MECHATRONICS (ME 433)

1.   What is Mechatronics?
          The term Mechatronics is used for the integration of microprocessor control system, electrical systems and mechanical systems.
          Mechatronics is defined as the integration of precision mechanical & electronic control for the development of smart products & process.

2.   What is a system? Give an example.
          A system can be considered as a box, which has an input, and an output and where it is not concerned with what goes on inside the box but only the relationship between the output and the input.
Example: A motor may be thought of as a system, which has as its input electric power and as output the rotation of a shaft.

3.   What is a measurement system?
          A measurement system can be considered as a black box, which is used for making measurements. It has as its input the quantity being measured and its output the value of that quantity.

4.   Write about the sensor and give an example?
          A sensor, which responds to the quantity being measured by giving as its output a signal which is related to the quantity.
Example: A thermocouple is a temperature sensor. The input to the sensor is a temperature and the output is an e.m.f. which is related to the temperature value.

5.   Write about the signal conditioner?
          A signal conditioner takes the signal from the sensor and manipulates it in to a condition, which is suitable for either display, or in the case of a control system, for use to exercise control.

6.   What are the two basic forms of the control system?
          The two basic forms of the control systems are,
          a. Open loop control system.
          b. Closed loop control system.
          The advantages of an open loop system are,
          a. It is being relatively simple
          b. Low cost
          c. Good reliability.
          The disadvantage is that, they are often inaccurate since there is no correction for error.

Closed loop systems have the advantage of being relatively accurate in matching the actual to the required values.

The disadvantage of the closed loop system are,
a. More complex
b. More costly
c. Greater chance of breakdown as a consequence of the greater number of components.

7.   What are the elements of the closed loop control system?
The various elements of a closed loop control system are,
a. Comparison element
b. Control element
c. Correction element
d. Process element
e. Measurement element

8.   What are the two types of feedback loop?
The two types of feed back loop are,
a. Positive feed back loop
b. Negative feed back loop.
The feedback is said to be negative feedback when the signal; which is feed back, subtracts from the input value. It is required to control a system.
The control elements decides what action to take when it receives an error signal. There are two types of control elements. They are,
a. Hard – wired systems   b. Programmable systems.
Control plans are hard – wired systems in which the control plan is permanently fixed by the way the elements are connected together.
Programmable system is where the control system is stored within a memory unit and may be altered by reprogramming it.

9.   What are the various elements of a closed loop system for a person controlling the temperature?
The various elements of a closed loop system are,

Controlled variable	-	The room temperature
Reference value	-	The required room temperature
Comparison element	-	The person comparing the measured value with the required value of temperature.
Error signal	-	The difference between the measured and required temperatures
Control unit	-	The person
Correction unit	-	The switch on the fire
Process	-	The heating by the fire
Measuring device	-	A thermometer

10.   Write about the Mechatronics approach in a micro-processor – controlled washing machine?

In the microprocessor-controlled washing machine, a mechanical system has become integrated with electronic controls. As a consequence, a bulky mechanical system is replaced by a much more compact microprocessor system, which is readily adjustable to give a greater variety of programs.

11.   What is the larger scale application of Mechatronics?
A larger scale application of Mechatronics is a Flexible Manufacturing engineering System (FMS) involving computer – controlled machines, robots, automatic material conveying and overall supervisory control.

12.   What is the purpose of a sensor?
Sensor is used for an element which produces a signal relating to the quantity being measured. I.e., an electrical resistance temperature element, the quantity being measured is temperature and the sensor transforms an input of temperature into a change in resistance.

13.   Define transducer?
The term transducer is often used in place of the term sensor. Transducer are defined as elements that when subject to some physical change experience a related change. Thus, sensors are transducers.

14.   What are the terms that define the performance of the transducers?
The terms are,
a. Range and span
b. Error
c. Accuracy
d. Sensitivity
e. Hysteresis error
f. Non – linearity error
g. Repeatability / reproducibility
h. Stability
i. Dead band / time
j. Resolution
k. Output impedance.

