

**Academic Year 2024 -25**

**Question Bank**

<b>Year/Semester:IV/ VII</b>	<b>Department: ECE</b>	<b>Unit : I/II/III/IV/V</b>
<b>Date:09.08.2024</b>	<b>Subject Code/Title :OMR351/ Mechtronics</b>	<b>Section :Part A/B/C</b>
	<b>Faculty Name:M.Prabhakaran</b>	

**UNIT I**  
**INTRODUCTION AND SENSOR**  
**PART-A**

**1. What is mechatronics approach?**

The approach of the complete integration of Mechanical, Electronics, Control and Computer technology to produce products and systems is called Mechtronics approach.

**2. Mention the functions of a Mechatronics system.**

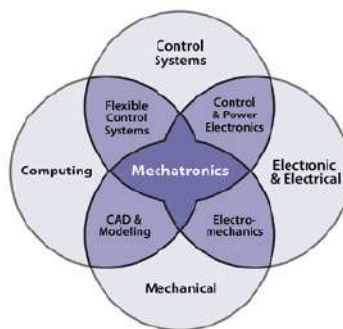
- It allows to integrating the Mechanical systems with micro elements to obtain the process design automation
- It ensures the higher efficiency and reliability for the quality of products through the latest technologies.

**3. What do you understand by signal conditioning?**

- A signal conditioning system performs manipulating an analog signal.
- It performs filtering and amplification functions.

**4. Define Mechtronics and sketch the graphical representation of mechatronics systems.**

Mechatronics is synergistic integration of mechanical engineering, electronics and intelligent computer control in design and manufacture of products and processes.



**5. What are the key elements of a mechatronics system?**

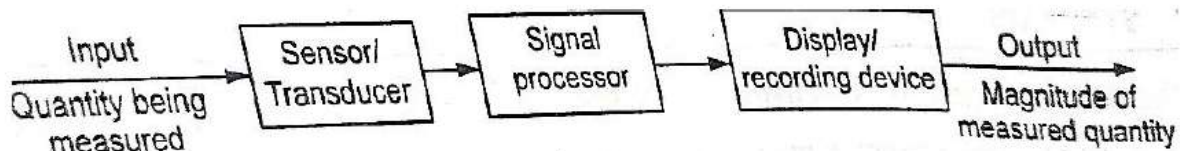
- Actuators and sensors
- Signals and conditioning
- Digital logic systems
- Software and data acquisition systems
- Computers and display devices.

**6. How precision machine is achieved in mechatronics systems?**

The use of nano-materials in manufacturing machine components by using mechatronics systems leads to more accuracy and high precision.

**7. What are the basic elements of the measurement system and sketch its block diagram?**

A generalized measurement system comprises of a sensor/transducer, sig processor, and a display/recording device as shown in Figure



**Measurement system**

**8. Identify the different mechatronics systems used in automobiles.**

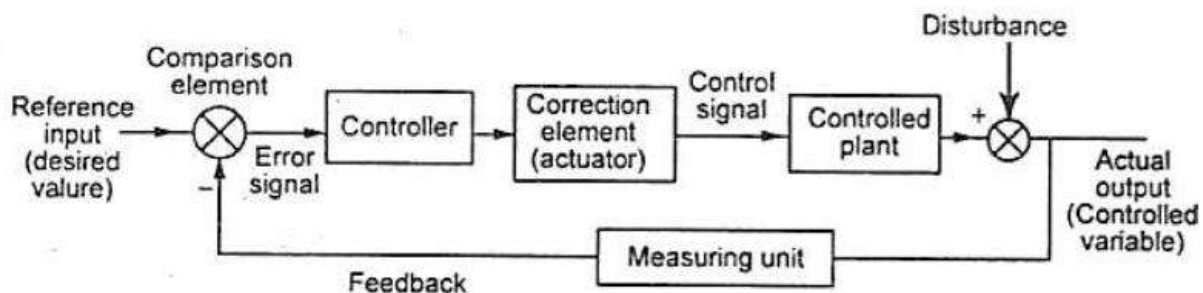
Automobile applications of mechatronics include electronic engine management system, collision detection system, global positioning system, anti-lock brake system, keyless entry system, cruise control, parking assistance system and many more.

**9. Distinguish between measurement system and control system.**

A measurement system involves the precise measurement and display/recording of physical, chemical, mechanical, electrical or optical parameters. It provides a means of describing natural phenomena in quantitative terms.

A control system in mechatronics refers to a group of physical component connected or related in such a manner as to command direct or regulate itself or another system. The physical components may be of electrical, mechanical, hydraulic, pneumatic, thermal or chemical in nature

**10. Draw the basic feedback system and indicate various terms associated with this block diagram.**



**Elements of closed loop system**

**11. Give an example for a transducer and state its transduction principle.**

Transducers are devices which convert an input of one form of energy (pressure, temperature, displacement, force, etc) into an output of another form of energy (mechanical, electrical, magnetic, etc). For example, a thermocouple is a transducer which converts changes in temperature into a voltage.

