   c) Decaying exponential
   b) Ramp
   d) Oscillatory
4. The period of the observation is large, and then the type of the error will be:
   a) Transient error
   c) Half-power error
   b) Steady state error
   d) Position error constant
5. The system in originally critically damped if the gain is doubled the system will be :
   a) Remains same
   c) Under damped
   b) Overdamped
   d) Undamped
6. The damping ratio and peak overshoot are measures of:
   a) Relative stability
   c) Steady state error
   b) Speed of response
   d) Absolute stability
7. Laplace transform of unit impulse signal is :
   a) A/s
   c) 1
   b) A
   d) 1/s
8. Time taken for the response to rise from zero to 100 % for very first time is called _____
   a) Rise time.
   c) Delay time.
   b) Settling time.
   d) Peak time
9. Type and order of transfer function G (s) = K / {s(s + 2)}
   a) 1, 2.
   c) 0, 2.
   b) 2, 1.
   d) 1, 1.
10. First column elements of the Routh's tabulation are 3, 5, -3/4, ½, 2. It means that there are:
    a) Is one root in the left half of s-plane
    b) Are two roots in the left half of s-plane
    c) Are two roots in the right half of the s-plane
    d) Is one root in the right half of s-plane

11. Consider the following statements: mark correct one
    a) The effect of feedback is to reduce the system error
    b) Feedback increases the gain of the system in one frequency range but decreases in the other
    c) Feedback can cause a system originally stable to become unstable
    d) Both a and c
12. Stability of a system implies that:
    a) Small changes in the system input does not result in large change in system output
    b) Small changes in the system parameters does not result in large change in system output
    c) Small changes in the initial conditions does not result in large change in system output
    d) All of the above mentioned
13. Bounded input and Bounded output stability notion concerns with _____
    a) A system under influence of input
    b) A system not under influence of input
    c) A system under influence of output
    d) A system not under influence of output
14. If a system is given unbounded input then the system is _____
    a) Stable
    c) Not defined
    b) Unstable
    d) Linear
15. Linear mathematical model applies to _____
    a) Linear systems
    c) Unstable systems
    b) Stable systems
    d) Non-linear systems
16. The polynomial s4+Ks3+s2+s+1=0 the range of K for stability is _____
    a) K>5
    c) K>-4
    b) -10<K
    d) K-1>0
17. The characteristic equation of a system is given by3s4+10s3+5s2+2=0. This system is _____
    a) Stable
    c) Unstable
    b) Marginally stable
    d) Linear
18. The initial response when tune output is not equal to input is called _____.
    a) Transient response
    c) Dynamic response
    b) Error response
    d) Either of the above
19. 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

21. If gain of the critically damped system is increased, the system will behave as
a) Under damped
b) Over damped
c) Critically damped
d) Oscillator

22. The system with the open loop transfer function 1/s(1+s) is:
a) Type 2 and order 1
b) Type 1 and order 1
c) Type 0 and order 0
d) **Type 1 and order 2**

23. The identical first order system has been cascaded non-interactively. The unit step response of the systems will be:
a) Overdamped
b) Underdamped
c) Undamped
d) **Critically damped**

24. A system has a single pole at origin. Its impulse response will be:
a) **Constant**
b) Ramp
c) Decaying exponential
d) Oscillatory

25. When the period of the observation is large, the type of the error will be:
a) Transient error
b) **Steady state error**
c) Half-power error
d) Position error constant

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

27. An under damped second order system with negative damping will have the roots :
a) On the negative real axis as roots
b) On the left hand side of complex plane as complex roots
c) **On the right hand side of complex plane as complex conjugates**
d) On the positive real axis as real roots

28. Given a unity feedback system with G (s) =K/ s (s+4). What is the value of K for a damping ratio of 0.5?
a) 1
b) **16**
c) 4
d) 2

29. How can the steady state error can be reduced?
a) By decreasing the type of the system
b) **By increasing system gain**
c) By decreasing the static error constant
d) By increasing the input

30. Which of the following transfer function will have the greatest maximum overshoot?

a) $9/(s^2+2s+9)$
c) $25/(s^2+2s+25)$
b) $16/(s^2+2s+16)$
d) $36/(s^2+2s+36)$

31. A system generated by $\frac{dy}{dx} + 2y = 4tu(t)$. The ramp component in the forced response will be:

a) tu(t)
c) 3t u(t)
b) **2t u(t)**
d) 4t u(t)

