



QUESTION BANK

Name of the Department : Mechanical Engineering
Subject Code & Name : ME 8791 & Mechatronics
Year & Semester : IV & VII

UNIT – I: INTRODUCTION

PART -A (2 Marks)

1) Define mechatronics?

Mechatronics brings together the areas of technology involving sensors and measurement system, drive and actuation system, analysis of behavior of the system, control system and microprocessor system.

2) What is meant by system in mechatronics?

The system is a group of physical component combined to perform a specific function. Any mechatronics devices consist of system.

3) What are the main applications of mechatronics?

Washing machines, dish washers, micro ovens, cameras, atm and camcorders.

4) What are the types of control systems?

- a) Closed loop system
- b) Open loop system

5) Obtain the basic function of control system?

- a) To minimize the error between the actual and desired output
- b) To minimize the time response to load changes in the system.

6) List down the requirements of control system?

- a) Stability
- b) Accuracy
- c) Response

7) Give example for closed loop system and open loop system?

- a) Closed loop system-automatic water level controller
- b) Open loop system-electric fire.

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8) Mention the examples of automatic system?

- 1) Furnace pressure control system
- 2) Temperature control in a metal melting furnace

9) Name elements of feed back system?

- a) Forward path
- b) Feed back path
- c) Error detecting device
- d) Amplifier
- e) Compensating network

10) Name few elements of engine management system?

- a) Engine temperature
- b) Solenoid
- c) Fuel injection nozzle
- d) Spark timing

11) What is a sensor?

A sensor is an element in measurement system that acquires a physical parameter and changes it into signal.

12) What is transducer?

Transducer is related to conversion of energy from one form to another form, especially between two physical parameters.

13) Define error?

Error may be defined as the difference between the measured value and the true value.

14) What is hysteresis?

Hysteresis is defined as the difference in the output for a given input when this value is approached from the opposite direction.

15) What is resolution?

It is the smallest increment in the measured value that can be detected with certainty by the instrument.

16) State the dynamic characteristics of simplified measuring system?

- 1) Speed of response
- 2) Lag
- 3) Fidelity
- 4) Dynamic error

17) State the purpose of using potentiometer in displacement sensor?

A potentiometer can be used to convert rotary or linear displacement to a voltage.

18) What are the types of strain gauge?

- a) Unbounded strain gauge
- b) Bonded strain gauge
- c) Fine wire strain gauge

19) Mention the types of electrical strain gauges?

- 1) Inductive
- 2) Capacitive
- 3) Piezo electric
- 4) Resistance types

20) Name few materials used in binding of strain gauge?

- a) Ceramic cement
- b) Epoxy
- c) Nitrocellulose

21) What is tachogenerator?

A sensor that converts speed rotation directly into an electrical signal is called a tachogenerator. It is used to convert angular speed into a directly dependent voltage signal.

22) Write the advantages of tachogenerator?

- a) Direction of rotation is directly indicated
- b) Conventional type dc voltmeters are sufficient to use with.

23) What are the instruments used to measure linear velocity?

- 1) Electromagnetic transducer
- 2) Digital transducer
- 3) Transducers with Doppler Effect.

24) Mention some instruments that measure angular velocity?

- a) Hand speed indicators
- b) DC and AC tachogenerator
- c) Photoelectric tachometer
- d) Stroboscope

25) what are the types of bimetallic sensors?



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- a) Spiral type
- b) Helix type
- c) Flat type
- d) Cantilever type

PART – B (16 Marks)

