Summer – 15 EXAMINATION

Subject Code: **17619** **Model Answer**

Important Instructions to examiners:
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills).
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

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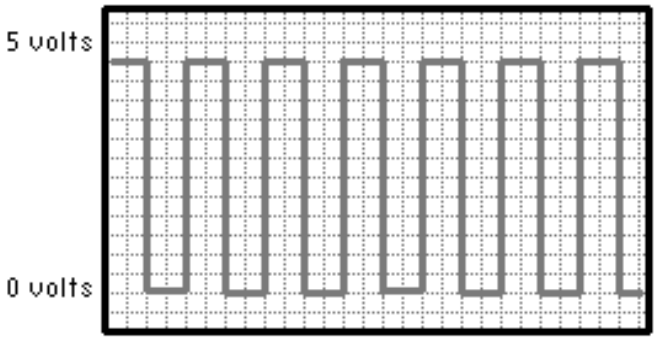
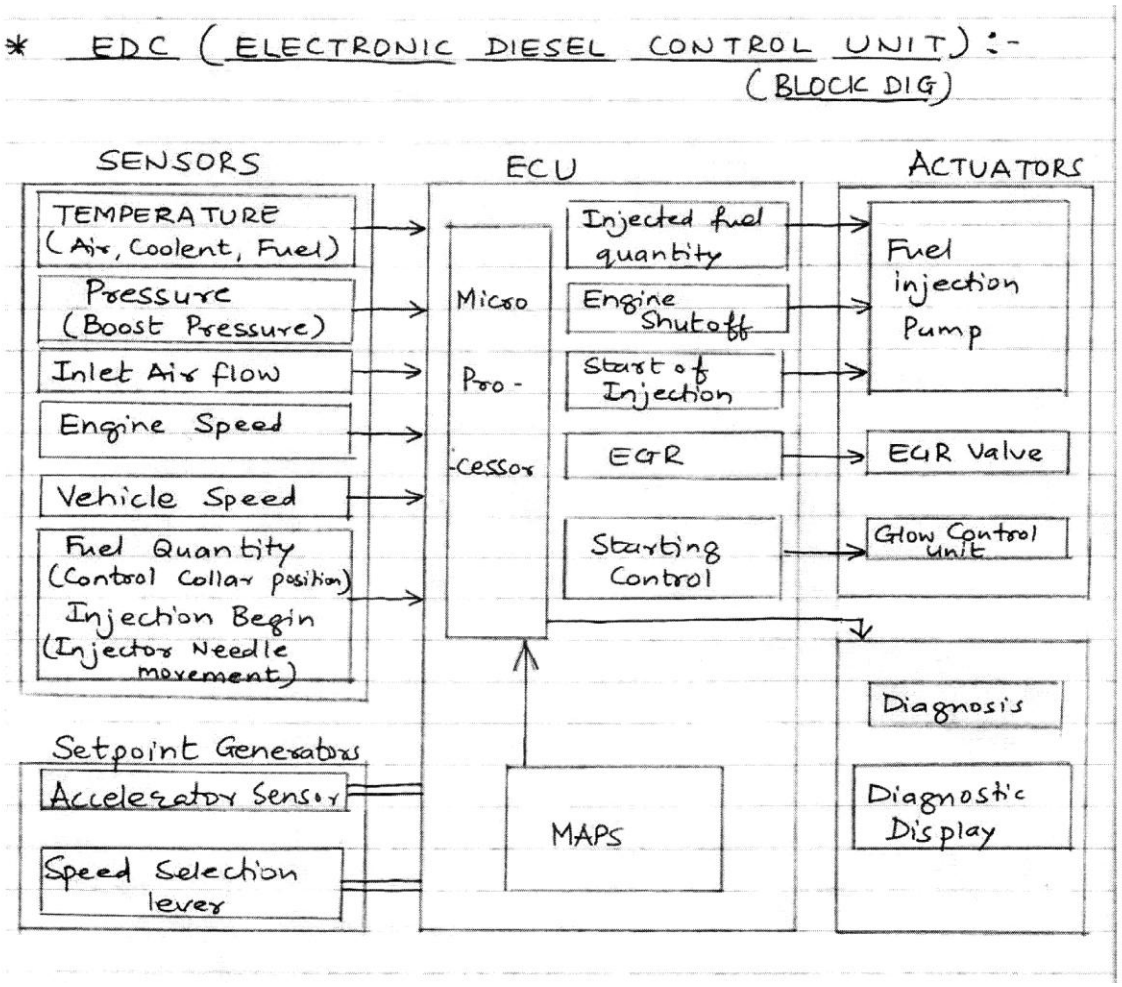
	Marks
1. a) Attempt any THREE of the following.	**12**
i) Enlist the four uses of diodes in Automobiles.	04
Answer : ***(Note:1 marks each)*** The four different uses of diodes in automobiles are:- 1. Voltage regulation in charging system. 2. Ignition system. 3. Rectifier circuit in charging system. 4. Lighting system (head lamps and tail lamps) 5. Automotive Accessories etc.	04
ii) Write the meaning of the following : 1) PROM 2) EPROM 3) EEPROM 4) RAM	04
Answer: ***(Note:1 mark each for abbreviation as well as description)*** 1. **PROM: (Programmable Read only Memory)** the information in PROM is used to define or adjust the operating parameters held in ROM. It contains specific data that pertains to the exact vehicle in which the computer is installed. 2. **EPROM: Erasable Programmable read only memory** is similar to the PROM except its contents can be erased to allow new data to be installed. 3. **EEPROM: Electrically Erasable Programmable read only memory** allows changing the information electrically one bit at a time. 4. **RAM: Random access memory (RAM).** The RAM will store temporary information that can be read from or written to by the CPU.	04

iii) List four sensors and four actuators.	04
Answer: **Following are the sensors:** *(Any four -1/2 Mark each)* 1. Oxygen Sensor 2. Manifold Absolute Pressure Sensor 3. Crankshaft Position Sensor 4. Coolant Temperature Sensor 5. Inlet Air temperature sensor 6. Camshaft position sensor 7. Detonation sensor 8. Throttle position sensor **Following are the actuators:** *(Any four -1/2 Mark each)* 1. Idle speed actuator 2. Exhaust gas recirculation valve 3. Fuel injector 4. Canister purge control valve 5. Air conditioning 6. Electronic spark timing control	02 02
iv) State the need of following safety system: 1) Collision avoidance 2) Park assist	04
Answer: Need of following safety system: ***(Note: 2 marks each for each safety system)*** i) **Collision avoidance:** CAS is a system designed to help prevent rear-end collisions with vehicles which are stationary or travelling in the same direction. The system is aimed at alerting the driver to an imminent rear end collision both at low speeds, typical of urban driving, and at higher speeds typical of rural roads and highways. ii) **Park assist**: This system uses ultrasonic sensors to detect obstacles at the rear of the vehicle. The system then informs the driver of the approximately distance between the sensors and the obstacles by sounding a buzzer. In this way the driver is able to park the vehicle properly.	02 02
Q.1. b) Attempt any ONE of the following:	06
i) Describe the construction and working of a sensor which is used for cylinder identification. Also show its output voltage signal.	06
Answer: ***(Note: Identification of the sensor - 1mark, construction and working - 3 marks and output voltage signal 2 marks)*** Crankshaft position sensor is used for cylinder identification. **Construction & Working:** The principle elements of the sensor are: 1. An iron rotor with lobes on it 2. A permanent magnet 3. A metallic path (the pole piece) for carrying the magnetic flux 4. A coil, wound around the metallic path, in which a voltage is induced.	01 03

It consists of a permanent magnet with a coil surrounding it. A metal tab passing close to the magnet fluxes the magnetic field across the coil, which in turn causes a change in the reluctance of the coil. A current being sent through the coil would change. The momentary change in the current is the output signal of the sensor. The output voltage is shown below: It should be in the range of 0V to 5V  Amplitude remains constant but frequency increases with engine rpm	02
ii) Describe electronic control system used in CRDI with block diagram.	06
Answer: Electronic control system used in CRDI (*Description 3 marks block diagram 3 marks)* In a CRDI system, the microprocessor works with input from multiple sensors. Based on the input from these sensors, the microprocessor can calculate the precise amount of the diesel and the timing when the diesel should be injected inside the cylinder. Using these calculations, the CRDI control system delivers the right amount of diesel at the right time to allow best possible output with least emissions and least possible wastage of fuel. The input sensors include Accelerator Pedal Position (APP) sensor, crank position sensor, pressure sensor, lambda sensor etc. The use of sensors and microprocessor to control the engine makes most efficient use of the fuel and also improved the power, fuel-economy and performance of the engine by managing it in a much better way.	03



03

2. Attempt any FOUR of the following	16
a) Describe binary number system with examples.	04

Answer : ***(Description 3 marks and example 1 marks)***

Most modern computer systems operate on the binary logic. A binary number system use only two digits namely 0 and 1. It uses a base 2 system.