**12. Distinguish between open-loop and closed-loop control systems.**

S.No	Open-loop	Closed-loop
1	Open loop operation and it does not uses on a feedback to control the operation of the system	Closed loop operation uses negative feedback
2	The effects of known disturbances alone can be countered	The effects of disturbances are countered by virtue of negative feedback
3	The presence of non-linearity causes malfunctioning	Usually, it performs accurately even in the presence of non-linearity
4	It provides slow response because of manual control	Closed loop control can perform a task faster than open-loop
5	Optimization in control not possible	Optimization in control is possible

**13. What do you understand by the term static and dynamic characteristics of transducers?*****Static Characteristics***

Static Characteristics of an instrument are the parameters which are more or less constant or varying very slowly with time.

***Dynamic Characteristics***

Any system that changes with time is considered a dynamic system. Various characteristics of such system are called dynamic characteristics.

**14. What are pressure sensor?**

A pressure sensor measures pressure of gases or liquids .These sensors generate a signal as a a function of the pressure applied by the fluid.

**15. What is the basic principle in thermocouples?**

A thermocouple is a junction between two different metals that produces a voltage related to a temperature difference.

The amount of current that will be produced is dependent on the temperature difference between the measurement and reference junction.

**16. What is RTD?State its applications.**

It is used to measure the measure the temperature by correlating the resistance of the RTD element with temperature.

Applications are in Automatic temperature control (Oven Temperature)

### **PART-B & C**

1. Explain open loop and closed loop control system with neat sketches.
2. Explain the Hall Effect sensor and its types.
3. Discuss how resistance strain gauge is used as displacement sensors.
4. Explain in detail the static and dynamic characteristics of a sensor
5. Describe the concept of LVDT and capacitance sensor
6. Explain the principle and applications of light sensor.
7. Enumerate the working principle of eddy current sensor with a neat sketch.
8. Explain the construction , working and applications of following
  - (i) Hall effect sensor
  - (ii) Capacitance sensor
  - (iii) Pressure sensor
  - (iv) Strain gauge
9. Formulate the factors to be considered for the selection of sensor.

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**HoD Remarks:**

**Academic Year 2024 - 25**

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**UNIT II**  
**8085 MICROPROCESSOR**  
**PART-A**

**1. What is Microprocessor?**

A microprocessor is a semiconductor component that incorporates the functions of a central processing unit (CPU) on a Single Integrated Circuit (IC).

The central Processing Unit (CPU) built on a single IC is called microprocessor and which can fetch, decode and executes instructions.

**2. What is the function of Accumulator?**

Accumulator is an 8-bit register. It holds one of the data to be processed by Arithmetic Logic Unit (ALU). It also stores the result of the operation performed by the ALU. It is also called as A-register.

**3. Name the 3 main units of the Microprocessor.**

- (i) ALU-Arithmetic Logic Unit.
- (ii) Register Array.
- (iii) Timing and Control Unit.

**4. List the advantages of microprocessor.**

1. It simplifies system design
2. It reduces development time
3. It reduces cost and size
4. It is flexible in operation
5. It is very fast to perform operation

**5. What is a BUS?**

Various input/output devices and memory devices are connected to a CPU by groups of lines called Buses. There are three types of buses are available.

- (i) Address Bus
- (ii) Data Bus.
- (iii) Control Bus.

**6. List few applications of microprocessor.**

1. It is used for speed control of machines.
2. It is used for traffic control and industrial tool control.
3. It is used for measurement, display and control of current, voltage, pressure, temperature, etc.,

**7. Name four basic processor cycles.**

1. Fetch Cycle

2. Execute Cycle.
3. Machine Cycle.
4. Instruction Cycle.

### 8. Define Machine Cycle.

Machine Cycle is defined as the time required to complete one operation of accessing memory, I/O or acknowledging an external request. This cycle may consist of three to six T-states.

### 9. What are the registers available in 8085 microprocessor?

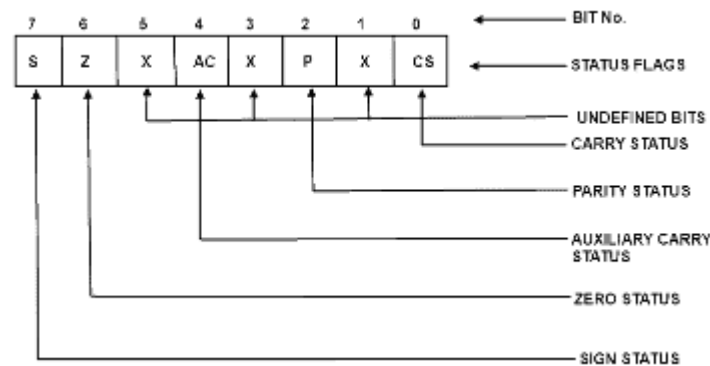
1. One 8-bit accumulator.
2. Six 8-bit general purpose registers.
3. One 16-bit stack pointer.
4. One 16-bit program counter.
5. Instruction Register.
6. Temporary Register.