1. What are the basic elements of a closed loop control system?
2. What is a RTD?. Explain the relationship between resistance and temperature for the RTD with temperature resistance curve?
3. Identify the various elements of a closed loop control system in an automatic water level controller and describe their functions.
4. Explain the function of a capacitive sensor in a robot end effectors?
5. Compare and contrast the control system for the domestic central heating system involving a bimetallic thermostat and that involving a microprocessor? Explain the static characteristic of a sensor?
6. Write short notes on,
 - (a) Thermocouple
 - (b) Piezoelectric transducer
 - (c) Incremental encoder
 - (d) Photovoltaic transducer
- (7) Briefly explain any two mechatronics system with example
- (8) Explain the following terms,
 - (i) Sensitivity
 - (ii) Hysteresis error
 - (iii) Stability
 - (iv) Resolution
- (9) Explain the working principle of,
 - (i) light sensor
 - (ii) Fluid sensor to determine the level of fluid in a container
 - (iii) Velocity sensor
- (10) Explain with a neat sketch the working principle of tachogenerator



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- (11) Explain with a neat sketch microprocessor based controllers.
- (12) Explain the different methods by which fluid pressure can be measured.

UNIT II: 8085 MICROPROCESSOR AND 8051 MICROCONTROLLER

PART -A (2 Marks)

1. What is a microprocessor?

A microprocessor is a multipurpose, programmable, clock driven, registers – 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.

2. 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.

3. 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.

4. What the types of languages used?

The types of languages used are,

- Machine language
- Assembly language
- Low – level language
- High – level language.

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5. What is a machine language?

The binary medium of communication with a computer through a designed set of instructions specific to each computer.

6. What is an 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.

7. 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.

8. What is a high – level language?

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

9. 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 into the machine language of a computer. An interpreter translates one statement at a time from a source code to an object code.

10. 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 an operand (directly, indirectly, etc.,) is called the addressing mode.

11. What are the types of bus?

The types of bus are,

- 1) Address bus
- 2) Data bus
- 3) Control bus

12. Define the term , Data Bus, Address bus, Control Bus

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.

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.

Control Bus:

Single lines that are generated by the MPU to provide timing of various operations.

13. 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.

14. What are the two types of memories?

The two types of memories are,

- a. Static memory (SRAM)
- b. Dynamic memory (DRAM)

15. Write about the SRAM?

- a. This memory is made up of flip – flops, and it stores 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.

16. What are the advantages of DRAM?

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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 at least 8K for small systems.

17. 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.

18. What is flash memory?

The flash memory must be erased either in its entirety or at the sector level. The memory chips can be erased and programmed at least a million times. The power supply requirement for programming these chips was 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.

19. 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 semiconductor chips that are needed to connect peripherals to the bus system.

20. 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.

21. 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

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accomplished by using Jump instructions.

22. What are the types of loops?

Loops can be classified in to two groups. They are,

- a) Continuous loop
- b) Conditional loop.

23. 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.

24. 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.

PART – B (16 Marks)

- 1). Draw a block diagram of the structure of a CNC controller. Explain the functions.
- 2). How is adaptive control used in metal cutting machines? What are the parameters checked? What type of sensors used?
- 3). Explain adaptive control system with a diagram
- 4). Explain with a diagram of point to point system
- 5). Explain the architecture of 8051 controller
- 6). What are the functions of interfacing circuit
- 7). Explain the difference between a parallel and serial interface.
- 8). Explain the term hand shaking in microprocessor
- 9). Explain the characteristics of PID controller.



UNIT III: PROGRAMMABLE PERIPHERAL INTERFACE

PART -A (2 Marks)

1. 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,

- i) a.MOV R,M : Move from Memory to Register
- ii) b.LDAX B/D : Load Accumulator Indirect
- iii)c.LDA 16 – bit : Load Accumulator Direct

2. 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,

- i) MOV. R,M : Move from Memory to Register
- ii) STAX B / D : Store Accumulator Indirect
- iii)STA 16 – bit : Store Accumulator Direct
- iv)MVI M, 8 – bit : Load 8 – bit data in memory.

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

The opcodes related to rotating the accumulator bits are,

- i) RLC – Rotate Accumulator Left through Carry
- ii) RAL – Rotate Accumulator Left
- iii)RRC – Rotate Accumulator Right through Carry
- iv)RAR – Rotate Accumulator Right

4. 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.

5. What are the tools used for dynamic debugging?

The tools used for dynamic debugging are,

- i) Single step
- ii) Register examine
- iii) Break point.