15.   Write about the static characteristics?
The static characteristics are the values given when the steady – state conditions occur. i.e., the values given when the transducer has settled down after having received some input.

16.   Write about dynamic characteristics?
The dynamic characteristics refer to the behavior between the time that the input value changes and the times that the value given by the transducer settles down to the

steady – state value. Dynamic characteristics are stated in terms of the response of the transducer to inputs in particular forms.

17.   What are the terms that you can find from the dynamic characteristics?
    The terms are,
    a. Response time
    b. Time constant
    c. Rise time
    d. Settling time.

18.   What is a displacement sensor?
    Displacement sensors are concerned with the measurement of the amout by which some object has been moved.

19.   What is a position sensor?
    Position sensors are concerned with the determination of the position of some object with reference to some reference point.

20.   What is a proximity sensor?
    Proximity sensors are a form of position sensor and are used to determine when an object has moved to within some particular critical distance of the sensor.

21.   What are the two basic types of the displacement and the position transducers?
    The two basic types are,
    a. Contact sensors
    b. Non contacting sensors.

22.   Write about the contact sensors?
    In contact sensors the measured object comes into mechanical contact with the sensor. For those linear displacement methods involving contact, there is usually a sensing shaft, which is in direct contact with the object being monitored by a sensor.

23.   What is the use of the contact sensors?
    The movement of the shaft may be used to cause changes in electrical voltage, resistance, capacitance, or mutual inductance. For angular displacement methods involving mechanical connection, the rotation of a shaft might directly drive, through gears, the rotation of the transducer element.

24.   Write about the strain – gauged element?
    The electrical resistance strain gauge is a metal wire, metal foil strip, or a strip of semiconductor material, which is wafer – like and can be stuck onto surfaces like a postage stamp.

25.   What is gauge factor?
When the strain – gauged element is subjected to strain, its resistance R changes, the fractional change in resistance $\Delta R/R$ being proportional to the strain.

i.e. $\Delta R/R = G\varepsilon$, where G, the constant of proportionality is termed as the gauge factor.

26.   Write about the gauge factors for different types of strain gauges?
The gauge factor of metal wire or foil strain gauges with the metals generally used is about 2.0. Silicon p – and n – type semiconductor strain gauges have gauge factors of about + 100 or more for p- type silicon and – 100 or more for n – type silicon.

27.   What is the capacitance of a parallel plate capacitor?
The capacitance of a parallel plate capacitor is given by,

$$C = \frac{\varepsilon_r \varepsilon_0 A}{d}$$

Where, ε_r the relative permittivity of the dielectrio between the plates.

ε_0 – a constant called the permittivity of free space
A – the area of overlap between the two plates
d – the plate separation.

28.   Write about LVDT?
The Linear Variable Differential Transformer consists of three coils symmetrically spaced along an insulated tube. The central coil is the primary coil and the other two are identical secondary coils, which are connected in series in such a way that their outputs oppose each other.

29.   How does an LVDT work?
When there is an alternating voltage input to the primary coil, alternating e.m.f.s are induced in the secondary coils. With the magnetic core central, the amount of magnetic material in each of the secondary coil is the same.

30.   What are the uses of LVDT?
The uses are as follows.
a.   Widely used as primary transducers for monitoring displacements.
b.   Also used as secondary transducers in the measurement of force, weight and pressure.

31.   Write about inductive proximity switch?
Inductive proximity switch consists of a coil wound round a core. When the end of the coil is close to a metal object is inductance changes. This change can be monitored

by its effect on a resonant circuit and the change used to trigger a switch. It can only be used for the detection of metal objects and is best with ferrous metals.

32.   What is an encoder?
An encoder is a device that provides a digital output as a result of a linear or angular displacement.

33.   What are the two types of position encoders?
The two types of position encoders are,
a. Incremental encoders
b. Absolute encoders.