The binary digits (0 and 1) are also called as bits. Thus the binary system is a two bit system. The left most bit in a given binary number with the highest weight is called as the most significant bit (MSB) whereas the rightmost bit in a given number with the lowest weight is called as the least significant bit (LSB). It is represented as (0, 1)

In the binary system, whole numbers are grouped from right to left. Because the system uses only two digits. The first portion must equal a 1 or a 0. To write the value of 2, the second position must be used. In binary, the value of 2 would be represented by 10 (one two and zero ones). To continue, a 3 would be represented by 11(one two and one one). Figure illustrates the conversion of binary numbers to digital base ten numbers. For example, if a thermistor is sensing 150 degrees, the binary code would be 10010110. If the temperature increases to 151 degrees, the binary code changes to10010111

03

Decimal number	Binary number code 8 4 2 1	Binary to decimal conversion
0	0000	= 0 + 0 = 0
1	0001	= 0 + 1 = 1
2	0010	= 2 + 0 = 2
3	0011	= 2 + 1 = 3
4	0100	= 4 + 0 = 4
5	0101	= 4 + 1 = 5
6	0110	= 4 + 2 = 6
7	0111	= 4 + 2 + 1 = 7
8	1000	= 8 + 0 = 8

01

b) Distinguish between digital visual display and analog visual display. 04

Answer : *(Any four points- 1 marks each)*

Digital visual display	Analog visual display
A digital signal is a physical signal that is a representation of a sequence of discrete values.	An analog signal is any continuous signal for which the time varying feature of a signal is a representation of some other time varying quantity.
The reading is precise.	The reading is not precise.
Recording of the reading is easy	Recording of the reading is not easy.
No convex/errors are present.	Convex errors may be present
Extension of the reading is possible	Extension of the reading is not possible.
Complex in design.	Simple in design
High cost	Low cost

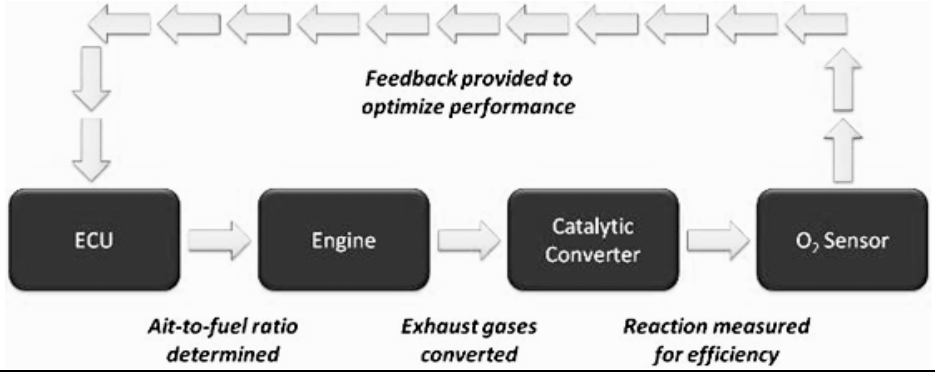
04

c) Describe closed loop control system with block diagram. Enlist its two applications. 04

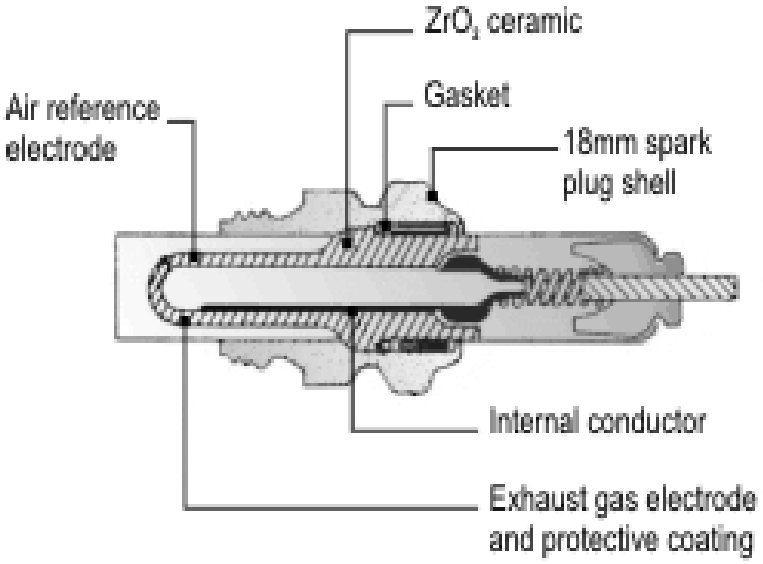
Answer: ***(Note: Description with block diagram 3 marks and applications 1 marks)***

Control system in which the output has an effect on the input quantity in such a manner that the input quantity will adjust itself based on the output generated is called **closed loop control system**. Open loop control system can be converted in to closed loop control system by providing a feedback. This feedback automatically makes the suitable changes in the output due to external disturbance. In this way closed loop control system is called automatic control system. Figure below shows the block diagram of closed loop control system in which feedback is taken from output and fed in to input.

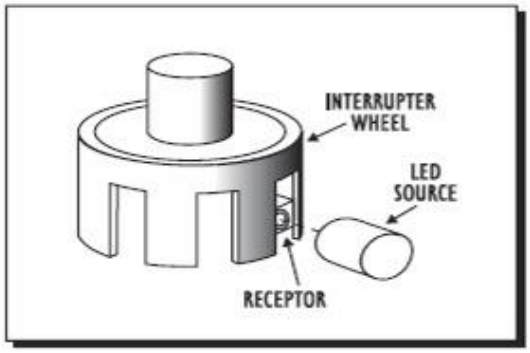
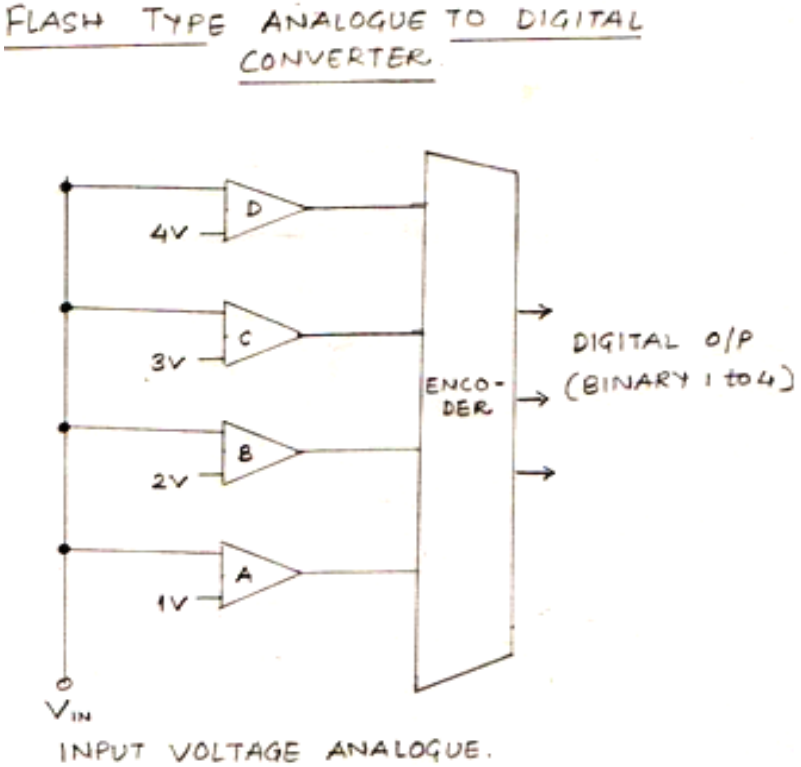
02