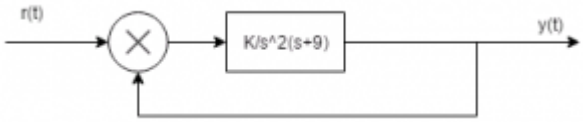
32. The system in originally critically damped if the gain is doubled the system will be:

a) Remains same
c) **Under damped**
b) Overdamped
d) Undampe

33. The damping ratio and peak overshoot are measures of:

a) Relative stability
c) Steady state error
b) **Speed of response**
d) Absolute stability

34. Find the type and order of the system given below:



a) 2
b) 3
d) 3,3
c) **2,2**
e) None of the mentioned

35. A system has a complex conjugate root pair of multiplicity two or more in its characteristic equation. The impulse response of the system will be:

a) A sinusoidal oscillation which decays exponentially; the system is therefore stable
b) A sinusoidal oscillation with a time multiplier ; the system is therefore unstable
c) **A sinusoidal oscillation which rises exponentially ; the system is therefore unstable**
d) A dc term harmonic oscillation the system therefore becomes limiting stable

36. The step response of the system is $c(t) = 10+8e^{-t}-4/8e^{-2t}$. The gain in time constant form of transfer function will be:

a) -7
c) 7.5
b) 7
d) -7.5

37. The transfer function of the system is G(s) =100/(s+1) (s+100). For a unit step input to the system the approximate settling time for 2% criterion is:

a) 100 sec
c) 1 sec
b) 4 sec
d) 0.01 sec

38. A system with transfer function 1/Ts+1, subjected to a step input takes to seconds to reach 50% of step height. The value of **t** is:

a) 6.9s
c) 14.4s
b) 10s
d) 20s

39. Routh Hurwitz criterion gives:

a) **Number of roots in the right half of the s-plane**
b) Value of the roots
c) Number of roots in the left half of the s-plane
d) Number of roots in the top half of the s-plane

40. Consider the following statement regarding Routh Hurwitz criterion:

a) It gives absolute stability
b) It gives gain and phase margin
c) It gives the number of roots lying in RHS of the s-plane
d) It gives gain, phase margin and number of roots lying in RHS of the s-plane

41. The order of the auxiliary polynomial is always:

a) Even
c) May be even or odd
b) Odd
d) None
e) of the mentioned

42. Which of the test signals are best utilized by the stability analysis.

a) **Impulse**
c) Ramp
b) Step
d) Parabolic

43. The characteristic equation of a system is given as3s4+10s3+5s2+2=0. This system is:

a) Stable
c) **Unstable**
b) Marginally stable
d) Linear

44. The characteristic equation of a system is given ass3+25s2+10s+50=0. What is the number of the roots in the right half s-plane and the imaginary axis respectively?

a) 1,1
c) 2,1
b) **0,0**
d) 1,2

45. The necessary condition for the stability of the linear system is that all the coefficients of characteristic equation 1+G(s)H(s) =0, be real and have the :

a) Positive sign
c) **Same sign**
b) Negative sign
d) Both positive and negative

46. First column elements of the Routh's tabulation are 3, 5, -3/4, ½, 2. It means that there are:

a) Is one root in the left half of s-plane
b) Are two roots in the left half of s-plane
c) **Are two roots in the right half of the s-plane**
d) Is one root in the right half of s-plane

47. Consider the following statements:

a) The effect of feedback is to reduce the system error
b) Feedback increases the gain of the system in one frequency range but decreases in the other
c) Feedback can cause a system originally stable to become unstable
d) Both a and c

48. The Routh-Hurwitz criterion cannot be applied when the characteristic equation of the system contains any coefficients which is :

a) Negative real and exponential function
b) Negative real, both exponential and sinusoidal function of s
c) Both exponential and sinusoidal function of s
d) Complex, both exponential and sinusoidal function of s

49. The following characteristic equation results in stable operation of the feedback system $s^3+4s^2+10s+11=0$

a) **True**
b) False

50. The given characteristic equation $s^4+s^3+2s^2+2s+3=0$ has:

a) Zero root in the s-plane
b) One root in the RHS of s-plane
c) **Two root in the RHS of s-plane**
d) Three root in the RHS of s-plane

3. Process Controllers

Position in Question Paper **Total Marks-21**

Q.1. f) 2-Marks.
Q.1. e) 2-Marks.
Q.2. a) 4-Marks.
Q.3. c) 4-Marks.
Q.4. d) 4-Marks.
Q.5. e) 6-Marks.