6. 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.

7. What are the advantages of single step?

With the single step technique, it is able to spot,

- i) Incorrect addresses
- ii) Incorrect jump locations for loops
- iii) Incorrect data or missing codes.

8. Write about register examines?

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.

9. Write about the break point?

In a single – board computer, the break point facility is a software routine that allows executing 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.

10. What are the advantages of the break point?

With the break point facility,

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- i) Isolate the segment of the program with errors.
- ii) Isolated segment can be debugged with the single – step facility.
- iii) Check out the timing loop.
- iv) Check the I/O section
- v) Check the interrupts.

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

I/O devices can be interfaced using two techniques. They are,

- i) Peripheral – mapped I/O
- ii) Memory – mapped I/O.

12. 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.

13. 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.

14. 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.

15. What are the types of D/A converters?

Digital to analog converters can be broadly classified in three categories. They are,

- i) Current output
- ii) Voltage output
- iii) Multiplying type

16. 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 delays in converting the current signal in to the

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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.

17. What are the elements required for D/A converter?

A D/A converter circuit requires three elements. They are

- i) Resistor network with appropriate weighting
- ii) Switches
- iii) Reference source.

18. What are the two techniques involved in A/D conversion?

The techniques involved in A/D conversion are,

- i) Comparing a given analog signal with the internally generated equivalent signal. This group includes successive approximation, counter, and flash – type converters.
- ii) 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.

19. 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.

20. 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,

- i) Send a pulse to the ‘START’ pin. This can be derived from a control signal such as write (WR)
- ii) Wait until the end of the conversion. This period can be verified either by status checking (polling) or by using the interrupt.
- iii) Read the digital signal at an input port.

21. What is ladder programming?

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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.

22. 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.

PART – B (16 Marks)

1. Discuss any five types of signal conditioning process with example.
2. Draw the ladder diagram of motor latching and explain.
3. How are internal relays used for starting multiple outputs? Discuss with a ladder diagram.
4. develop a PLC circuit for the following lighting control system. The system will be controlled by four switches S1,S2,S3 and S4. These switches will control the lighting in a room based on the following criteria:
 - i) Anyone three switches S1,S2, and S3 if turned ON can turn the lighting on, but all three switches must be OFF before the lighting will turn off
 - ii) The fourth switch S4 is a master control switch. If this switch is in ON position, the lights will be OFF and more of the other three switches have any control
5. Distinguish between inverting and non-inverting amplifiers
6. Draw the circuit diagram of Integrator and Differentiator by the use of OPAMP. Also discuss the principle of operation.
7. Explain the microcontroller with a block diagram.
8. Explain the factors for selecting the microcontrollers.

UNIT-IV: PROGRAMMING LOGIC CONTROLLERS

PART -A (2 Marks)

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 component parts of a PLC?

- Central processing unit (CPU)
- The input/output unit
- The programming device
- Memory unit.

3. What is the function of programming devices?

The programming device is used to enter the required program using ladder logic into the memory of the processor. The sequence of operation and ultimate control of equipment or machinery is specified and determined by ladder program.

4. List various types of PLC programming devices.

- Use of hand held programmer
- Terminal with video display unit
- A personal computer with appropriate software.

5. List down the types of buses required in a PLC.

- Data buses for communications data between elements.
- The address buses to read the address of locations for accessing stored data.
- Control buses for internal control actions.

6. What is ALU? State its function.

The ALU is responsible for data manipulation and performs arithmetic and logical operations such as addition and subtraction. In addition, the ALU

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contains a number of control inputs, which specify the data manipulation function to be performed. ALU is combinational logic circuit, whose output is an instantaneous function of its data and control inputs.

7. Highlight the important role of control unit.

The control unit is used to control the timing of operation and to control the units within the microprocessor to ensure that operations are carried out in the correct order.

8. What is RAM?

Random access memory is for the user's program and data storage is designed so that information can be written into or read from the memory and normally incorporated in the solid-state form contained in an integrated circuit.