01

Applications: (Any Two-1/2 marks each) 1. **An Air Conditioner** – An air conditioner functions depending upon the temperature of the room. 2. **Cooling System in Car** – It operates depending upon the temperature which it controls. 3. **Automatic Electric Iron** – Heating elements are controlled by output temperature of the iron. 4. **Servo Voltage Stabilizer** – Voltage controller operates depending upon output voltage of the system. 5. **Water Level Controller**– Input water is controlled by water level of the reservoir. 6. **Missile Launched & Auto Tracked by Radar** – The direction of missile is controlled by comparing the target and position of the missile.	01
d) State the functions of the followings : i) ROM ii) KAM	04
Answer: Functions ***:(Note: 2 marks each for appropriate function)*** 1. **Read only memory (ROM)** contains a fixed pattern of 1s and 0s that represent permanent stored information. ROM contains the basic operating parameters for the vehicle. This information is used to instruct the computer on what to do in response to input data. The CPU reads the information contained in the ROM, but it cannot write to it or change it. ROM memory is not lost when power to the computer is lost. **2. Keep Alive memory (KAM)** is a variation of RAM. KAM is connected directly to the battery through circuit protection devices. For example, the microprocessor can read and write information to and from the KAM, and erase KAM information. However, the KAM retains information when the ignition switch is turned off. KAM will lost when the battery is disconnected, if the battery drains too, or if the circuit opens.	02 02
e) Describe the construction and operation of oxygen sensor with neat sketch.	04
Answer: ***(Note: Construction and Operation 2 marks and figure 2 marks)***  	02

Construction: The core of the sensor consists of a hollow ceramic bulb or tube like structure coated with a platinum film and a protective coating. Surrounding that is a metal shield with perforations to allow exhaust gases to come in contact with the bulb. The inside of the bulb is vented to the atmosphere. **Operation:** The oxygen sensor operates on the basis of a difference between the oxygen partial pressure of atmospheric air and the partial pressure of oxygen in the exhaust gas. Figure shows that the sensor element is essentially a cell (battery). The plates are made from platinum which have a layer of ceramic zirconia between them which acts as an electrolyte. The platinum plates acts as a catalysts for the oxygen which makes contact with them, and they are also used to conduct electricity away from the sensor. The catalyzing action that takes place when oxygen contacts the platinum plates causes the transport of oxygen ions through the electrolyte and this creates the electric current that gives rise to the e.m.f (voltage) of the sensor.	02
3. Attempt any FOUR of the following:	16
a) Convert $4322_{(10)}$ into equivalent binary number and write the steps involved.	04
Answer: ***(Note: 04 marks for correct steps.)*** The binary number can be calculated by using L division method: 2 | 4322 ------- 2 | 2161 -- 0 ------- 2 | 1080 -- 1 ------- 2 | 540 --0 ------- 2 | 270 -- 0 -------- 2 – 135 -- 0 ------- 2 | 67 -- 1 ------- 2 | 33 -- 1 ------- 2 | 16 -- 1 ------- 2 – 8 -- 0 ------- 2 | 4 -- 0 ------- 2 | 2 -- 0 ------- 2 | 1 -- 0 So the conversion of $4322_{(10)}$ into equivalent binary number is 1000011100010	04

b) How photodiode and LED will be useful for ignition system? Describe with suitable sketch.	04
Answer: Operation: *(Note: Operation 2 marks and figure 2 marks)* An optical triggering mechanism consist of a light emitting diode (LED) and light sensitive photo transistor (photocell) and also a slotted disc called a light beam interrupter . The slotted disc is attached to the distributor shaft. The LED and photocell are situated over and under the slotted disc opposite of each other. As the slotted disc rotates between the LED and the photocell, light from LED shines through the slots. The intermittent flashes of the LED are translated into voltage pulses by the photocell. Where the voltage signal occurs, the control unit turns ON the primary circuit. When the disc interrupts the light and the voltage signal is not given the control system turns the primary circuit OFF causing the magnetic field in the primary coil to collapse and sending a high voltage current to spark plug through secondary winding.  	02 02
c) Describe the conversion of analog to digital signal with suitable sketch.	04
Answer: Analog to Digital Conversion: ***(Note: Description -03 Marks; sketch- 01 mark)***  	04

Analog to digital conversion is necessary because many sensor signals are of analog (varying voltage) form. In order for the control computer (ECU) to function these analog signals must be converted to binary codes (digital signals). Conversion from an analog voltage to a digital code can be done in a number of ways. Figure shows one type of A/D converter that is known as a 'flash' converter.

The flash converter consists of four comparators and an encoder circuit which takes the comparator outputs and converts them into a binary code. An electronic comparator is a circuit which continuously compares two signals. One of the inputs, at each comparator is a reference voltage. When the input voltage matches the reference voltage the comparator outputs logic 1. The reference voltages shown in the figure are 1V up to 4 V. Table shows the input/output performance of the converter.

A/D converter input Voltage range	**Comparator outputs A B C D**	**Encoder outputs**
0-1V	**0 0 0 0**	**0 0 0**
1-2V	**1 0 0 0**	**0 0 1**
2-3V	**1 1 0 0**	**0 1 0**
3-4V	**1 1 1 0**	**0 1 1**
4-5V	**1 1 1 1**	**1 0 0**

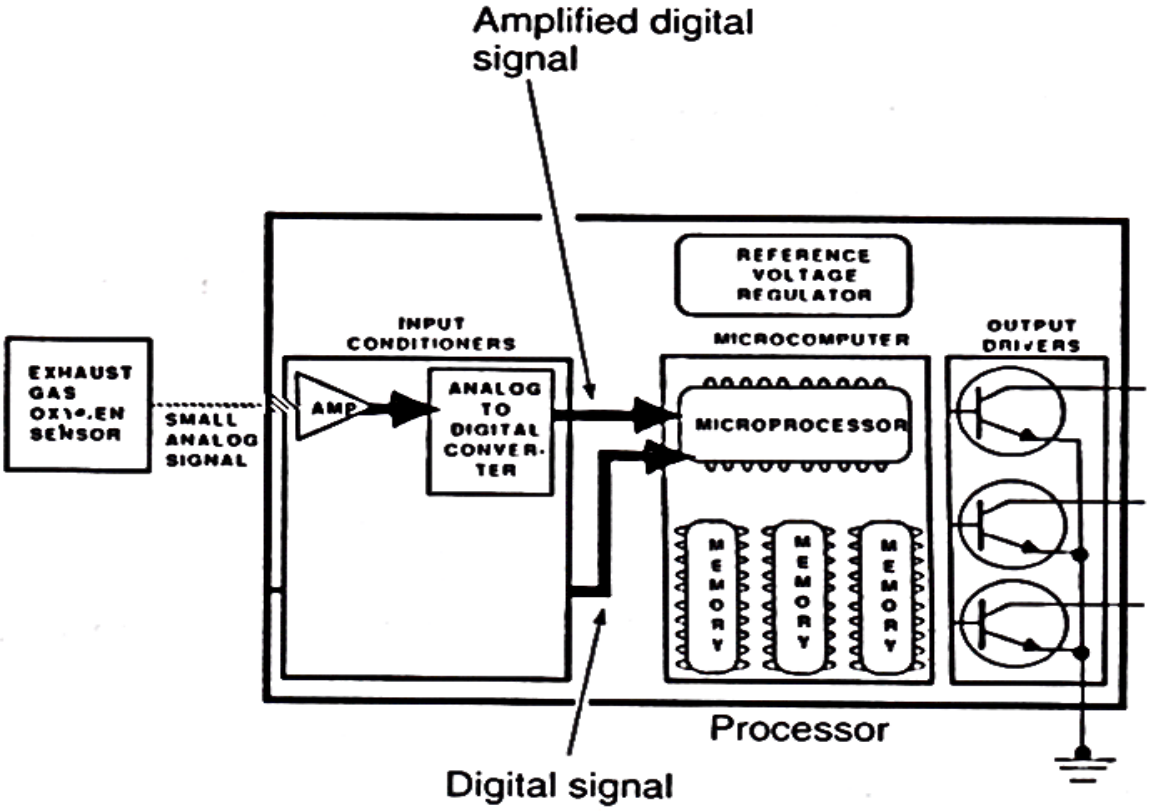
d) Explain the concepts of signal conditioning. 04

Answer: *Note: Suitable credit may be given to sketch if drawn)*

Signal Conditioning:

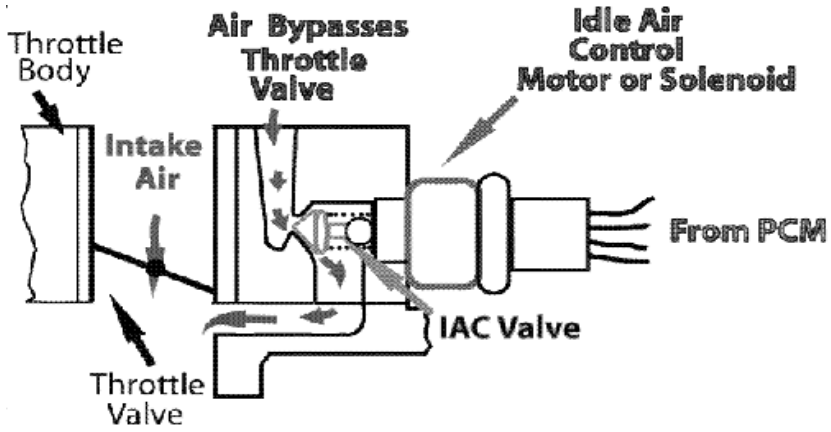
The input and/or output signals may require conditioning in order to be used. This conditioning may include amplification and/or signal conversion. Some input sensors, such as the oxygen (O_2) sensor, produce a very low voltage signal of less than 1V. This signal also has an extremely low current flow. Therefore, this type of signal must be amplified, or increased, before it is sent to the microprocessor. This amplification is accomplished by the amplification circuit in the input conditioning chip inside the computer.

For the computer to receive information from the sensor, and to give commands to actuators, it requires an interface. The computer will have two interface circuits: input and output, The digital computer cannot accept analog signals from the sensors and requires an input interface to convert the analog signal to digital. The analog to digital (A/D) converter continually scans the analog input signals at regular intervals, For example, if the A/D convertor assigns a numeric value to signal at 5V the A/D converter assigns a numeric value this specific voltage. The A/D converter then changes this numeric value to binary code. Also, some of the controlled actuators may require an analog signal. In this instance, an output digital to analog (D/A) converter is used. 04



e) Describe with neat sketch construction and operation of idle speed actuator used in a vehicle that has power steering. 04

Answer: ***(Note: Construction with operation description -02 Marks; diagram 02 marks)***

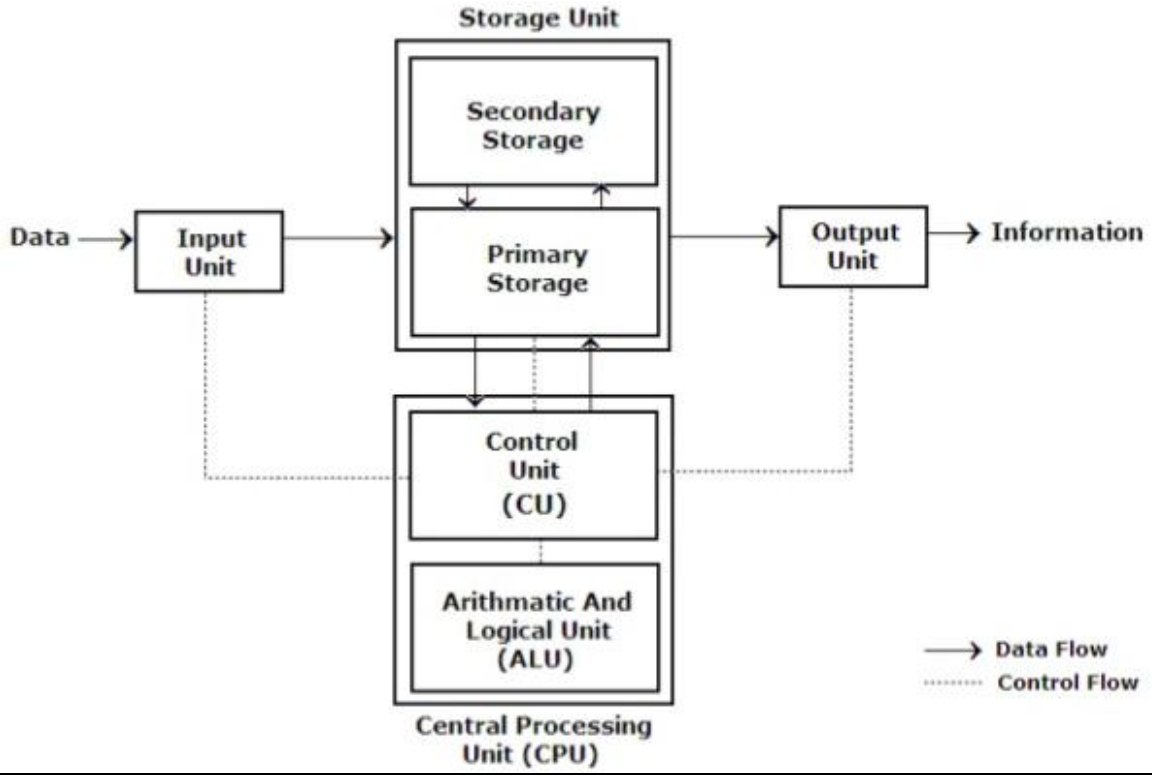


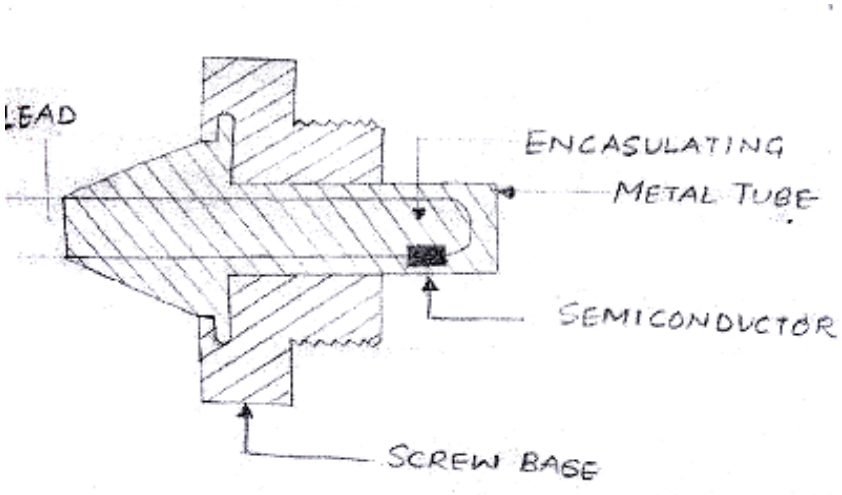
02

Fig : Idle Speed Actuator

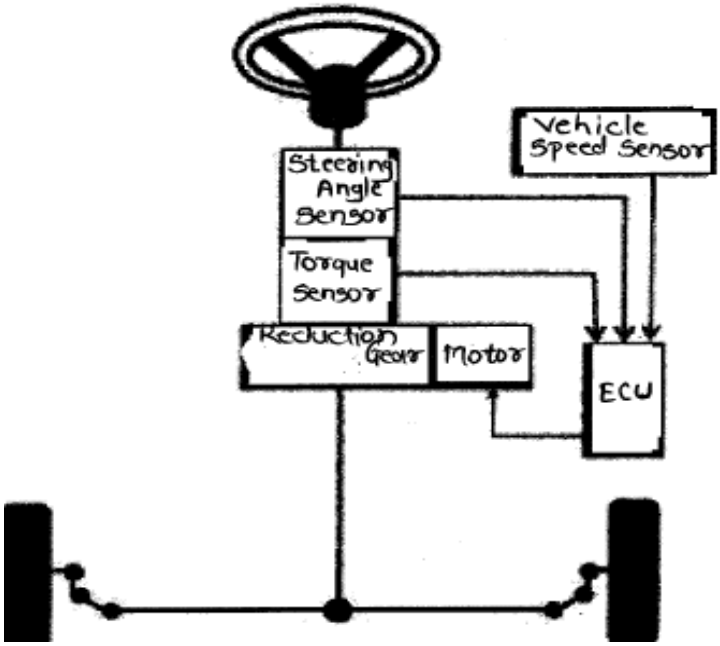
Construction: In throttle body and port fuel injection systems, engine idle speed is controlled by passing a certain amount of air flow past the throttle valve in the throttle body housing.