### 10. What are the flags available in 8085 microprocessor?

These are five flags available in 8085 microprocessor such as

1. Carry Flag (CS).
2. Parity Flag (P).
3. Auxiliary Carry Flag (AC).
4. Zero Flag (Z).
5. Sign Flag(S).

### 11. Draw the status of flag register in 8085 microprocessor.



### 12. What are the interrupts of Intel 8085?

Intel 8085 has five kinds of interrupts

1. TRAP (Highest Priority)
2. RST 7.5
3. RST 6.5
4. RST 5.5
5. INTR (Lowest Priority)

### 13. What are the types of addressing mode in 8085 microprocessor?

Intel 8085 has the following addressing mode such as

1. Direct addressing
2. Register addressing
3. Register indirect addressing

4. Immediate addressing
5. Implicit addressing

**14. List the control and status signals of 8085 microprocessor and mention its need?**

Control and status signals include two control signals (RD and WR), these status signals (IO/M, S1 and S0) used to identify the nature of the operation and one special signal (ALE) to indicate the beginning of the operation.

**15. What is a stack in an 8085 microcomputer system?**

Stack is a set of memory locations in the R/W memory specified by the programmer in a main program. The stack is shared by the programmer and the microprocessor. The programmer can store and retrieve the contents of a register pair by using PUSH and POP instructions.

**16. What is indexing?**

Indexing means Pointing or Referencing Objects with sequential numbers. In a library, books are arranged according to numbers and they are referred to or sorted by numbers. This is called Indexing.

**17. What is the function of program counter in 8085 microprocessor?**

Program Counter is a 16-bit register sequencing the execution of operations. It is also called Memory Pointer. The function of this register is to hold the address of the instruction which is to be executed next.

**18. What is the different control machine instruction used in 8085 microprocessor?**

SIM -Set Interrupt Mask  
RIM-Read Interrupt Mask  
NOP- No Operation  
HLT- Halt the Processor.  
EI- Enable Interrupt  
DI- Disable Interrupt

**19. What is the function of Arithmetic Logic Unit (ALU)?**

The ALU is responsible for data manipulation and performs arithmetic and logical operation such as addition and subtraction. In addition the ALU contains a number of control inputs, which specify the data manipulation function to be performed. ALU is a combinational logic circuit whose output is an instantaneous function of its data and control inputs.

**PART-B & C**

1. Explain with a neat block diagram the architecture and functional units of 8085 microprocessor.
2. Illustrate various addressing modes of 8085 microprocessor.
3. Draw the pin diagram of microprocessor and explain.
4. Explain the instruction format of Intel 8085.
5. Explain about the 8085 Pin diagram.
6. Mention what are the difference between the Microprocessors and Microcontrollers.
7. Explain with timing diagram the memory read cycle in 8085.
8. Write short notes on
  - (i) Addressing modes
  - (ii) Instruction set of 8085 microprocessor
9. What are the functions of address, data and data buses?
10. Draw the timing diagram of the instruction MOV A,B and explain the process.

11. Draw the timing diagram for the instruction IN 02. Opcode for IN is 'DB'.
12. Explain with timing diagram the memory read cycle in 8085.
13. With a suitable example explain the 8085 microprocessor interrupt system in detail.
14. Draw the opcode fetch machine cycle of 8085.

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**HoDRemarks:**

9202 - CANCEL



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**UNIT III**  
**PROGRAMMABLE PERIPHERAL INTERFACE**  
**PART-A**

**1. What is Key debouncing?**

When a key press is found, the microprocessor waits for at least 10ms before it accepts the key as input. It is called key debouncing.

**2. Define PPI.**

8255 is a widely used, programmable, parallel I/O device. It can be programmed to transfer data under various conditions from simple I/O to interrupt I/O.

**3. What is USART?**

USART is an integrated circuit. It is a programmable device its function and specifications for serial I/O can be determined by writing instructions in its internal registers.

**4. What are the applications of D/A converter interfacing with 8255?**

1. Temperature control
2. Air conditioning control
3. Washing machine control
4. Traffic light control.

**5. Write down the function of OBF in 8255.**

OBF (Output Buffer Full)

This is an active low output signal for the output device. The 8255 activates this signal to indicate output device that the data is available on the output port.