9. What is meant by program scan?

A PLC does control the machine by taking repeated snapshots of the input state and reads to take the values, and energize or de-energize outputs according to the user program. This process is known as a program scan.

10. What is meant by a "retentive timer"?

A retentive timer accumulates time as and when it receives the power and time due to loss of power which will not be accounted for the timer coil operation. Retentive on delay timer will hold its accumulated value when the timer rung goes false and will continue timing where it left off when the timer rung goes true again.

11. What are counters?

Counters allow a number of occurrences of input signals to count or record the number of times some event occurs. PLCs include some form of counting element and are set to some preset number value. When this value of input pulse has been received, it will operate its contact, the normally open contacts would be closed and a normally closed contact would be opened.

12. Write down various types of counters.

- Down counters
- Up-counters

13. When are cascaded counters needed?

In some applications, it may be required to count events that exceed the maximum number allowable per counter instruction. The counters are programmed in series to produce an output in way that the output of first counter is programmed into the input of the second counter.

14. At what conditions master control is used?

It is often necessary to provide means of executing sections of the control logic when certain criteria are realized. They include instructions comprising the override instruction.

15. How does jump control work?

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 instructions not pertinent to the machine operation thereby missing intermediate program and can skip instruction when a production fault occurs.

16. Categorize data manipulation in shift registers.

- Data transfer
- Data comparison.

17. List down PLC programming methods.

- Structured text
- Ladder diagrams
- Function block diagram
- Sequential function charts
- Instruction list

18. What are the types of memory?

- Random Access Memory
- Read Only Memory (ROM)

19. Mention various tasks of CPU.

- Provide a mechanism for fetching instruction from memory prior to execution.
- Include logic which decodes the operation code of each instruction to generate low level control signal which perform data manipulation specified by the instruction.

20. List down the different types of timers.

- On delay timer
- Off delay timer
- Retentive timer
- Pulse delay.

PART - B (16 Marks)

- 1). Sketch the basic architecture of a PLC and explain the function of each element.
- 2). Explain how a PLC can be used to handle an analog input.
- 3). Draw the ladder diagram to represent
 - (i) Two switches are normally open and both have to be closed for a motor to operate.
 - (ii) Either of two, normally open, switches has to be closed for a coil to be energized and operate an actuator.
 - (iii) A motor is switched on by pressing a spring –return push button start switch and the motor remains on until another spring –return push button stop switch is pressed.
- 4). Derive a system using, using a PLC that could be used with a conveyor belt which is used to move an item to work station. The presence of item, at the work station IS DETECTED BY means of breaking a contact activated by a beam of light type a photo sensor. There it stops for 100 sec
- 5). Explain master relay control in PLC with diagram.
- 6). Explain architecture of PLC
- 7). Explain any one type of operational amplifier



UNIT – V: ACTUATORS AND MECHATRONIC SYSTEM DESIGN

PART -A (2 Marks)

1. What are the stages in designing a mechatronic system?

- i) Need for design
- ii) Analysis of problem
- iii) Preparation of specification
- iv) Generation of possible solution
- v) Selection of suitable solution or Evaluation
- vi) Production of detailed design
- vii) Production of working drawing

2. Mention any four statements about the problem definition.

- Mass and dimensions of design
- Type and range of motion required
- Accuracy of the element
- Input and output requirements of elements.

3. Distinguish between traditional design approach and Mechatronics approach.

Traditional design	Mechatronics design
It is based on a traditional system such as mechanical, hydraulic and pneumatic	It is based on mechanical, electronics, computer technology and control Engineering.
Less flexible	More flexible
Less accuracy	More accuracy
More complicated mechanism in design	Less complicated mechanism in design
It involves more components and moving parts.	It involves fewer components and moving parts.