34.   What is an incremental encoder?
An incremental encoder is used for the measurement of angular displacement. A beam of light passes through slots in a disc and is detected by a suitable light sensor. When the disc is rotated, the sensor produces a pulsed output with the number of pulses being proportional to the angle through which the disc is rotated. Hence, the angular position of the disc is determined.

35.   Write about absolute encoder?
An absolute encoder is used for the measurement of angular displacement. This gives an output in the form of a binary number of several digits, each such number representing a particular angular position. The rotating disc has three concentric circles of slots and three sensors to detect the light pulses.

36.   What are the uses of photosensitive devices?
Photosensitive devices can be used to detect the presence of an opaque object by it breaking a beam of light or infrared radiation, falling on such a device or by detecting the light reflected back by the object.

37.   Write about Hall effect sensors?
When a beam of charged particles passes through a magnetic field, forces act on the particles and the beam is deflected from its straight line path. A current flowing in a conductor is like a beam of moving charges and thus can be deflected by a magnetic field.

38.   What is Hall co-efficient?
The transverse potential difference is given by,

$$V = K_H \frac{BI}{T}$$

Where, K_H =   Hall co-efficient,
        B =   Magnetic flux density at right angles to the plate,
        I =   Current

$$T \quad = \quad \text{Plate thickness.}$$

39. What is a tachogenerator?

A tachogenerator is used to measure angular velocity. Variable reluctance tachogenerator consists of a toothed wheel of ferromagnetic material, attached to the rotating shaft. As the wheel rotates, the teeth move past the coil and the air gap between the coil and the ferromagnetic material changes and so the flux. The resulting cyclic change in the flux produces an alternating e.m.f. in the coil.

40. Write about pyroelectric sensor?

A pyroelectric sensor consists of a polarized pyroelectric crystal with thin metal film electrodes on opposite faces. Ions are drawn from the surrounding air and electrons from any measurement circuit connected to the sensor to balance the surface charge.

41. Write about the principle of load cell?

Force – measuring transducer is based on the use of electrical resistance strain gauges to monitor the strain produced in some member when stretched, compressed or bent by the application of the force. The arrangement is referred to as load cell.

42. What are the types of pressure measurements?

The types of pressure measurements are,
a. Absolute pressure, where the pressure is measured relative to zero – pressure. I.e., vacuum.
b. Differential pressure, where a pressure difference is measured and gauge pressure where the pressure is measured relative to the barometric pressure.

43. What are the material used for diaphragms, capsules and bellows?

Various materials are used for diaphragms. They are,
a. Stainless steel
b. Phosphor bronze
c. Nickel
d. Rubber and
e. Nylon.

44. Write about piezoelectric sensors?

Piezoelectric materials when stretched or compressed generate electric charges with one face of the material becoming positively charged and the opposite face negatively charged. As a result, a voltage is produced.

45. What are the applications of the tactile sensor?

A tactile sensor is a particular form of pressure sensor. Such a sensor is used on the 'fingertips' of robotic hands to determine when a 'hand' has come into contact with an object. They are also used for touch display screens where a physical contact has to be sensed.

46.   Write about the tactile sensor?

Two layers of the film are used and are separated by a soft film, which transmits vibrations. The lower PVDF film has an alternating voltage applied to it and this results in mechanical oscillations of the film. These vibrations cause an alternating voltage to be produced, when pressure is applied to the upper PVDF film.

47.   Write about orifice plate?

The orifice plate is simply a disc, with a central hole, which is placed in the tube through which the fluid is flowing. The pressure difference is measured between a point equal to the diameter of the tube upstream and a point equal to half the diameter downstream.

48.   Write about the constructional features of a turbine meter?

The turbine flow meter consists of a multi – bladed rotor that is supported centrally in the pipe along which the flow occurs. The fluid flow results in rotation of rotor. The rate of revolution of the rotor can be determined using a magnetic pick – up.

49.   Write about the bimetallic strips?

Bimetallic strips consists of two different metal strips bonded together. The metals have different co-efficients of expansion and when the temperature changes the composite strip bends into a the curve. The deformation may be used as a temperature – controlled switch.