Descriptive Questions:

1. With neat diagram describe on off controller
2. What is meant by PD controller? Explain
3. Compare proportional and derivative controlling action mode
4. Draw electronic PI controller and write its output equation
5. Draw electronic PID controller and give its output equation
6. Draw neat diagram of process control system and state the function of each element
7. What is control action mode and classify it
8. State the principle of derivative controller action mode and give its mathematical expression
9. Explain integral controller
10. What is offset and how it eliminated

MCQ Question

(Total number of Question=Marks*3=10*3=30)

Note: Correct answer is marked with **bold.**

1. Which of the following is not a type of Continuous control action mode:
   a) Proportional Controller
   b) Integral Controller
   c) ON-OFF Controller
   d) Derivative Controller

2. The output of control system is combination of Proportional and Derivative of Error signal is called as _____
   a) PD Controller
   b) PID Controller
   c) PI Controller
   d) ON-OFF Controller

3. Which of the following is good example of ON-OFF control action mode?
   a) Automatic Freeze
   b) Automatic Washing Machine
   c) Automatic Wending Machine
   d) Non Automatic Iron

4. _____ controller consumes more electricity than other controllers.
   a) Proportional Controller
   b) ON OFF Controller
   c) Integral Controller
   d) Derivative Controller

5. In process control system, _____ acts as feedback element.
   a) Actuator
   b) Plant
   c) Amplifier
   d) Sensor Element

6. Consider the following statements: mark correct one
   a) The effect of feedback is to reduce the system error
   b) Feedback increases the gain of the system in one frequency range but decreases in the other
   c) Feedback can cause a system originally stable to become unstable
   d) Both a and c

7. Stability of a system implies that:
   a) Small changes in the system input does not result in large change in system output
   b) Small changes in the system parameters does not result in large change in system output
   c) Small changes in the initial conditions does not result in large change in system output
   d) All of the above mentioned

8. Bounded input and Bounded output stability notion concerns with _____
   a) A system under influence of input
   b) A system not under influence of input
   c) A system under influence of output

d) A system not under influence of output

10. If a system is given unbounded input then the system is _____

a) Stable
c) Not defined
b) Unstable
d) Linear

11. PID controller is also known as:

a) three term controller
c) two term controller
b) proportional controller
d) four term controller

12. Which of the following system provides excellent transient and steady state response:

a) Proportional + Differential action
b) Proportional + Integral + Differential action
c) Proportional action
d) Proportional + Integral action

13. The transfer function of a P-I controller is:

a) $K_p + K_i/s$
c) $(K_p/s) + K_i \cdot s$
b) $K_p + (K_i/s)$
d) $K_p \cdot s + (K_i/s)$

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

a) Digital
c) Non-linear
b) Linear
d) Discontinuous

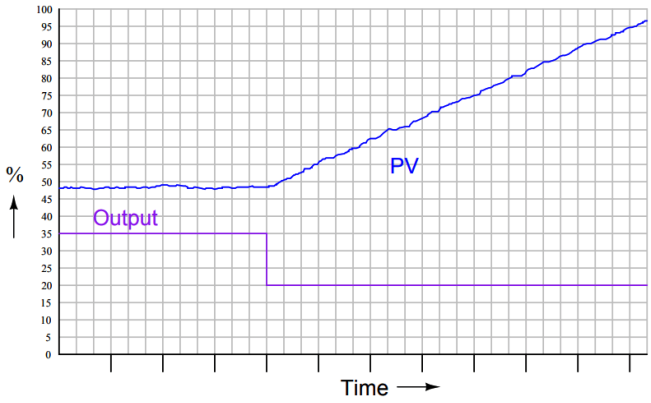
15. Proportional band of a controller is expressed as

a) Percentage
c) Ratio
b) Range of control variable
d) Gain

16. A controller is basically a _____ .

a) Sensor
c) Amplifier
b) Comparator
d) Clipper

17. The open-loop response of a process is shown in the following trend. What sort of process is indicated by this behavior?



a) Integrating
c) Derivative
b) Proportional
d) ON-OFF

18. Out of following which control action produces fast response in output

a) PI
c) PID
b) PD
d) On-OFF controller

19. At output of which control action offset is present?
a) Integrating
c) Derivative
b) Proportional
d) ON-OFF

20. Out of following which controller can be used alone in control system?
a) Integrating
c) Derivative
b) Proportional
d) None of the above

21. Processes always require some degree of control action to achieve set point.
a) Integrating, Derivative
c) Self-regulating, Proportional
b) Integrating, Feed forward
d) Self-regulating, Integral

22. Process variable filtering should be used:
a) **To dampen noise**
c) to improve response time
b) only on integrating processes
d) only on self-regulating processes