The IAC system consists of an electrically controlled stepper motor or actuator operated by the ECM. The ECM controls the idle speed by opening and closing the air passage into the intake manifold as shown in the figure. 02

Operation: The ECM/PCM calculates the amount of air required for smooth idling based on input data such as coolant temperature, engine load, and engine speed and battery voltage. The ECM/PCM the signals the IAC motor to extend or retract the idle air control valve in the air bypass channel.	
f) State the instruments used for measuring following parameters: 1. Speed 2. Level 3. Distance 4. Temperature	04
Answer: ***(Note: 1 mark each for each instrument name)*** 1. Speed: Tachometer 2. Level: Level gauge, for example to check fuel level fuel gauge is used. 3. Distance: Odometer 4. Temperature: Thermometer	04
4. a) Attempt any THREE of the following:	12
i) Draw the labeled block diagram of basic computer.	04
Answer: Block diagram of basic computer: ***(Note: Correct labeled block diagram - 2 marks)*** 	04

ii) Describe construction and working of coolant temperature sensor.	04
Answer: Construction and working of c**oolant temperature sensor:** *(Note: Equivalent Sketch - 2 marks, construction and Working- 2 mark.)*  **Fig. Semiconductor Resistor temperature sensor.** A commonly used device for sensing temperature is thermistor. A thermistor utilizes the concept of negative temperature coefficient i.e. its resistance gets lower as its temperature increases and this is a characteristic of semiconductor material. **Construction and Working:-** A typical coolant sensor is shown in the fig. It consists of a thermistor (Semi conducting material) mounted in a housing that is design to be inserted in coolant stream. This housing is typically threaded with pipe threads that seal the assembly against coolant leakage. A thermistor is made of semi conducting material whose resistance varies inversely with temperature. For example at -40^0C a typical coolant sensor has a resistance of 1,00,000 ohms. The resistance decreases to about 70,000 ohms at 130^0C. The change in current is the sensor signals.	02 02
iii) State and describe types of errors.	04
Answer: ***(Note: list - 1 marks and explanation- 3 mark.)*** **Types of error:-** 1)Gross error 2) Systematic error 3) Random error **1. Gross error:** The class of errors covers human mistakes in reading instruments and recording and calculating measurement results. The responsibility of the mistakes normally lies with the experimenter. **2. Systematic error:** Systematic error result from known variation in instrument performance, for which corrections can be made if desired. There are many sources of systematic errors, including temperature variation in calibration, loading and dynamic response. a. **Systematic loading errors -** This error are due to energy extracted by the instruments when making measurements. Whenever the energy extracted from a system under measurement is not negligible, the extracted energy causes a change in the quantity being measured.	01 03

Whenever possible, an instrument is designed to minimize such loading effects. b. **Dynamic Response-** This are the another source of Systematic error. Any instruments has limited response rate to very rapidly changing input. In many automotive instrumentation applications the bandwidth is purposely reduced to avoid rapid fluctuation in reading. **3. Random Error-** Random errors are essentially random fluctuations in indicated value for the measurement. Most random measurement error results from noise.	
iv) Write the applications of following measuring instruments 1) Oscilloscope 2) Lux meters 3) Digital multimeters 4) Battery testers.	04
Answer: ***(Note: any two applications of each instrument carry 1 mark.)*** **Applications of following measuring instruments:-** **1) Oscilloscope: -** Power analysis, Serial data analysis, Jitter analysis, Data storage device testing, Time domain, Reflectometry, Engine vibrations, Rise time measurement, Phase measurement, Bandwidth measurement etc. **2) Lux meters: -** Used to measure light intensity. It is used in photography and video filming, Check intensity of headlights in the automatic ON/OFF headlight system. **3) Digital multi meters:-** Current measurement, Voltage measurement, Resistance measurement, Continuity check, Diode test, Temperature measurement, Duty cycle etc. **4) Battery Testers:-** Voltage measurement, Resistance measurement, CCA value measurement, Battery condition, Battery load test etc.	01 01 01 01
b) Attempt any ONE of the following:	06
i) Describe construction and working of electronic power steering with block diagram.	06
Answer: (*Note: equivalent sketch -3 marks and Construction and Working - 3 marks*) **Electronic power steering:-** An electronically control power steering system adjusts steering boosts adaptively to driving conditions using electronic control of power steering the available boost is reduced by controlling a pressure relief valve on the power steering pump. The system consists of following components : 1. **Steering column** that connects the steering pinion with steering wheel inside the vehicle 2. **Steering pinion** that converts the rotating steering movement into linear movement of the rack 3. **Rack** connected to the wheels via tie rods and links 4. **Sensors** to record the information required to calculate the necessary supporting steering torque 5. **Servo unit** consisting of an ECU and servo motor (electric motor) that generates the supporting steering torque. **Working:** When the driver moves the steering wheel a sensor registers the steering torque exerted and sends this information as an electric signal to ECU. This calculates the supporting torque and activates the servo motor on the basis of the calculated result. Generally the steering torque generated by these motors is 3-6 Nm. The direction of rotation of motors depends on the direction of motion of steering wheel. The control electronics takes into account the different signals and parameters e.g. Driving speed, steering angle, steering torque and steering speed with the help of other sensors in the vehicle and due to networking of steering ECU with other ECUs in the vehicle framework. This steering system can be used to implement assistance function to enhance comfort and safety.	03



03

ii) Enlist and describe six step approach for components testing. 06

Answer:

Six step approach for components testing:-

1. Collect evidence.
2. Analyze evidence.
3. Locate the fault.
4. Find the cause of the fault and remedy it.
5. Rectify the fault (if different from 4).
6. Test the system to verify that repair is correct.

06

Six step approach for components testing:-

1. Collect Evidence

Collecting evidence means looking for all the symptoms that relate to the fault and not jumping to conclusions, e.g. because the system is controlled by an ECU it must be the ECU that is at fault. In order to collect the evidence it is necessary to know which components on the vehicle actually form the part of the faulty system. This is where sound basic skills come in. If an engine control system is malfunctioning because one cylinder has poor compression it is important to discover this at an early stage of the diagnostic process.

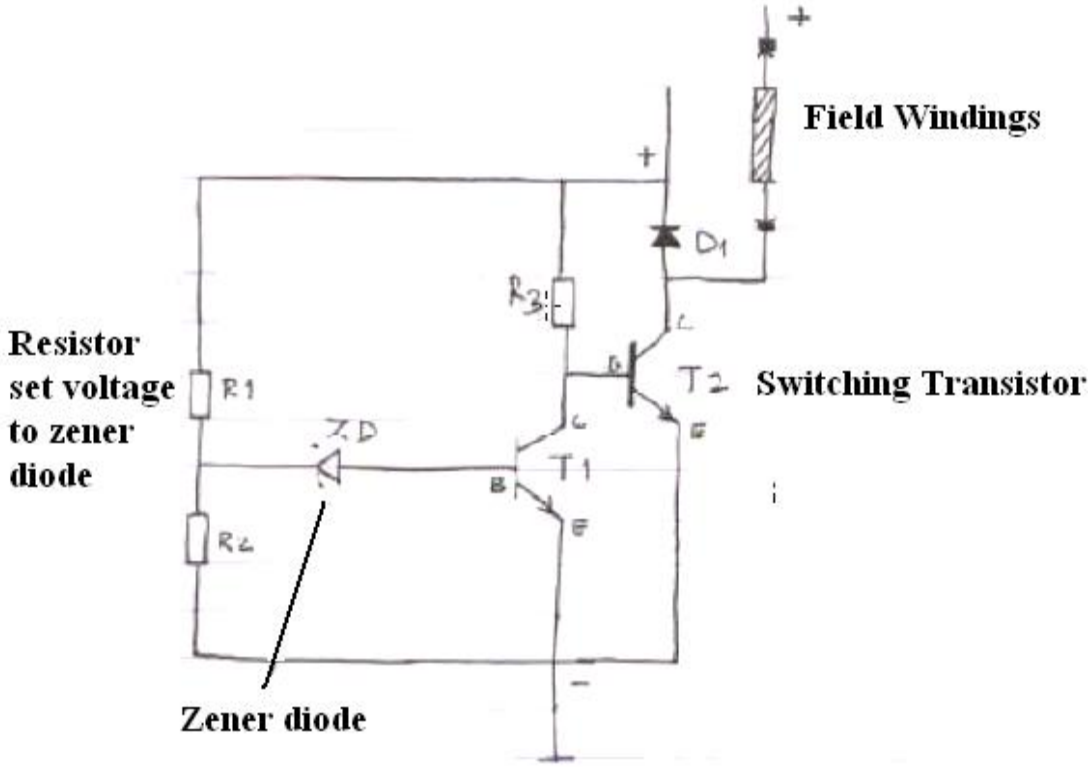
2. Analyze Evidence

In the case of poor compression on one cylinder, given above as an example, the analysis would take the form of tests to determine the cause of low compression, E.g. burnt valve, blown head gasket etc. The analysis of evidence that is performed will vary according to the system under investigation. But these steps are obviously important.