50.   Write about Thermistors?

Thermistors are small pieces of material made from – mixtures of metal oxides, such as those of chromium, cobalt, iron, manganese and nickel. These oxides are semiconductors. The material is formed into various forms of element, such as beads, discs and rods.

51.   What are thermocouples?

The base metal thermocouples, E,J,K and T are relatively cheap but deteriorate with age. They have accuracies which are typically about ± 1 to 3%. Noble metal thermocouples, e.g. R, are more expensive but are more stable with longer life. They have accuracies of the order of ± 1 % or better.

52.   What are the types of light sensors?

The types of light sensors are,
a. Photodiodes
b. Phototransistors
c. Photo resistors.

53.   What are photodiodes?

Photodiodes are semiconductor junction diodes, which are connected into a circuit in reverse bias, so giving a very high resistance, so that when light falls on the junction the diode resistance drops and the current in the circuit rises appreciably.

54.   What are phototransistors?
The phototransistors have a light – sensitive collector – base p – n junction, when there is no incident light there is a very small collector – to – emitter current. When light is incident, a base current is produced that is directly proportional to the light intensity. This leads to the production of a collector current which is then a measure of the light intensity.

55.   What is a photo resistor?
A photo resistor has a resistance which depends on the intensity of the light falling on it, decreasing linearly as the intensity increases.

56.   What are digital signals?
Digital signals are discrete time signals in that they are not continuous functions of time but exist at only discrete times.

57.   What does the signal conditioning required?
Signal conditioning of analogue signals requires components such as amplifiers filter circuits and digital signal microprocessor.

58.   What is a microprocessor?
A microprocessor is a multipurpose, programmable, clock driven, register – based electronic device that reads binary instructions from a storage device called memory, accepts binary data as input and processes data according to those instructions, and provides results as output.

59.   What are the four components of a programmable machine?
A typical programmable machine can be represented with four components.
a. Microprocessor   b. Memory
c. Input   d. Output.

60.   Define the terms. a) Bus b) RAM c) ROM.
BUS – A group of lines used to transfer bits between the microprocessor and other components of the computer system.
RAM – Random Access Memory . Data is stored in a read / write memory.
ROM – Read only Memory.   A memory that stores binary information permanently. The information can be read from this memory but cannot be altered.

61.   What the types of languages used?
The types of languages used are,
a. Machine language

b. Assembly language
c. Low – level language
d. High – level language.

62.   What is a machine language?
The binary medium of communication with a computer through a designed set of instructions specific to each computer.

63.   What is a assembly language?
A medium of communication with a computer in which programs are written in mnemonics. An assembly language is specific to a given computer.

64.   What is low – level language?
A medium of communication that is machine – dependent or specific to a given computer. The machine and the assembly language of a computer are considered low – level languages. Programs written in these languages are not transferable to different types of machines.

65.   What is a high – level language?
A medium of communication that is independent of a given computer. Programs are written in English – lie words, and they can be executed on a machine using a translator (a compiler or an interpreter).

66.   Differentiate a compiler and an interpreter?
Compiler – A program that translates English – like words of a high level language into the machine language of a computer. A compiler reads a given program, called a source code, in its entirety and then translated the program into the machine language, which is called an object code.

Interpreter – A program that translates the English – like statements of a high – level language in to the machine language of a computer. An interpreter translates one statement at a time from a source code to an object code.

67.   What are the two parts of an instruction?
An instruction has two parts.
Opcode – Operation to be performed.
Operand – The operand can be data (8 – or 16 – bit), address, or register, or it can be implicit. The method of specifying and operand (directly, indirectly, etc.,) is called the addressing mode.