23. For a linear time invariant system, an optimal controller can be designed if
a) The system is controllable and observable
b) The system is uncontrollable but stable
c) The system is unstable but observable
d) The system is stable but unobservable

24. A first order dynamic linear system with a proportional controller exhibits an offset to a unit step input. The offset can be reduced by
a) Decreasing the proportional gain
c) Adding integral mode
b) Adding derivative mode
d) Increasing the proportional gain

25. Which of the following is the input to a controller?
a) Servo signal
c) Error signal
b) Desired variable value
d) Sensed signal

26. Proportional band of a controller is expressed as
a) Percentage
c) Ratio
b) Range of control variable
d) Gain

27. Derivative error compensation:
a) Improvement in transient response
c) Reduction is settling time
b) Reduction in steady state error
d) Increase in damping constant

28. Lead compensation leads to:
a) Increases bandwidth
c) Increases damping factor
b) Attenuation
d) Second order

29. A proportional plus integral controller
a) has high sensitivity
b) increases stability of system

c) it increases rise time d) both 2 and 3

30. Which of the following controller has sluggish response?

a) proportional controller c) derivative controller

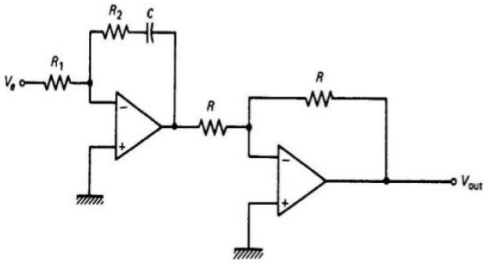
b) integral controller d) both 2 and 3

31. The disadvantage of ON-OFF controller is:

a) Offset voltage c) Neutral Zone

b) Continuous Output d) None of the above

32. Identify the Electronic circuit of control action mode

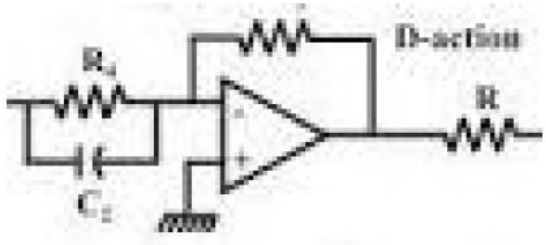


$$Vout = (\frac{R_2}{R_1})Ve + (\frac{R_2}{R_1})\frac{1}{R_2C}\int_0^t Ve\,dt + Vout(0)$$

a) Proportional c) Derivative

b) Integral d) Proportional Integral

33. Identify the Electronic circuit of control action mode



a) Proportional **c) Derivative**

b) Integral d) Proportional Derivative

34. A good application for a timed interrupt in a PLC program would be _____ .

a) A communications function block c) A math function block

b) A PID function block d) A motor start/stop rung

4. Fundamentals of PLC

Position in Question Paper **Total Marks-18**

Q.1. e) 2-Marks.
Q.1. d) 2-Marks.
Q.2. d) 4-Marks.
Q.4. a) 4-Marks.
Q.6. d) 6-Marks.

Descriptive Questions:

1. What is programmable logic control? Explain
2. Explain the need of PLC in automation
3. List the advantages and application of PLC
4. List the input devices available for PLC
5. List the output devices available for PLC
6. Draw and explain block diagram of PLC
7. Explain CPU unit of PLC
8. Explain memory unit with respect to PLC
9. Write a short note on power supply of PLC
10. Describe the input and output module of PLC
11. Give the classification of PLC and explain modular PLC
12. What is meant by PLC scan cycle? Explain.

MCQ Question

(Total number of Question=Marks*3=14*3=42)

Note: Correct answer is marked with **bold.**

1. _____ of the following is an input device of Programmable Logic Controller.
   a) Motor
   b) Light
   c) Switch
   d) Valve

2. In a PLC programming, "I" is used for output and "O" is used for input.
   a) True
   b) False
   c) None of Above
   d) Either True or False

3. The acronym PLC stands for _____.
   a) Pressure Load Control
   b) Programmable Logic Controller
   c) Pneumatic Logic Capstan
   d) PID Loop Controller

4. In a PLC, the scan time refers to the amount of time in which_____ .
   a) the technician enters the program
   b) timers and counters are indexed by
   c) one "rung" of ladder logic takes to complete
   d) the entire program takes to execute

5. The acronym PLC stands for:
   a) Pressure Load Control
   b) **Programmable Logic Controller**
   c) Pneumatic Logic Capstan
   d) PID Loop Controller