**6. Name the modes available in 8255A Control Word format.**

1. BSR Mode
2. I/O Mode
  - Mode 0 : Simple I/O Mode
  - Mode 1 : I/O with Handshaking Mode
  - Mode 2 : Bidirectional Data Transfer Mode

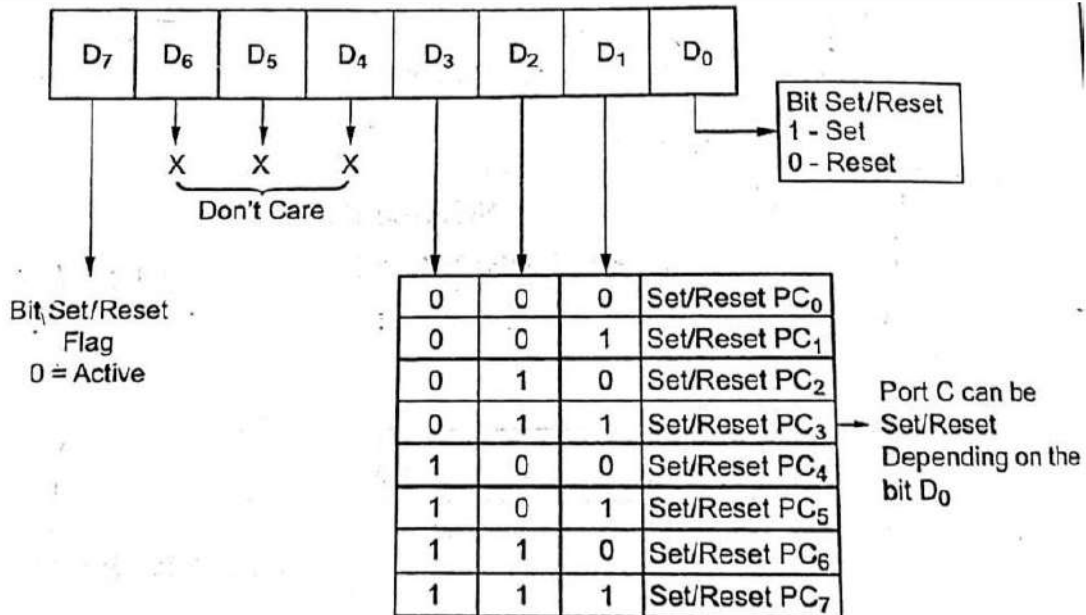
**7. What is key board interfacing?**

A keyboard consists of number of key switches used for entering data, event etc, using this keyboard, the input data is applied to the microprocessor is known as keyboard interfacing.

### 8. Write some features of 8255.

- The 8255 is a widely used programmable parallel I/O device.
- It can be programmed to transfer data under various conditions from simple I/O to interrupt I/O.
- It is compatible with all Intel and most other microprocessors.
- It is completely TTL compatible.

### 9. Show the control word format of 8255 in BSR mode.



**BSR Control Word Format**

### 10. State the purpose and importance of NOP instructions.

NOP: Perform NO Operation

- This instruction simply used up three clock cycles and increments the instruction
- Pointer to pointer to the next instruction
- It can also be used to hold a place in a program for instruction that will be added later.

### 11. Name any two types of ADCs.

1. Single Ramp or Single Slope
2. Dual Slope
3. Successive approximation
4. Flash

### 12. What is the bit set Reset mode of 8255 PPI?

The Individual bits of port C can be set or reset by sending out a single OUT instruction to the control Register. When port C is used for control/status operation, this feature can be used to set or reset individual bits.

### 13. Define conversion Time.

It is the time required for conversion of Analog signal into its digital equivalent. It is also called as setting time. It depends and the output of the amplifier. on the response time of the switches

**14. Define Monotonicity.**

A converter is said to have good monotonicity if it does not miss any step backward when stepped through its entire range by a counter.

**15. Define Settling Time.**

This is the time required for the output of the DAC to settle to within  $\pm 1/2$  LSB of the final value for a given digital input ie, zero to full scale

**16. Define Resolution.**

Resolution is the number of different analog output values that can be provide by a DAC. For an n-bit DAC

$$\text{Resolution} = 2^n$$

**17. Define Stepper Motor**

A stepper motor is a widely used to device that translates electrical pulses mechanical movement. In applications such as disk drives, dot matrix pr and robotics, the stepper motor is used for position control

**18. Define Pulse Width Modulation.**

The speed of the motor depends on three factors such as load, voltage current. For a given fix to load, we can maintain a steady speed by using method called pulse width modulation.

**19. Define Step Angle.**

The step angle is the minimum degree of rotation associated with a single step. Various motors have different step angles.

**20. Describe the need of interfacing.**

Data between memory I/O devices and register has to be transferred for the operation of processor in real time applications as a microprocessor is not capable of storing data in it, i.e., it has no internal memory.