68.   What are the types of bus?
The types of bus are,
a. Address bus
b. Data bus
c. Control bus.

69.   Define the terms.
     a. Address bus
     A group of lines that are used to send a memory address or a device address from the MPU to the memory location or the peripheral and is unidirectional. The 8085 microprocessor has 16 address lines.
     b. Data bus
     A group of bi-directional lines used to transfer data between the MPU and peripherals and is bi-directional. The 8085 microprocessor has eight data lines.
     c. Control bus
     Single lines that are generated by the MPU to provide timing of various operations.

70.   Write about the 16 – bit register of a 8085 microprocessor?
     The 8085 has two 16 – bit register.
     a.   The program counter
     b.   Stack pointer
     The program counter is used to sequence the execution of a program.
     The stack pointer is used as a memory pointer for the stack memory.

71.   What are the two types of memories?
     The two types of memories are,
     a.   Static memory (SRAM)
     b.   Dynamic memory (DRAM)

72.   Write about the SRAM?
     a.   This memory is made up of flip – flops, and it sores the bit as a voltage.
     b.   Each memory cell requires six transistors.
     c.   The memory chip has low density, but high speed.
     d.   More expensive, and consumes more power.
     e.   Also known as cache memory.

73.   What are the advantages of DRAM?
     The advantages of DRAM are,
     a.   This memory is made up of MOS transistor gates and it stores the bit as a charge.
     b.   It has high density.
     c.   Low power consumption
     d.   Cheaper than static memory
     e.   Economic to use when the system memory size is atleast 8K for small systems.

74. What are the disadvantages of DRAM?
     The disadvantages of DRAM are,
     a.   The charge (bit information) leaks.

b. Stored information needs to be read and written again every few milliseconds this is called refreshing the memory.

c. Requires extra circuitry, adding to the cost of the system.

75.   What is flash memory?

The flash memory must be erased either in its entirely or at the sector level. The memory chips can be erased and programmed atleast a million times. The power supply requirement for programming these chips 2was around 12V, but now chips are available that can be programmed using a power supply as low as 1.8 V. Hence, this memory is ideally suited for low – power systems.

76.   What are the interfacing devices?

The bus drivers increase the current driving capacity of the buses, the decoder decodes the address to identify the output port, and the latch holds data output for display. These devices are called interfacing devices. The interfacing devices are semiconductorchips that are needed to connect peripherals to the bus system.

77.   Write about buffer?

The buffer is a logic circuit that amplifies the current or power. It has one input line and one output line. The logic level of the output is the same as that of the input, logic 1 input provides 1 output. The buffer is used primarily to increase the driving capability of a logic circuit. It is also known as driver.

78.   Define looping?

The programming technique used to instruct the microprocessor to repeat tasks is called looping. A loop is set up by instructing the microprocessor to change the sequence of execution and perform the task again. This process is accomplished by using Jump instructions.

77.   What are the types of loops?

Loops can be classified in to two groups. They are,
a. Continuous loop
b. Conditional loop.

78.   Write about the continuous loop?

A continuous loop is a set up by using the unconditional jump instruction. A program with a continuous loop does not stop repeating the tasks until the system is reset.

79.   Write about the conditional loop?

A conditional loop is set up by the conditional jump instructions. The instructions check flags (Zero, Carry etc.,) and repeat the specified tasks if the conditions are satisfied. These loops usually include counting and indexing.

80.   What are the instructions of a 8085 instruction set for data transfer from memory to the microprocessor?

The 8085 instruction set includes three memory transfer instructions. They are,
a. MOV R,M : Move from Memory to Register
b. LDAX B/D : Load Accumulator Indirect
c. LDA 16 – bit : Load Accumulator Direct

81.   What are the instructions of a 8085 instruction set for data transfer from microprocessor to the memory?

The 8085 instruction set includes three memory transfer instruction. They are,
a. MOV. R,M : Move from Memory to Register
b. STAX B / D : Store Accumulator Indirect
c. STA 16 – bit : Store Accumulator Direct
d. MVI M, 8 – bit : Load 8 – bit data in memory.