6. In a PLC, the scan time refers to the amount of time in which …..
   a) the technician enters the program
   b) timers and counters are indexed by
   c) one "rung" of ladder logic takes to complete
   d) the entire program takes to execute

7. The difference between online and offline PLC programming is . . .
   a) whether the PLC is running or stopped
   b) whether the programming PC has internet connectivity\
   c) the type of programming cable used
   d) where the edited program resides

8. In PLC programming, a retentive function is one that:
   a) Defaults to the "on" state
   b) Comes last in the program
   c) Defaults to the "off" state
   d) Is not reset after a power cycle

9. What is the largest integer number that a PLC counter function can reach if it uses a 16 bit register?
   a) 32,768
   b) **65,535**
   c) 65,536
   d) 65,537

10. A good application for a timed interrupt in a PLC program would be:
    a) A communications function block
    b) **A PID function block**
    c) A math function block
    d) A motor start/stop rung
11. The PLC was invented by ….
    a) Bill Gates
    b) **Dick Morley**
    c) Bill Landis
    d) Tod Cunningham
12. The first company to build PLCs was ….
    a) General Motors
    b) Allen Bradley
    c) Square D
    d) Modicon
13. The part that monitors the inputs and makes decisions in a PLC is the CPU.
    a) **True**
    b) False
    c) None of Above
    d) Either True or False
14. One of the following is an input device
    a) Motor
    b) Light
    c) Valve
    d) **Sensor**
15. Which one of the following is not a PLC manufacturer
    a) Siemens
    b) Mitsubishi
    c) **Microsoft**
    d) AB
16. Solenoids, lamps, motors are connected to:
    a) Analog output
    b) **Digital output**
    c) Analog input
    d) Digital input
17. In a PLC "I" is used for output and "Q" is used for input
    a) True
    b) False
    c) None of Above
    d) Either True or False
18. PLC stands for programmable logo controller
    a) True
    b) False
    c) None of Above
    d) Either True or False
19. To increase the number of inputs and outputs of the PLC, one can use expansion modules.
    a) **True**
    b) False
    c) None of Above
    d) Either True or False
20. An example of discrete (digital) control is:
    a) Varying the volume of a music system
    b) **Turning a lamp ON or OFF**
    c) Varying the brightness of a lamp
    d) Controlling the speed of a fan

21. Which of the following statements is correct?
    a) Ladder logic is a PLC graphical programming technique introduced in the last 10 years.
    b) A ladder logic program is hard to analyze because it is totally different when compared with the equivalent relay logic solution.
    c) The number of ladder logic virtual relays and input and output instructions is limited only by memory size.
    d) The number of contacts for a mechanical relay is limited to number of coils on the relay.
22. Which of the following statements is NOT correct?
    a) The status of each input can be checked from one location and outputs can be forced on and off.
    b) All symbols in the RLL represent actual components and contacts present in the control system.
    c) PLCs are not as reliable as electromechanical relays in RLL.
    d) Input (-| |-) and output (- ( ) -) instruction symbols in the ladder logic represent only data values stored in PLC memory.
23. Which of the following statements is NOT correct?
    a) If a problem in a PLC module occurs, the module can be changed in a matter of minutes without any changes in wiring.
    b) Outputs can be paralleled on the same rung.
    c) The physical wires between the input and output field devices and the PLC input and output modules are the only signal wires required in the PLC system.
    d) **The cost and size of PLCs have increased significantly in the last 10 years.**
24. Which of the following statements about a single pole double throw relay is NOT true?
    a) It is called an SPDT type of relay.
    b) It has one common contact.
    c) It has two positions (NC and NO).
    d) **It has a center off position.**
25. Which of the following statements about a single pole double throw relay is true?
    a) Insulators are used in the armature to isolate the electrical switching contacts from the rest of the relay components.
    b) The NC contact and the pole are in contact when the relay is off.
    c) It has just one coil.
    d) **All of the above.**

26. Which of the following statements about RLL is NOT true?
   a) NO contact symbol has two parallel lines to indicate an open contact.
   b) RLL stands for Relay Ladder Logic.
   c) NC contact symbol has the same two parallel lines with a line across them to indicate closed contacts.
   d) **The right power rail is positive or the high side of the source and the left power rail is the power return or ground.**

27. The _____ is moved toward the relay electromagnet when the relay is on.
   a) **Armature**
   b) Coil
   c) NO contact
   d) NC contact