5. How a traditional design of temperature control of domestic central heating system is improved by mechatronic design?

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The traditional design of the temperature control for a central AC system involves a bimetallic thermostat in a closed loop system. The basic principle behind this system is that the bending of the metallic strip changes as the temperature changes and is used to operate ON/OFF switch for the temperature control of the AC system. The same system can be modified by mechatronics approach. This system uses a microprocessor controlled thermocouple as the sensor. Such a system has many advantages over traditional systems. The bimetallic thermostat is less sensitive compared to the thermo diode.

6. What are the configurations in operating stepper motor?

- Full-step configuration.
- Half-step configuration.

7. Write the basic steps of the program to run a stepper motor.

- Advance a step by applying a data.
- Call time delay routine to complete a step.
- Repeat step 1 and step 2 until the required no of steps completed in forward direction.
- To reverse the direction of stepper motor, the same steps given above are repeated in the reverse order of data.

8. What are the various movements of pick and place robots?

- Clockwise and anticlockwise rotation of robot unit in its base.
- Linear movement of the arm horizontally i.e., extension or contraction of arm.
- Up and down movement of the gripper.

9. Name the two barriers used in automatic car parking system and state its uses.

There are two barriers used namely in barriers and out barriers. In barriers is used to open when the correct money is inserted while out barrier opens when the car is detected in front of it.

10. List the various sensors contained in engine management system.

- Temperature sensor
- Hot wire anemometer

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- Oil and pressure sensors
- Oxygen sensor

11. What is an engine management?

An electronic engine management system is made up of sensors, actuators, and related wiring that is tied into a central processor called microprocessor or microcomputer (a small version of a computer).

12. Point out the two important operations categories of sensors in engine management.

i) Reference voltage sensors

Reference voltage sensors provide input to the microprocessor by modifying or controlling constant, predetermined voltage signal.

ii) Voltage generation sensors

This varying voltage signal, when received by the microprocessor enables the microprocessor to monitor and adjust for changes in the computerized engine control system.

13. List out the various sensors used in engine management system.

- Throttle-position sensors
- Exhaust Gas Oxygen (EGO) sensors
- Manifold Absolute Pressure (MAP) sensors
- Temperature sensors
- Speed/Timing sensors
- Engine position sensor
- EGR diagnostic switch
- EGR Valve position sensor
- Coolant temperature sensor
- Intake air temperature sensor
- Mass Airflow (MAF) sensor
- Crankshaft position sensors
- Knock sensor

14. How does a car park barrier works?



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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.

PART – B (16 Marks)

- 1) What are the different stages in designing a mechatronics system, explain in detail?
- 2) Explain in detail what is the difference between Traditional and Mechatronic Design with an example?
- 3) Discuss the possible design solutions for a pick and place robot?
- 4) Explain the construction and working principle of stepper motor.
- 5) Design a mechatronics system for an automatic Car Park Systems?
- 6) Design a mechatronics system for an Engine Management Systems with a neat sketch?
- 7) Explain the construction and working principle of servo motor.
- 8) Two cylindrical parts of different height are produced and made to move in a conveyor and randomly placed. Tolerance in height is specified for both the parts. Give the schematic diagram for measuring the height of both the parts and counting them by the proper sensor.
- 9) Discuss the following actuation system
 - (i) Self excited wound field shunt configuration dc motor
 - (ii) Self excited wound field series configuration dc motor
 - (iii) Stepper motor
 - (iv) Induction motor
- 10) A flat belt, 7mm thick and 95mm wide transmits power between two pulleys running at 1500 rpm/min. the mass of the belt is .85kg/mlength. the angle of lap in the smaller pulley is 155 and the coefficient of friction between the belt and pulley is 0.25. if the maximum permissible stress in the belt is 2MN/m^2 , find the maximum power transmitted and initial tension in the belt.
- 11) Compare the functions of series wound D.C. motor and shunt wound D.C. motor.
- 12) Explain the specification of a stepper motor in detail

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- 13) A hydraulic cylinder is to be used to move a work piece in a manufacturing operation through a distance of 50mm in 10sec. A force of 10KN is required to move the work piece. Determine the required working pressure and hydraulic liquid flow if a cylinder with a piston dia of 100mm is available.