82.   What are the opcodes related to rotating the accumulator bits?

The opcodes related to rotating the accumulator bits are,
a. RLC – Rotate Accumulator Left through Carry
b. RAL – Rotate Accumulator Left
c. RRC – Rotate Accumulator Right through Carry
d. RAR – Rotate Accumulator Right

83.   What is dynamic debugging?

After the steps have been completed in the process of static debugging, and if the program still does not produce the expected output, attempt is made to debug the program by observing the execution of instructions. This is called dynamic debugging.

84.   What are the tools used for dynamic debugging?

The tools used for dynamic debugging are,
a. Single step
b. Register examine
c. Break point.

85.   Write about single step?

The single step key on a keyboard allows to execute one instruction at a time, and to observe the results following each instruction. Generally, a single-step facility is built with a hard-wired logic circuit. When the single step key is pushed, addresses and codes are observed as they are executed.

86.   What are the advantages of single step?

With the single step technique, it is able to spot,
a. Incorrect addresses
b. Incorrect jump locations for loops
c. Incorrect data or missing codes.

87.   Write about register examine?

The register examine key allows to examine the contents of the microprocessor register. When the appropriate keys are pressed, the monitor program can display the contents of the registers. This technique is used in conjunction either with the single – step or the break point facilities. After executing a block of instructions, the register contents at a critical juncture of the program and compare these contents with the expected outcomes.

88.   Write about the break point?

In a single – board computer, the break point facility is a software routine that allows to execute a program in sections.   The break point can be set in a program by using RST instructions. When the execute key is pushed, the program will be executed until the breakpoint, where the monitor takes over again. If the segment of the program is found satisfactory, a second breakpoint can be set at a subsequent memory address to debug the next segment of the program.

89.   What are the advantages of the break point?

With the break point facility,
  a. Isolate the segment of the program with errors.
  b. Isolated segment can be debugged with the single – step facility.
  c. Check out the timing loop.
  d. Check the I/O section
  e. Check the interrupts.

90.   How will you interface the I/O devices?

I/O devices can be interfaced using two techniques. They are,
  a. Peripheral – mapped I/O
  b. Memory – mapped I/O.

91.   Write about peripheral mapped I/O?

In peripheral – mapped I/O, a device is identified with an 8 – bit address and enabled by I/O related control signals.

92.   Write about memory – mapped I/O?

In memory mapped I/O, a device is identified with a 16-bit address and enabled by memory – related control signals.

93.   What is A/D and D/A converter?

The electronic signal that translates the analog signal into digital signal is called analog to digital (A/D) converter.

The electronic signal that translates the digital signal into analog signal is called digital to analog (D/A) converter.

94.   What are the types of D/A converters?
         Digital to analog converters can be broadly classified in three categories. They are,
      a. Current output
      b. Voltage output
      c. Multiplying type

95.   Write about the three types of D/A converters?
         Current output – It provides current as the output signal.
         Voltage output – Internally converts the current signal into the voltage signal. It is slower than the current output DAC because the delay in converting the current signal in to the voltage signal.
         Multiplying type – Its output represents the product of the input signal and the reference source and the product is linear over a broad range.

96.   What are the elements required for D/A converter?
         A D/A converter circuit requires three elements. They are
      a. Resistor network with appropriate weighting
      b. Switches
      c. Reference source.

97.   What are the two techniques involved in A/D conversion?
         The techniques involved in A/D conversion are,
      a. Comparing a given analog signal with the internally generated equivalent signal. This group includes successive approximation, counter, and flash – type converters.
      b. Changing an analog signal into time or frequency and comparing these new parameters to known values. This group includes integrator converters and voltage to frequency converters.

98.   What are the applications of A/D converters?
         The A/D converters are used in applications such as data loggers and instrumentation, where conversion speed is important. The integrating type converters are used in applications such as digital meters, panel meters and monitoring systems, where the conversion accuracy is critical.

99.   What are the functions of a microprocessor to be interfaced with an A/D converter?
         To interface an A/D converter with the microprocessor, the microprocessor should,
      a. Send a pulse to the 'START' pin. This can be derived from a control signal such as write $(\overline{WR})$

b. Wait until the end of the conversion. This period can be verified either by status checking (polling) or by using the interrupt.
c. Read the digital signal at an input port.