3. Locate the fault

The Procedure for doing this on an electronics system varies according to the type of test equipment available. It may be the case that the system has some self- diagnostics which will read you to the area of the system which is defective Let us assume that this is the case and the self-

diagnostics report that an engine coolant temperature sensor is defective. How do you know whether it is the sensor, or the wiring between it and the remainder of the system? Again this is where a good basic knowledge of the make-up of the system is invaluable. **4. Find the cause of the fault and remedy it** With electronic system repair it is often the case that a replacement unit must be fitted. However, this may not be the end of the matter. If the unit has failed because of some fault external to it, it is important that this cause of failure is found and remedied before fitting the new unit. It is often not just a matter of fitting a new unit. **5. Give the system a thorough test** Testing after repair is an important aspect of vehicle work and especially so where electronically controlled systems are concerned. In the case of intermittent faults, such testing's may need to be extended because the fault may only occur when the engine is hot and the vehicle is being used in a particular way. **6. Test the system to verify that repair is correct.** It is mandatory to test the system so that it will verify that the steps followed during the testing are correct. However we can come across any fault then we have to follow the stepwise procedure of testing.	
5. Attempt any FOUR of the following:	16
a) How semiconductor diode will be used in voltage regulator of charging system? Describe with suitable sketch.	4
Answer: Voltage regulator of charging system: *Note: (Description- 2 marks & sketch-2 marks)* The alternator is a variable speed machine. As the vehicle speed raises the generated voltage rises and if it is run without load the output voltage could reach 140 volts. Therefore some control is required and it is provide by the modern electronic regulator. The regulator maintain constant average current in the rotor field winding by switching current ON and OFF and the result will be an alternator output voltage of about 14.2 volts. The main component of the electronic voltage regulator is the zener diode. It acts as a sensing element in an electronic regulator. Figurer shows a simplified diagram of electronic voltage regulator. This regulator operates as follows:- 1. When the alternator first increase is speed the output will be below the prescribe set level 2. Under these conditions transistor T_2 will be switched on by a feed to its base through resistor R_3. 3. This allows full field current to flow thus increasing voltage output 4. When the prescribed set voltage is reached the zener diode will conduct. 5. Resistor R_1 and R_2 are a simple series circuit to set the voltage appropriate to the volue of the Z_D says 14.2 V. 6. Once Z_D conducts transistor T_1 will switch on and pull the base of T_2 down to ground 7. This switches T2 off and so the field current is interrupted causing output voltage to fall. 8. This will cause Z_D to stop conducting T_1 will switch off allowing T_2 to switch back on and so the cycle will continue.	04



b) State four types of communications system in automobile. Describe optic fibers. 04

Answer: ***(Note: name any four types- 2 marks, optic fibers explanation- 1 mark and fig.- 1mark.)***

Four types of communication system in automobile

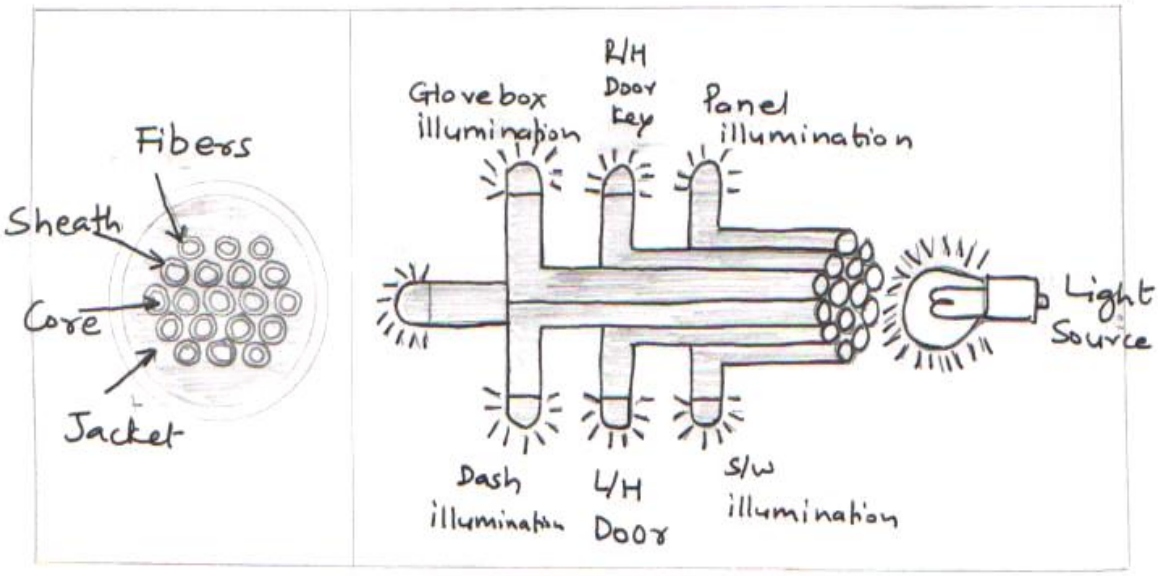
1. Bluetooth
2. Wi-Fi
3. CAN Bus
4. LIN Bus
5. GSM Network
6. Optic fibers.
7. Ethernet

02

Optic Fibers:-

- The invention of fiber optics material has provided a means of illuminating several objects with a single light source.
- Plastic fiber optic strands made from a special plastic (**polymethylmethacrylate plastic)** are used to transmit light from the source to the object to be illuminated.
- This plastic helps to keep the light rays parallel even in the presence of extreme bends in the plastic.
- The strands of plastic are sheathed by a polymer that insulates the light rays as they travel within the strands.
- The light rays travel through the strands by means of internal reflections.

01



01

c) State various methods of air flow measurement and describe operation of air flow sensor plate. 4

Answer: ***(Note:*** **various methods -** ***1 marks,*** **operation-2 marks, diagram-1marks)**

Methods of air flow measurement are:

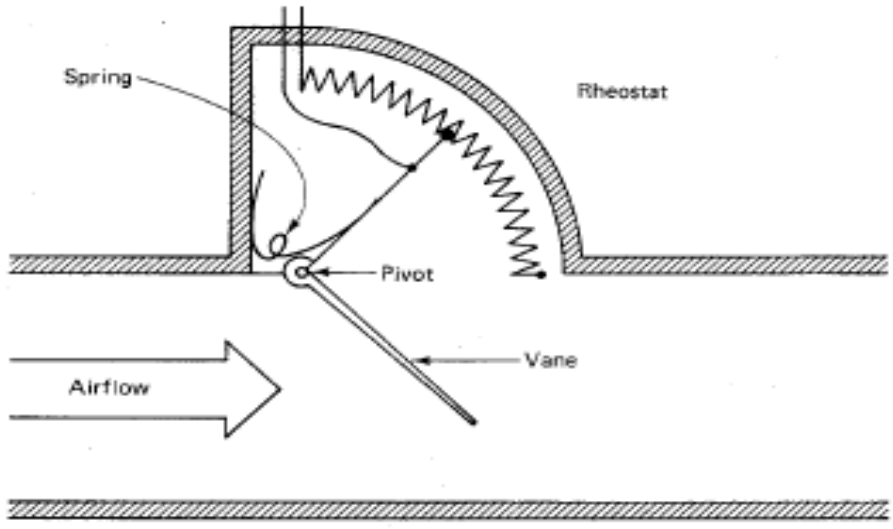
1.Vane type air flow sensor
2.Ultrasonic air flow sensor
3.Hot wire air flow sensor