28. Which of the following RLL applications is not normally performed in early automation systems?
   a) On/off control of field devices
   b) Logical control of discrete devices
   c) On/off control of motor starters
   d) **Proportional control of field devices**

29. In a current sinking DC input module _____
   a) **The current flows out of the input field device**
   b) Requires that a AC sources be used with mechanical switches
   c) The current flows out of the input module
   d) Currents can flow in either direction at the input module

30. What one item in the input module circuit above should be changed to make it correct.
   a) The battery polarity
   b) **Input module should be sinking**
   c) Field device should be sinking
   d) Current flow direction

31. When _____ contacts are actuated, they disrupt the power supply through them.
   a) normally open type
   b) **normally closed type**
   c) both a. and b.
   d) none of the above

32. How is the speed of operation of conventional relay system as compared to digital controllers?
   a) **very slow**
   b) very fast
   c) same
   d) almost similar

33. The capability of convention relay systems for complex operations is ____ that of the PLCs .
   a) **poor than**
   b) excellent than

c) as good as
d) unpredictable as

34. How is the noise immunity of PLCs to electrical noises as compared to that of conventional relay controllers?
a) **poor**
b) excellent
c) as good as noise immunity of conventional relay controllers
d) unpredictable

35. _____ of PLCs can be done in very little time.
a) Programming
b) Installation
c) Commissioning
d) **All of the above**

36. PLC can be _____ in plant to change the sequence of operation.
a) only programmed
b) only reprogrammed
c) Programmed and reprogrammable to give a set point
d) None of the above

37. The PLC is used in _____.
a) machine tools
b) automated assembly equipment
c) moulding and extrusion machines
d) all of the above

38. Which of the following cannot be an input that is given to the PLC?
a) Manual switches
b) Relays
c) Sensors
d) **None of the above**

39. When _____ contacts are actuated, they disrupt the power supply through them.
a) normally open type
b) **normally closed type**
c) both a and b
d) none of the above

40. How is the speed of operation of conventional relay system as compared to digital controllers?
a) very slow
b) very fast
c) same
d) almost similar

41. The capability of convention relay systems for complex operations is _____ that of the PLCs.
a) poor than
b) excellent than
c) as good as
d) unpredictable as

42. _____ of PLCs can be done in very little time.
a) Programming
b) Installation
c) Commissioning
d) All of the above

5. PLC Hardware and Programming

Position in Question Paper **Total Marks-22**

Q.1. a) 2-Marks.
Q.1. c) 2-Marks.
Q.2. d) 4-Marks.
Q.4. b) 4-Marks.
Q.5. d) 4-Marks.
Q.6. c) 6-Marks.

Descriptive Question

1. Draw and explain the block discrete AC input module
2. Draw the typical writing of discrete AC input module
3. Draw the block diagram of discrete DC input module and explain
4. State how many timers available PLC and explain on timer
5. Explain instruction counter with respect to PLC
6. Develop ladder diagram for AND, OR, NOT, X-OR, NAND NOR Gates
7. Draw ladder diagram for following Boolean expression
8. Develop a ladder diagram for two motors for following condition
   i. Start button starts motor 1 after 10 second
   ii. Motor two start stop button stops
9. Draw ladder diagram for 1:8 mux.
10. Draw ladder diagram for following Boolean expression:
    Y=A+B+(C.D.E)+F+I
    Q=A xor B xor C
11. Develop a ladder diagram for logic gates.

MCQ Question

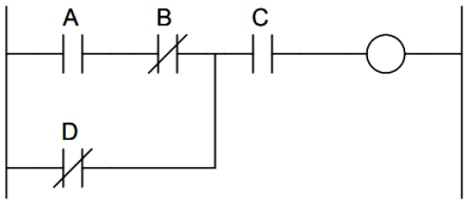
(Total number of Question=Marks*3=14*3=42)

Note: Correct answer is marked with **bold.**

1. When _____ contacts are actuated, they disrupt the power supply through them.
   a) Normally open type
   c) Both
   b) Normally closed type
   d) None of the above

2. The capability of convention relay systems for complex operations is_____ that of the PLCs.
   a) poor than
   c) as good as
   b) excellent than
   d) unpredictable as

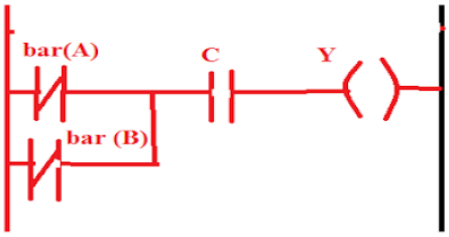
3. The Boolean representation of this PLC program is _____ .