100. Give some applications of microprocessor.?
The examples of the microprocessor are,
a. Microprocessor Controlled Temperature System (MCTS)
b. Stepper motor control
c. Traffic light controller.

101. What is a PLC?
A programmable Logic Controller (PLC) is defined as a digital electronic device that uses a programmable memory to store instructions and to implement functions such as logic, sequencing, timing, counting and arithmetic in order to control machines and processes.

102. What is main advantage of PLC?
PLC's have great advantage that it is possible to modify a control system without having to rewire the connections to the input and output devices.

103. What are the features of PLC as a controller?
The features of PLC as a controller are,
a. They are rugged and designed to withstand vibrations, temperature, humidity and noise.
b. The interfacing for inputs and outputs is inside the controller.
c. They are easily programmed and have an easily understood programming language.

104. Write about the architecture of a PLC?
It consists essentially of a central processing unit (CPU), memory and input/output circuitry. The CPU controls and processes all the operations within the PLC. It is supplied with a clock with a frequency between 1 and 8 MHz. It also has a bus system, memory and input/output units, a system ROM for permanent storage, RAM for the users program and temporary buffers.

105. How are programs entered?
Programs are entered into the input / output unit from a panel, which can vary from small keyboards with liquid crystals to those using a visual display unit (VDU) with keyboard and screen display. Alternatively, the programs can be entered into the system by means of a link to a PC.

106. Write about the input / output channels?
The input/output channels provide signal conditioning and isolation functions so that sensors and actuators can be generally directly connected to them without the need

for other circuitry. Common input voltages are 5 V and 24V. Common output voltages are 24 V and 240 V.

107.   Write about the relay?

With the relay type, the signal from the PLC output is used to operate a relay and so is able to switch currents of the order of a few amperes in an external circuit. The relay isolates the PLC from the external circuit and can be used for both D.C. and A.C. switching. Relays are, however, relatively slow to operate.

108.   What are optoisolators?

Optoisolators are used with transistor switches to provide isolation between the external circuit and the PLC. They are also used to provide isolation.

109.   What is ladder programming?

The ladder programming involves each program task being specified as though a rung of a ladder. Thus such a rung could specify that the state of switches A and B, the inputs, be examined and if A and B are both closed then a solenoid, the output is energized.

110.   What are the methods used for input / output processing?

There are two methods used for input / output processing. They are
a. Continuous updating
b. Mass input/output copying.

111.   What is continuous updating?

This involves the CPU scanning the input channels as they occur in the program instructions. Each input point is examined individually and its effect on the program determined. Each input is scanned with a 3 ms delay, before the program has the instruction for a logic operation to be executed and an output to occur. This process is called continuous updating.

112.   What is the disadvantage of continuous updating?

Because of the 3 ms delay in the continuous updating on each input, the time taken to examine several hundred input/output points can become comparatively long.

113.   Write about the mass input/output copying?

To allow a more rapid execution of a program, a specific area of RAM is used as a buffer store between the control logic and the input/output unit. At the start of each program cycle the CPU scans all the inputs and copies their status into the input/output address in RAM. At the end of each program cycle all the outputs are transferred from RAM to the output channels. The outputs are latched so that they retain their status until the next updating.

114.   What is a LATCH circuit?

The term latch circuit is used for the circuit used to carry out such an operation. It is a self – maintaining circuit in that, after being energized, it maintains that state until another input is received. It remembers its last state.

115.   Define the term point and delay–on?
The term point is used for a data point and so is a timing, marker (internal relay) or counter element. Thus, the 16 points for timers means that there are 16 timer circuits.
The term delay on is used to indicate that this type of timer waits for a fixed delay period before turning on.

116.   Write about timer circuit?
A timer circuit is specified by stating the interval to be times and the conditions or events that are to start and / or stop the timer. They are commonly regarded as delays with coils which, when energized, result in the closing or opening of input contacts after some preset time.