### **PART-B & C**

1. Explain the operating modes of 8255 programmable peripheral interface
2. Why do we need A/D converter and D/A converter Draw the block diagram to interface 8085 microprocessor with A/D converter and D/A converter
3. Explain the Mode 1 input mode operation of 8255 in detail.
4. Explain the mode 0 of 8255 in detail.
5. Interface a ADC chip with 8085 processor through 8255 ports and write an ALP to use BSR mode to START conversion and STATUS CHECK mode to read output data. Explain the complete circuit and programs
6. Explain how 8085 can be connected to an A/D convertor. Describe the signals involved in the process of conversion.
7. With necessary diagrams explain the interfacing of analog to digital converter with microprocessor 8085
8. Explain the seven segment LED interface with microprocessor
9. Design an interface circuit needed to connect DIP switch as an input device and display the value of the key pressed using a 7 segment LED display. Using 8085 system, write a program to implement the same.
10. Describe in detail the LED interfacing with Microprocessor
11. Describe with a neat diagram the stepper motor control using Microprocessor 8085.
12. Explain the program of traffic light control
13. Explain about Temperature control.

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**HoDRemarks:**



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**Faculty Name:** M.Prabhakaran

**UNIT IV**  
**PROGRAMMABLE LOGIC CONTROLLER**  
**PART-A**

**1. Define a programmable logic controller.**

A Programmable Logic Controller (PLC) is a microprocessor based controller 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 process.

**2. What are the main components parts of a PLC?**

1. Central Processing Unit (CPU)
2. The input/output unit
3. The programming device
4. Memory Unit

**3. What is an internal relay in a PLC?**

Most PLCs have an area of memory allocated for internal storage that are used to hold data which behave like relays. It is able to switch ON and OFF. But this is only for internal purpose. This will not exist in the real world.

**4. What is shift register? What is the data required for a shift register?**

Shift registers can be used where sequence of operations is required for movement or track the flow of parts and information.

The data required for the shift register are address of the bit array, address of the control structure, address of the source bit, number of bits in bit array.

**5. How does the PLC differ from relay logic?**

- 1) Rewiring should be easily done in PLC
- 2) No vertical connections are allowed
- 3) In PLC, there must always be one output on each line.

**6. State the use of JUMP control in PLCs**

The jump instruction is an output instruction enabling part of a ladder program to be jumped over. With jump instruction the processor scan time can be reduced by jumping over instruction not pertinent to the machine operation thereby missing intermediate program and can skip instructions when a production fault occurs.

**7. Define Adaptive control.**

The control system which can adapt changes and it can change its parameters depending on the situation. It is known as adaptive control system.

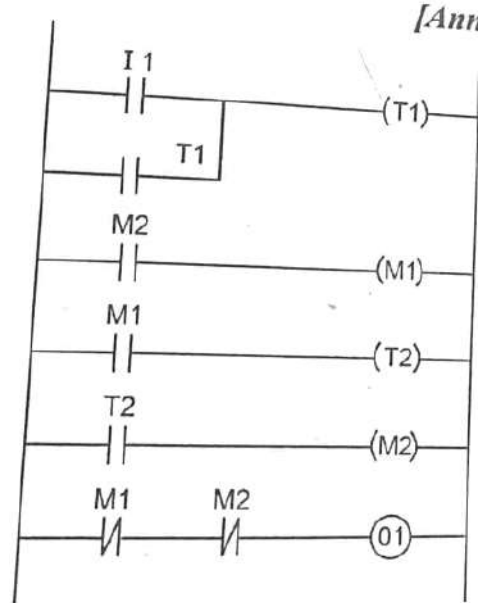
**8. State the purpose of Jump controls.**

By causing Jump instruction, the processor scan time is reduced by Jumping over instruction not pertinent to the machine operation. It is achieved by missing intermediate program and can skip instructions when a production fault occurs.

**9. How will you process the input and output of PLC?**

From the input/output module, the information about in and out of PLC obtained. The input module terminals receive signals from wires connected to input sensors and transducers. The output module terminals provide output voltages to energize actuators and indicating device.

**10. Derive a PLC timing circuit that will switch on output on for 10 seconds and then switch it off.**



I1 - input

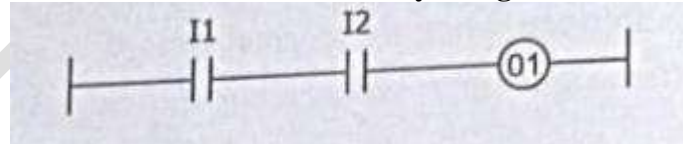
T1 - Timer 1 for 1 sec

T2 - Timer 2 for 20 sec

M1,M2 - Memory Coil

O1 - output (light)