   a) (AB(bar) + D(bar))C
   c) ABC + BD
   b) C + (A + B(bar))D
   d) D + (A + B)C

4. For providing delay in programming _____ is used in PLC.
   a) Counter
   c) Switches
   b) Timers
   d) Motors

5. Boolean expression for following ladder diagram is:

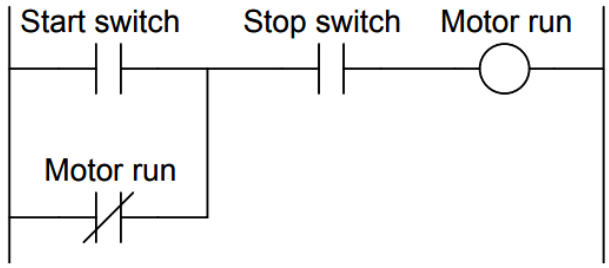


   a) Y= (BAR) A+ B . C
   c) Y= (A.C + B.C)
   b) Y= ((BAR)A + (BAR)B) . C
   d) Y= ((BAR)A + B) .(BAR)C

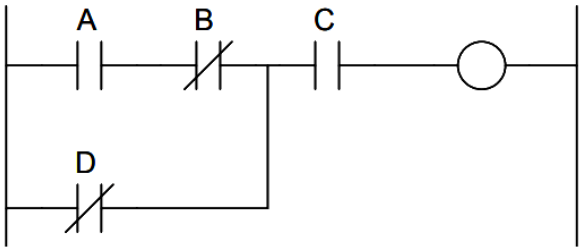
6. The difference between online and offline PLC programming is _____ .
   a) whether the PLC is running or stopped
   b) whether the programming PC has internet connectivity
   c) the type of programming cable used
   d) where the edited program resides

7. An OR function implemented in ladder logic uses _____
   a) Normally-closed contacts in series
   c) A single normally-closed contact
   b) Normally-open contacts in series
   d) Normally-open contacts in parallel

9. _____ of the following has large number of Inputs and Outputs.
   a) Small PLC
   b) Large PLC
   c) Unitary PLC
   d) Medium PLC
10. The PLC is used in _____.
   a) machine tools
   b) automated assembly equipment
   c) molding and extrusion machine
   d) all of the above
11. PLCs can be _____ in plant to change the sequence of operation.
   a) Only programmed
   b) Only reprogrammed
   c) Programmed and reprogrammed
   d) Able to give a set point
12. Which of the following can be the output of PLC? 1. Relay coils 2. Solenoids 3.Indicators 4. Motors 5. Lamps 6. Alarms
   a) Only (1), (2), (3) and (4)
   b) Only (3), (4), (5) and (6)
   c) Only (1), (2), (3) and (5)
   d) All the (1), (2), (3), (4), (5), and (6)
13. Ladder logic programming consists primarily of:
   a) **Virtual relay contacts and coils**
   b) Logic gate symbols with connecting lines
   c) Function blocks with connecting lines
   d) Text-based code
14. In a PLC, the scan time refers to the amount of time in which …..
   a) the technician enters the program
   b) timers and counters are indexed by
   c) one “rung” of ladder logic takes to complete
   d) the entire program takes to execute
15. Identify the problem in this motor control PLC program:



   a) Coil
   b) Start contact
   c) **Seal-in contact**
   d) Stop contact
16. The Boolean representation of this PLC program is:



a) ABC + D
b) C + (A + B)D
c) C + D(A + B)
d) **C(AB + D)**

17. The difference between online and offline PLC programming is _____ .
a) whether the PLC is running or stopped
b) whether the programming PC has internet connectivity
c) the type of programming cable used
d) **where the edited program resides**

18. In PLC programming, a retentive function is one that:
a) Defaults to the "on" state
b) Comes last in the program
c) Defaults to the "off" state
d) **Is not reset after a power cycle**

19. What is the largest integer number that a PLC counter function can reach if it uses a 16 bit register?
a) 32,768
b) **65,535**
c) 65,536
d) 65,537

20. An OR function implemented in ladder logic uses:
a) Normally-closed contacts in series
b) Normally-open contacts in series
c) A single normally-closed contact
d) **Normally-open contacts in parallel**

21. A good application for a timed interrupt in a PLC program would be:
a) A communications function block
b) **A PID function block**
c) A math function block
d) A motor start/stop rung

22. When _____ contacts are actuated, they disrupt the power supply through them.
a) normally open type
b) **normally closed type**
c) both a. and b.
d) none of the above