117.   Write about internal relays?
The term internal relay, auxiliary relay or marker is used for what can be considered as an internal relay in the PLC. These behave like relays with their associated contacts, but in reality are not actual relays with their associated by the software of the PLC. Internal relays are often used when there are programs with multiple input conditions.

118.   Write about counters?
Counters are used when there is a need to count a specified number of contact operations. Example – where items pass along a conveyor into boxes, and when the specified number of items has passed into a box the next item is diverted into another box.

119.   What is an up counter?
An up counter would count up to the preset value i.e., events are added until the number reaches the set value. When the set value is reached the counters contact changes state.

120.   What is a down counter?
Down counter means that the computer counts down from the preset value to zero i.e., events are subtracted from the set value. When zero is reached the counters contact changes state.

121.   Write about shift register?
The term shift register is used because the bits can be shifted along by one bit when there is a suitable input to the register.

122.   What are the inputs of shift register?

There are three inputs of shift register. They are,
a. One to load data into the first element of the register (OUT).
b. One as the shift command (SFT).
c. One for resetting(RST).

123. What the operations that are carried out with a PLC on data words?
The operations that are carried out with a PLC on data words are,
a. Moving data
b. Comparison of magnitudes of data
c. Arithmetic operations such as addition and subtraction
d. Conversions between binary coded decimal (BCD), binary and octal.

124. What are the criteria need for the selection of a PLC?
The criteria needed for the selection of a PLC are the following.
a. Input/output capacity is required.
b. Types of inputs/outputs are required.
c. Size of memory required.
d. Speed and power is required for the CPU.

125. What are the number of stages in the design process?
The design process can be considered as a number of stages.
They are,
a. The need
b. Analysis of the problem
c. Preparation of a specification
d. Generation of possible solutions
e. Selections of a suitable solution
f. Production of a detailed design
g. Production of working drawings.

126. What are the advantages of the microprocessor controlled system?
The microprocessor controlled system can cope easily with giving precision and programmed control. The system is much more flexible. This improvement in flexibility is a common characteristic of Mechatronics systems when compared with traditional systems.

127. What is the advantage of using PLC solution over mechanical solution?
A PLC solution could involve the arrangement with the given ladder program. This would have the advantage over the rotating cam of having off and on times which can be adjusted by purely changing the timer preset values in the program whereas a different cam is needed if the times have to be changed with the mechanical solution.

128. What are the axes of a pick and place robot?

The robot has three axes about which motion can occur.
a. Rotation in a clockwise or counter clockwise direction of the unit on its base.
b. Arm extension or contraction and arm up or down.
c. Gripper can open or close.

129.   How do the movements of robot take place?

Clockwise rotation of the unit might result from the piston in a cylinder being extended and the counter clockwise direction by its retraction. Likewise the upward movement of the arm might result from the piston in a linear cylinder being extended and the downward motion from it retracting, the extension of the arm by the piston in another cylinder extending and its return movement by the piston retracting.

130.   What is the use of PLC in automatic car park system?

An illustration of the use of a PLC in the coin operated barriers for a car park. The in-barrier is to open when the correct money is inserted in the collection box and the out – barrier is to open when a car is detected at the car park side of the barrier.

131.   How does a car park barrier works?

When a current flows through the solenoid of valve, the piston in a cylinder moves upwards and causes the barrier to rotate about its pivot and rise to let a car through.

133.   Write about the engine speed sensor?

The engine speed sensor is an inductive sensor and consists of a coil for which the inductance changes as the teeth of the sensor wheel pass it and so results in an oscillating voltage.

133.   How is the voltage produced by the oxygen sensor?

The oxygen sensor is generally a closed – end tube made of zirconium oxide with porous platinum electrodes on the inner and outer surfaces. Above about 300^0C, the sensor becomes permeable to oxygen ions with the result that a voltage is produced between the electrodes.

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