**11. What are the logic functions that can be obtained by using switches in series?**



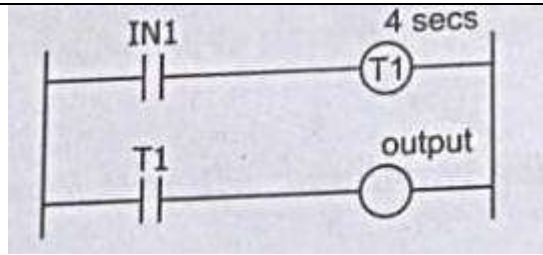
I1, I2 - input

O1 - output

**12. Explain delay-on and delay-off Timer with ladder diagrams.**

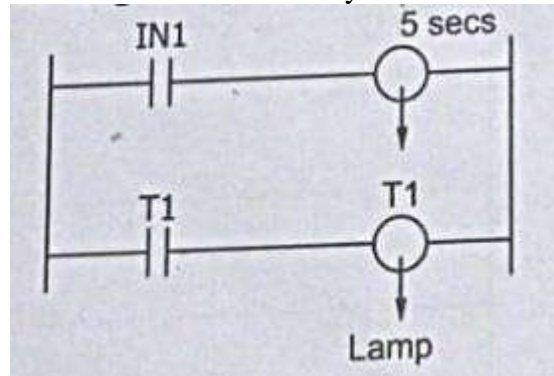
**ON-delay:**

The timer is energized when the input INI becomes energized. The timer starts running after some present time.



### OFF-delay:

When the contact IN1 is closed, the contact will energized the timer T1 and holds the output lamp ON for specified set value of 10 secs. The action of an OFF- delay Timer is to delay setting the lamp OFF.



### 13. Why a latch circuit is used in PLC?

LATCH circuit are used to hold an output energized, even when the input ceases. The output coil maintains its status until a different condition occurs, which is used to reset the coil to OFF

It is a self-maintaining circuit in that, after being energized, it maintains that state until another input is received.

### 14. What is ladder programming?

A ladder programming involves each program task being specified as though a RUNG of 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.

### 15. What are the criteria needs for the selection of a PLC?

The criteria needed for the selection of a PLC are the following

- 1) Input/Output capacity is required
- 2) Types of inputs/outputs are required
- 3) Size of memory required
- 4) Speed and power is required for the CPU

### 16. Why are PLC systems preferred over computers in factories?

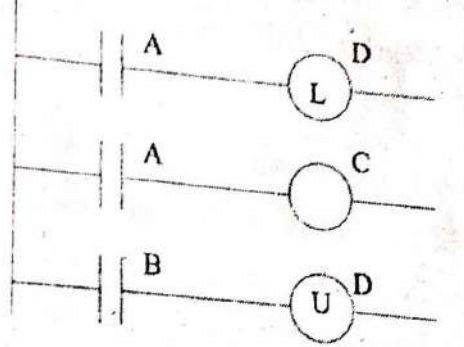
A PLC is a programmable Logic controller that is mainly used for industrial automation. However, the major reasons for preferred PLC systems over computers are as follows:

- 1) The PLC has a better processor power & memory.
- 2) It can handle more current in the L/O ports and the ports are opto coupled
- 3) It is more robust
- 4) It is closed architecture, it comes with industrial certificates, safety features etc.

**17. List the different programming methods of PLC.**

- 1) Structured text
- 2) Ladder diagrams
- 3) Function block diagram
- 4) Sequential function charts
- 5) Instruction list.

**18. How is a latch circuit represented in a ladder diagram?**



**19. Define on time delay?**

With an on delay timer, timing begins when voltage is applied. When the time has expired, the contacts close and remain closed until voltage is removed from the coil. If voltage is removed before time out, the delay resets.

**20. Brief the program scan cycle of PLC.**

The scan cycle is the cycle of which the PLC gathers the inputs, runs your PLC program and then updates the outputs. This will take some amount of time often measured in milliseconds or ms. The amount of time it takes for the PLC to make one scan cycle is called the scan time of the PLC.

**21. What is interlocking in ladder logic?**

An interlock is a feature that makes the state of two mechanisms or functions mutually dependent. It may be used to prevent undesired states in a finite-state machine, and may consist of any electrical, electronic, or mechanical devices or systems.

**PART-B & C**

1. Explain the Architecture of a PLC and explain about its elements.
2. Write the Specifications of a PLC.
3. Explain the basics of ladder programming used in PLC's.
4. With the help of Block diagram, explain the main components of a programmable logic controller.
5. Write a short note on Jump Control used in PLC using a ladder diagram.
6. List the factors to be considered while selecting a PLC.
7. Discuss how AND, OR, NOR and NAND systems can be formed with ladder diagram.
8. Explain how the shift register can be used to sequence the event with a neat diagram.
9. How will you select a PLC for a specification application?
10. Compare the differences between the PLC and computers.
11. Draw and explain the ladder diagram for the following.
  - a) Data movement
  - b) Data comparison
12. Explain the configuration of a PLC. List the considerations in selecting a PLC.
13. Using simple programs, explain the data handling operations in a PLC.
14. Explain the basic structure of a PLC.