23.The type of memory which is fast and temporarily stores the data which are immediately required for use is called as_____.
a) HDD
b) ROM
c) RAM
d) SSD

24. How is the speed of operation of conventional relay system as compared to digital

controllers?

a) very slow
c) same
b) very fast
d) almost similar

25. The capability of convention relay systems for complex operations is _____ that of the PLCs .

a) **poor than**
c) as good as
b) excellent than
d) unpredictable as

26. How is the noise immunity of PLCs to electrical noises as compared to that of conventional relay controllers?

a) Poor
b) Excellent
c) as good as noise immunity of conventional relay controllers
d) unpredictable

27._____ of PLCs can be done in very little time.

a) Programming
c) Commissioning
b) Installation
d) All of the above

28.PLC can be _____ in plant to change the sequence of operation.

a) only programmed
c) programmed and reprogrammed
b) only reprogrammed
d) able to give a set point

29. The PLC is used in _____ .

a) machine tools
c) molding and extrusion machines
b) automated assembly equipment
d) **all of the above**

30.Unitary PLC has 20 inputs and _____ outputs.

a) 20
c) 12
b) 18
d) 10

31. Medium PLC has _____ inputs and outputs.

a) 100-200
c) 2000-4000
b) 1000-4000
d) 4000-8000

32.SCADA stands for:

a) Supervisory Computer And Data Analog
b) Supervisory Computer And Data Acquisition
c) Supervisory Control And Data Acquisition
d) Supervisory Control And Data Aspiration

33.The most popular language for PLCs is:

a) **Ladder diagram**
c) OOP+
b) C++
d) VHDL

34. Statement 1: The instance data block is assigned to logical block
Statement 2: Shared data block is never assigned to logical block
a) Both statements are incorrect
b) Statement 1 is correct, 2 is wrong
c) Statement 2 is correct, 1 is wrong
d) **Both statements are correct**

35. Normally open contacts are open when:
a) When Input is not energized
b) When the input is energized
c) When input is higher than 20 volts
d) None of these

36. Typical examples of inputs to SCADA are:
a) Switches
b) LDVT
c) Potentiometer
d) All of these

37. NOR has output 1 when:
a) Both inputs are 1
b) First input is 1, Second is 0
c) First input is 0, Second is 1
d) Both inputs are 0

38. BOOL tag in Programmable logic controller:
a) Represents timer memory
b) Is used for PID control functions
c) Holds true or false values
d) None of these

39. PLCs that have a fixed amount of I/O capability built into the unit are known as:
a) Rack PLCs
b) Monolithic PLCs
c) Modular PLCs
d) None of these

40. Colored contact in PLC ladder diagram indicates:
a) Closed contact
b) Open contact
c) Any of these
d) None of these

41. According to PLC device signal module has _____
a) 3 parts
b) 5 parts
c) 2 parts
d) None of these

42. Abbreviate BF signal in PLC?
a) Bus Fault
b) Break fault
c) Bit fault
d) None of these

43. Who has known as the Father of PLC?
a) Steve Jobs
b) Bill Gates
c) Dick Morley
d) None of these

44. Relay consisting of _____
a) Only Coil Part
b) Only Contact Part
c) a & b both
d) None of these

45. The Programming line known as _____ uses in LADDER Logic for PLC?
a) Wrong
b) Rung
c) Right
d) None of these

46. How many possible stages an input can have in LADDER Logic?
a) Two
c) Three
b) One
d) None of these

47. What do you mean by "NO" contact using for Input in LADDER Logic?
a) Normally Operative
c) Not Operative
b) Normally Open
d) None of these

48. What do you mean by "NC" contact using for Input in LADDER Logic?
a) No Contact
c) Normally Close
b) Normally Contact
d) None of these

49. Which is/are mode normally present in the CPU module of the PLC unit?
a) UN-Mode
c) Both RUN & STOP Mode
b) STOP-Mode
d) None of these

50. One cycle through the program in a PLC unit is called a_____.
a) Period Time
c) Cycle Time
b) Scan Time
d) None of these

51. According to Module, How many most essential components are present in the PLC Unit?
a) 3
c) 4
b) 5
d) None of these

52. The Scan Time of the PLC is approximately_____.
a) 1/100th of a second
c) 1/10000th of a second
b) 1/1000th of a second
d) None of these

53. For larger PLC, normally the input cards contain _____ numbers of input.
a) 4 or 8
c) 16 or 32
b) 8 or 16
d) None of these

54. According to the module PLC categorizes into _____ types.
a) 4
c) 3
b) 2
d) None of these