01

Operation of air flow sensor:-

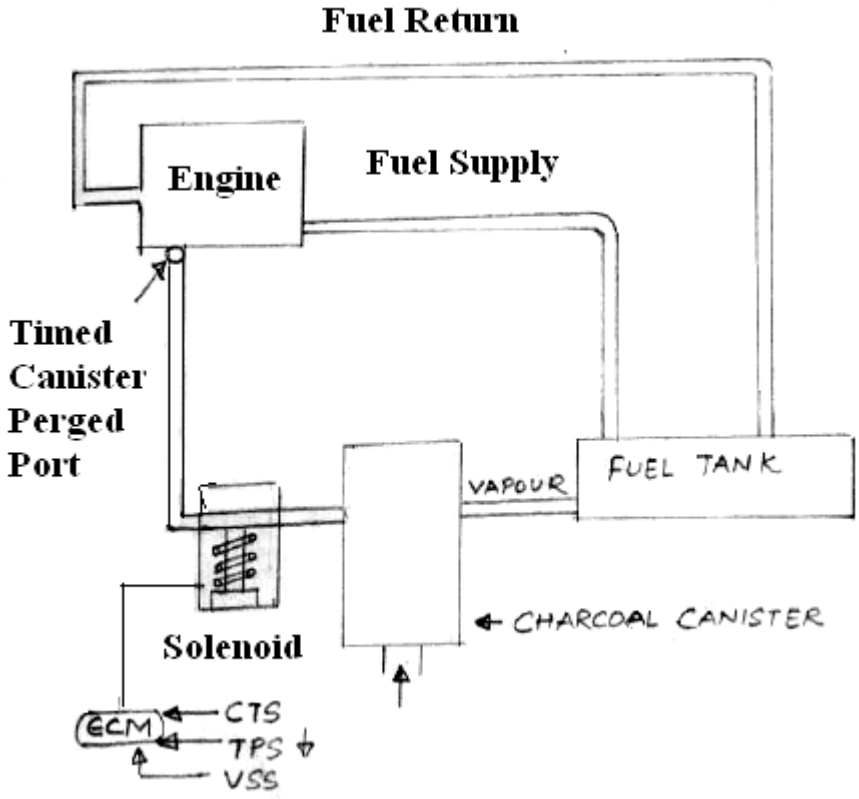
The vane type air flow measurement consists of lightly spring loaded valve that moves aside as air flow increases. The valve is tied to a rheostat, a type of variable resistor. The change in current in the resistor circuit is the sensor signal. Also used is a carbon film resistor with variable area connected to the air flow meter plate. It gives a signal that varies air/ fuel ratio with demand.

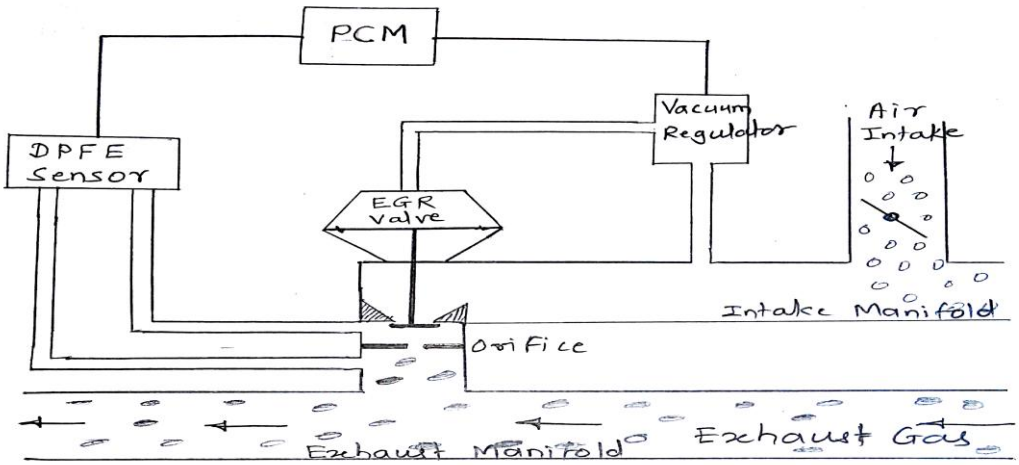
02

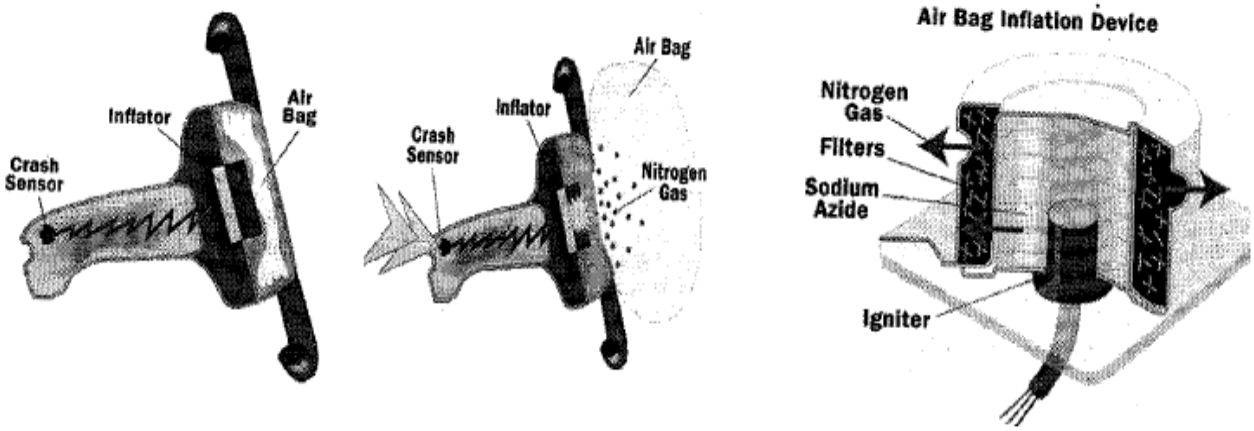


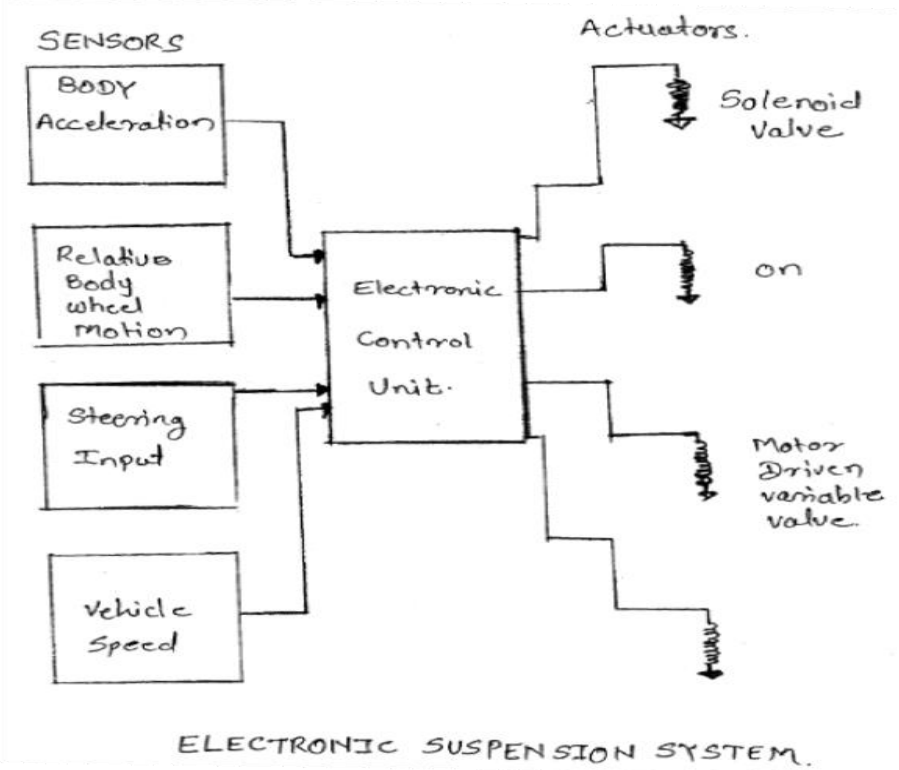
01

Figure: Air mass flow sensor

d) How purge control solenoid reduces exhaust emission and drivability problems? Describe with sketch.	4
Answer: Note: (Description -2 marks block diagram 2 marks) The vapours from the fuel tank are connected in the charcoal canister .The ECM operate the solenoid in the nose between the canister and intake manifold as shown in figure. The ECM operates the purge solenoid and allows canister purging. When the engine coolant temperature is warm the throttle is above idle speed and vehicle speed is 15 km/hr. 	04
e) How the actuators are tested? Describe.	4
Answer: Testing of actuators: *Note: (Description - 2 marks each)* **1.Sound Test** a. The injector sound test is a method of quickly checking the operation of the pintle on engine where the injectors are accessible. b. A port injector that is not functioning may cause a cylinder misfire at low engine speed c. With the engine idling a stethoscope pickup may be placed on the side of the injector body d. Each injector does not produce any clicking noise the injector connecting wires or PCM may be defective. f. When the injector clicking noise is erratic the injector plunger may be sticking g If there is no injector clicking noise, proceed with the injector ohms test to locate the cause of the problem. **2. Ohmmeter Test** a. An ohmmeter may be connected across the injector terminals to check the injector winding after the injector wire are disconnected b. If the ohmmeter reading is infinite the injector winding is open	