15. Explain the following.
- Timers
  - Counters
  - Internal Relays
16. Explain the basics of ladder programming used in PLCs.
17. Explain in detail about Jump control used in PLC using a ladder diagram.
18. Explain Latching with ladder diagram.
19. Device a circuit that could be used with a domestic washing machine to switch on a pump. To pump Water for 100s into the machine then switch OFF and switch ON a heater for 50s, to heat the water. The heater is then switched OFF, and another pump is to empty the water from the machine for 100s.
20. Create a ladder diagram for the following application: A pneumatic system with double solenoid valves controls two double acting cylinders A and B. The sequences of cylinder operations are as follows: Cylinder B retracts and finally the cycle is completed by the Cylinder A retracting. Explain the logic of the PLC circuit used.
21. What is meant by Counters? Name the various types of counters and draw a ladder diagram to control a machine which is required to direct 6 items along one path for packaging in a box and then 12 items along another path for packaging in another box.
22. Design a PLC circuit that can be used to start a motor and then after a delay of 100s start a pump when the motor is switched off there should a delay of 10s before a the pump is switched off.
23. Draw a ladder diagram for two motor system having following conditions
- Starting push button motor 1
  - After 10 seconds motor -2 is ON
  - Stopping the switch stops motor 1 and 2 (Time base 1 sec)
23. Develop the ladder logic to fill the tank
- Fill the tank up to 80%. When the tank is filled, turn ON the heater to raise the temperature up to 70 deg.
  - When this temperature is reached, turn OFF the heater and open the outlet valve.
  - When the level in the tank falls below 10% close the output valve.

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**UNIT V**  
**ACTUATORS AND MECHATRONIC SYSTEM DESIGN**  
**PART-A**

**1. How does a car park barrier work?**

An automatic car park barrier is operated by coin inserts. The system uses a PLC for its operation. There are two barriers used namely, in barrier and out barrier. In barrier is used to open when the correct money is inserted while out barrier opens when a car is detected in front of it. It consists of a barrier which is pivoted at one end, two solenoid actuated 3/2 way directional control valves (DCVs) and a piston cylinder arrangement. Solenoid actuated directional control valves are used to control the movement of the piston. Limit switches are used to detect the foremost position of the barrier.

**2. What is the difference between Traditional and Mechatronics approach?**

S.No	Traditional approach	Mechatronics approach
1	The cam operated rocker arm mechanism controls the valve operation. The rotation of cam is based on the crank rotation.	The valve operation is controlled by the signal received from electronic control unit. The timing of valve operation is pre-programmed in microcontroller the
2	The engine speed regulation is based on the governor controlled throttle valve. The governor is actuated by the speed of the crank shaft. The speed control has no effect on the engine temperature and air flow rate.	The engine speed regulation is based on the input signal from speed sensor, temperature sensor and MAF sensor. Based on the sensor information, the throttling valve is controlled by microcontroller.
3	Spark timing of the spark plug is controlled by the ignition coil and distributor at constant pre-set interval.	Spark timing of the spark plug is controlled by the ignition coil that receives signal from the microcontroller through a timing sequence program.

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

An illustration of the use of a PLC is 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 sides of the barrier.

**4. 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.

**5. What are the types of stepper motors?**

There are three basic types of stepper motors based on the construction.

- 1) Variable reluctance stepper motor
- 2) Permanent magnet stepper motor
- 3) Hybrid stepper motor

**6. How a servo motor is controlled?**

A servomotor is a simple electric motor combined with a position sensing device (e.g. a digital decoder) and controlled for specific angular rotation with the help of servomechanism. Servomechanism is a typical closed-loop feedback control system. The position of a servo motor is decided by electrical pulse and its circuitry is placed beside the motor. Servomotors are used when an object is required to rotate at some specific angles or distance.

**7. Compare Traditional design with Mechatronics design.**

S. No	Traditional design	Mechatronics design
1	It is based on traditional systems such as mechanical, hydraulic and pneumatic systems.	It is based on mechanical, electronics, computer technology and control engineering.
2	It is less flexible	It is more flexible
3	It is less accurate.	It is more accurate
4	It has more complicate mechanism in design.	It has less complicate mechanism design
5	It involves more components and moving parts.	It involves fewer components and moving parts.
6	It is bulky.	It is more compact
7	Simple monitoring is sufficient	Supervision with fault diagnosis is required.
8	It provides precision through narrow tolerances.	It provides precision through measurement and feedback control
9	It has fixed abilities	It has learning abilities
10	Non-measurable quantities change arbitrarily.	The control of non-measurable and estimated quantities is possible

**8. What are the sensors used in Engine Management System?**

- a) Airflow sensor
- b) Ford-type MAP sensors
- c) Hall effect and AC excited sensors

**9. A stepper motor has a step angle of 7.5 degree. How many pulses required for the motor to rotate though five complete revolutions?**

**Given Data:**

$$A_m = 5 \times 360^\circ$$

$$\alpha = 7.5^\circ$$

**Sol:**

$$\text{Number of pulses } n_p = A_m / \alpha = 5 \times 360 / 7.5 = 240$$

**10. Write the working of stepper motor.**

A stepper motor is a motor controlled by a series of electromagnetic coils. The center shaft has a series of magnets mounted on it and the coils surrounding the shaft are alternately given current or not thereby

creating magnetic fields which repulse or attract the magnets on the shaft by causing the motor to rotate. A stepper motor has no commutator. Instead, there are five or six wires coming out of the motor, one wire is for each coil (usually four) and one or two common ground wires for others. Power must be applied to one coil after another in the proper sequence in order to get the motor to turn. In order to obtain the maximum torque, two coils are always ON condition at any time.