c. An ohmmeter reading below the specified valve indicates that the injector winding is shorted d. A satisfied injector winding should have result between 0.3 to 0.4 ohms e. Replace the injector if the results do not have the specified resistance.	
6. Attempt any FOUR of the following	16
a) List four ways of controlling EGR action through ECM. Describe EGR system with Pressure Feedback Electronic (PEE) sensor with neat sketch.	4
Answer: Note: (List 1 marks, description and diagram 3 marks) Different ways of controlling EGR systems are as follows: * Positive backpressure * Negative backpressure * Pulse-width modulated * Digital (electronic) * Linear (electronic)	01
EGR system with Pressure Feedback Electronic sensor: It consists of EGR valve which is connected between exhaust and intake manifold, Differential pressure feedback electronic sensor (DPFE), Vacuum regulator and power control module (PCM). The PCM monitors and control the whole operation of EGR system. When the vehicle makes a quick acceleration or cruising speed the PCM tells the EGR vacuum regulator where as time to re circulate and how long time to re circulate. The regulator sense back into the EGR and the valve problem which allows the portion of the exhaust gas available to flow back into the combustion chamber via the intake manifold & DPFE sensor monitors the operation. DPFE sensor has two pressure lines connected to exhaust line and EGR passage, a small hole orifice is placed between them. The DPFE sensor senses the both pressure outside the orifice simultaneously and due to pressure difference between them sensor produces a voltage signal and passes to PCM.	02
If voltage is at least 1.5 volts, PCM knows that everything is an normal operating mode. If voltage is below 1.5 volts, PCM knows there is a trouble.	
	01

b) Describe the working of air bags. Also list materials of air bags.	4
Answer: Air bags: *(Note: Operation -3 marks, material -1 mark. Credit should be given to equivalent Sketch)* The goal of an air bag is to slow the passenger's forward motion as evenly as possible in a fraction of a second. There are three parts to an airbag that help to accomplish this feat:- 1. The bag itself is made of a thin nylon fabric, which is folded into the steering wheel or dash board or, more recently the seat or door. 2. The sensor is the device that tells the bag to inflate. Inflation happens when there is a collision force equal to running into a brick wall at 10 to 15 miles per hour (16 to 24 Km per hour). A mechanical switch is flipped when there is a mass shift that closes an electrical contact, telling the sensor that a crash has occurred. The sensors receive information from an accelerometer built into a microchip. 3. The airbag's inflation system reacts sodium azide (NaN3) with potassium nitrate (KNO3) to produce nitrogen gas. Hot blasts of the nitrogen inflate the airbag.  **Material of airbag:- (Any two)** 1. Polyamide 2. Nylon Fabric 3. Polyester fabric	03 01
c) Describe the system which displays road map marking the exact location of the vehicle.	4
Answer: System which displays road map marking the exact location of the vehicle: *Note: (Description 4 marks- Credit should be given to sketch if drawn)* An increasing number of vehicles are equipped with in-vehicle satnav/GPS (satellite navigation) systems that have two-way communication with a traffic data provider. Position readings from these vehicles are used to compute vehicle speeds. Modern methods may not use dedicated hardware but instead Smartphone based solutions using so called Telematics 2.0 approaches. Navigation is a field of study that focuses on the process of monitoring and controlling the movement of a craft or	04

vehicle from one place to another. The field of navigation includes four general categories: land navigation, marine navigation, aeronautic navigation, and space navigation. Car navigation systems receive signals from satellites and identify the vehicle's position and direction by combining that data with information obtained from various onboard sensors. 1. Receive signals from satellites and detect the vehicle's location. GPS antenna, GPS receiver 2. Detect the vehicle's direction. Direction sensor 3. Detect the vehicle's travel distance. Speed sensor 4. Car navigation system screen. Display 5. Map database 6. Check information from the antenna and sensors against the map database and show the results on the display using the car navigation system's control circuitry. Navigation computer	
d) Describe working of electronic suspension system. Enlist its two advantages.	4
Answer: Note: (Description and diagram -3 marks Advantages- 1 marks) Electronic suspension system consists of springs shock absorbers and various linkages to connect the wheel assembly to car frame. The purpose the suspension system is to isolate the car body motion as much as possible from wheel motion due to rough road input. The performance of suspension system is strongly influenced by the damping of shock absorber.  ELECTRONIC SUSPENSION SYSTEM.	03

Semi active suspension system:-The control system for a typical active suspension system is shown in the block diagram. It is in the form of a micro controller or microprocessor base digital controller the inputs for each sensor are sampled converted to digital format and stored in the memory the sampling is typically at about 500 Hz. In this control configuration the relative position and motion of the wheel of the wheel body.(sprung mass) acceleration the relative position and motion of the wheel body.(un sprung or sprung mass) the steering wheel input and vehicle speed. The body acceleration measurement can be used to evaluate ride qualify. The controller dies this by computing weighted average of spectrum of the acceleration the relative body or wheel motion can be used to estimate tire force **Advantages of Electronic Suspension system: (any two)** • Control the vertical movement of wheels relative to the chassis or vehicle body with an on-board system. • it achieves the greater degree of ride quality • Car handling by keeping the tires perpendicular to the road in corners, allowing better traction & control. • System virtually eliminates body roll & pitch variation in many driving situation including cornering, accelerating & braking.	01
e) What will happen if throttle position sensor is defective? Also state its procedure for testing.	4
Answer: *(Note: any four symptoms- 2 marks and testing procedure- 2 marks)* **If the TPS is defective following symptoms are seen:** 1. Hesitation while Accelerating 2. Idle Surging 3. Sudden Stalling of the Engine 4. Sudden Surge in Speed While Driving on the Highway 5. Difficulty while changing gears. 6. The fuel economy of the car drops drastically. **TESTING PROCEDURE OF THROTTLE POSITION (TP) SENSOR:-** Following procedure is followed to diagnose a TP sensor 1. With the ignition switch in the RUN position, connect a voltmeter from the sensor signal wire to ground. 2. Slowly open the throttle and observe the voltmeter. 3. The voltmeter reading should increase smoothly and gradually. 4. Typical TPS voltage readings are 0.5V to 1V with the throttle in the idle positions, and 3.5V to 4.5V at wide open throttle. 5. Always refer to the vehicle manufacturer's specifications. 6. If the TPS does not have the specified voltage or if the voltage signals is erratic, replace the sensor.	02 02

f) How load test of battery can be performed with the help of battery tester? Describe.	4

Answer: : ***(Note: Procedure- 3 marks and chart- 1 mark)***

Procedure of load test of battery: 03

i) First charge the battery when it reaches specific gravity for all cells above 80%.
ii) Determine the battery temperature.
iii) Connect battery tester (load tester and voltmeter) to battery properly.
iv) Apply electrical load equal to ½ of CCA rating for 15 seconds.
v) With load still applied read battery voltage.
vi) If battery meets or exceeds minimum voltage for respective temperature, it returns to service.
vii) If battery doesn't meet minimum voltage for respective temperature, replace the battery.

Minimum acceptable voltage under load chart for different temperatures: 01

Battery Temperature	**Minimum acceptable voltage under load**
120^0F	10.1V
110^0F	10V
100^0F	9.9V
90^0F	9.8V
80^0F	9.7V
70^0F	9.6V
60^0F	9.5V
50^0F	9.4V
40^0F	9.3V
30^0F	9.2V
20^0F	9.1V
10^0F	9V
0^0F	8.9V