**11. Mention the applications of servo motor.**

- For very high voltage power systems, DC motors are preferred because they operate more efficiently than comparable AC servomotor
- It has also found its application in inkjet printers and RC helicopters
- It is used to drive conveyors used in industrial manufacturing and assembling units to pass an object from one assembly station to another
- It is also used in a solar tracking system
- DC servomotors are widely used in robots, toy cars and other position controlled devices
- Widely used in radars, computers, robots, machine tools tracking system, process controllers etc.

**12. What are the steps involved in the Mechatronics system design process.**

Stage 1: Need for design

Stage 2: Analysis of problem

Stage 3: Preparation of specification

Stage 4: Generation of possible solution

Stage 5: Selection of suitable solution or Evaluation

Stage 6: Production of detailed design

Stage 7: Production of working drawing

Stage 8: Implementation of design

**13. What is modelling in design process?**

Modelling is often known as simulation. It is a method of predicting the likely behaviour of a real-life system by constructing a computer model. A model usually consists of a series of rules, the rules usually written as mathematical expressions. The rules determine how the model will behave in various situations. The rules work on data fed into the model. The model should behave in the same way as the situation that it represents. The designer uses the model to predict how whatever it is modelling will behave in reality.

**14. A stepper motor has a step angle of 1.8 degree. How many pulses required for the motor to rotate through five complete revolutions?**

**Given Data:**

$$A_m = 5 \times 360^\circ$$

$$\alpha = 1.8^\circ$$

**Sol:**

$$\text{Number of pulses } n_p = A_m / \alpha = 5 \times 360 / 1.8 = 1000$$

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

The main purpose of PLC in automatic car park system is to make a process fast and accurate. Also it is used to keep the record of number of the car available in the parking, also the parking spots which are full and empty. There are proximity sensors connected at each parking spot which will detect the car and give the signal to PLC. When a car approaches the entry gate, PLC will decide whether any space is available or not. If no space is available, the PLC will then send signal to entry gate to keep the gate closed and turn on the indication "Car Park Full". If there is space in the park, the entry gate will open to allow the car to enter the park. Similarly, at the time of exit, the PLC will send signal to the exit gate to

open and allow the car to leave the park after paid the parking payment. All these activities make the car parking system completely automatic.

**16. Write down the applications of stepper motors.**

Owing to their unique characteristics, stepper motors are widely used in applications involving positioning, speed control, timing and synchronized actuation. Typical applications include the following elements

- Floppy disc head drives
- Printer carriage drives
- Positioning of print heads and pens in X-Y plotters
- NC and CNC machine tool slide drives
- Automatic teller machines (ATM)
- Camera iris control mechanisms
- Recording heads in computer disc drives
- Paper feed motors in typewriters and printers.

**17. Define detent torque.**

Detent torque is defined as the torque at the maximum load which is applied to the shaft of the motor which is unexcited without causing continuous rotation. It is also known as restraining torque produced in the rotor of the permanent magnet motor.

**18. How can servo motor be controlled?**

Servo motors are controlled by sending an electrical pulse of variable width. or pulse width modulation (PWM) through the control wire. There is a minimum pulse, a maximum pulse and a repetition rate. A servo motor can usually only turn  $90^\circ$  in either direction for a total of  $180^\circ$  movement. The frequency of the control signal should be 50 Hz or a pulse should occur every 20ms.

**PART-B & C**

1. What is stepper motor? Explain the working principles of stepper motor in half step mode.
2. What are the roles of sensors in car engine management system? Explain with a block diagram?
3. Design a robot to pick and place the object and comment on the various elements in the system?
4. Discuss the various stages involved in the design of Mechatronic systems?
5. What are the differences between Traditional and Mechatronics approach? Give a case study.
6. With necessary diagrams explain the automatic car parking system.
7. What are the seven stages of mechatronics design? Discuss how they are applied to design a weighing machine with a digital output.
8. Compare the traditional and meahctornics design of car windscreen wiper.
9. A coin operate car park barrier is controlled using a PLC. Draw ladder diagram or its operations.
10. List out the specifications of stepper motor and write the advantages and disadvantages
11. Explain construction and working of a DC servomotor along with its torque speed characteristics.
12. Considering a computer controlled machine tool (CNC machine tool) as a mechatronics system. Discuss the design considerations and design solutions to those considerations.

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