MODEL ANSWER

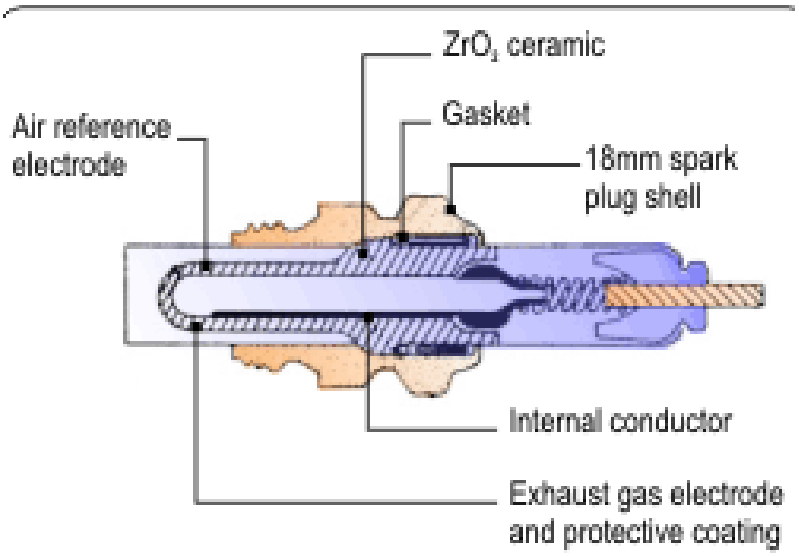
SUMMER– 17 EXAMINATION

Subject Title: Autotronics Subje 17619

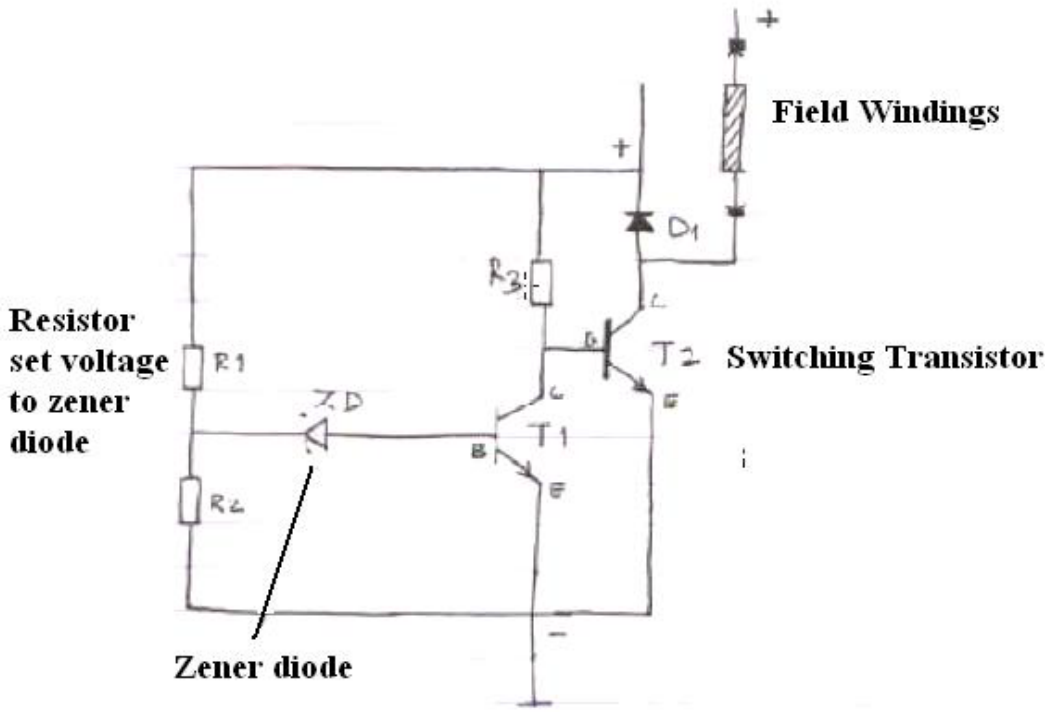
Important Instructions to examiners:

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 judgement 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.

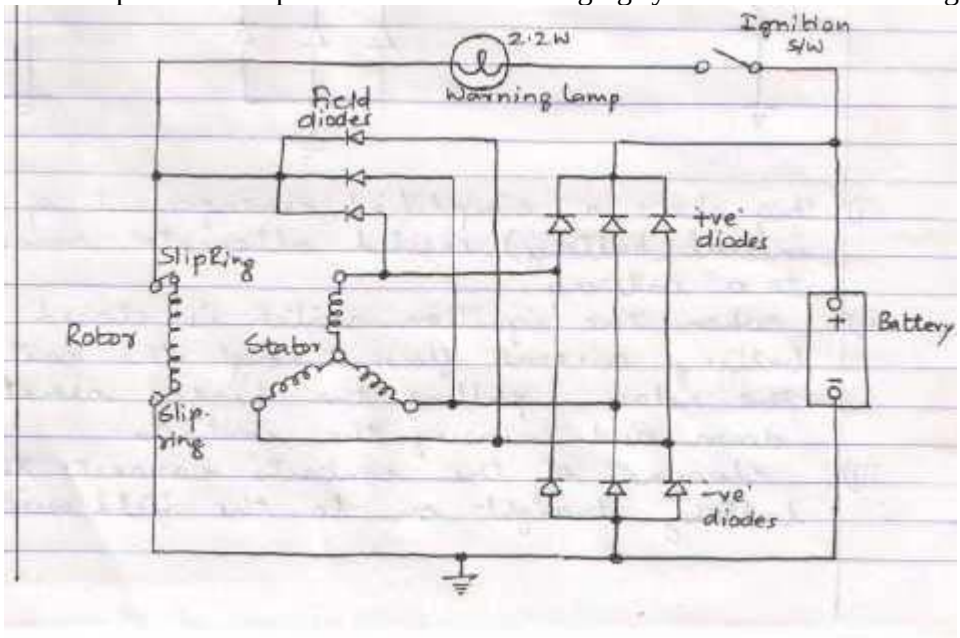
Q. No.	Sub Q. N.	Answer	Marking Scheme
1	A)	**Attempt any THREE of the following.**	12
	a)	**What are the uses of photodiode?**	4
		Answer: -*(Any four – 1 mark Each)* **Uses of Photo diode:** a. Used in automobile headlight system. b. Ignition system. c. Display system. d. Headlight Dimmer. e. Twilight Detectors. f. Climate Control - Sunlight Detector.	
	b)	**State the types of computer memory**.	4
		Answer:*(Note: Any four types- 4 marks)* ***(Note: Give full marks even if the student has given the correct names of all four memories)*** **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. 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.	

		3. EPROM: Erasable Programmable read only memory is similar to the PROM except its contents can be erased to allow new data to be installed. 4. EEPROM 5. RAM	
	c)	**Describe the construction and working of oxygen sensor with neat sketch**	4
		Answer: *(Note:figure-2 mark and Working-2 mark)* **Working of Oxygen sensor:** 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  Figure of oxygen sensor	
	d)	**State the need of** **i) Air bag** ii) **Park assists**.	4
		Answer: **Air bag**: To provide the occupants a soft cushioning and restraint during a crash event to prevent any impact or impact-caused injuries between the flailing occupant and the interior of the vehicle **Park assists**: 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
	e)	**List and explain the uses of lux meter**	04

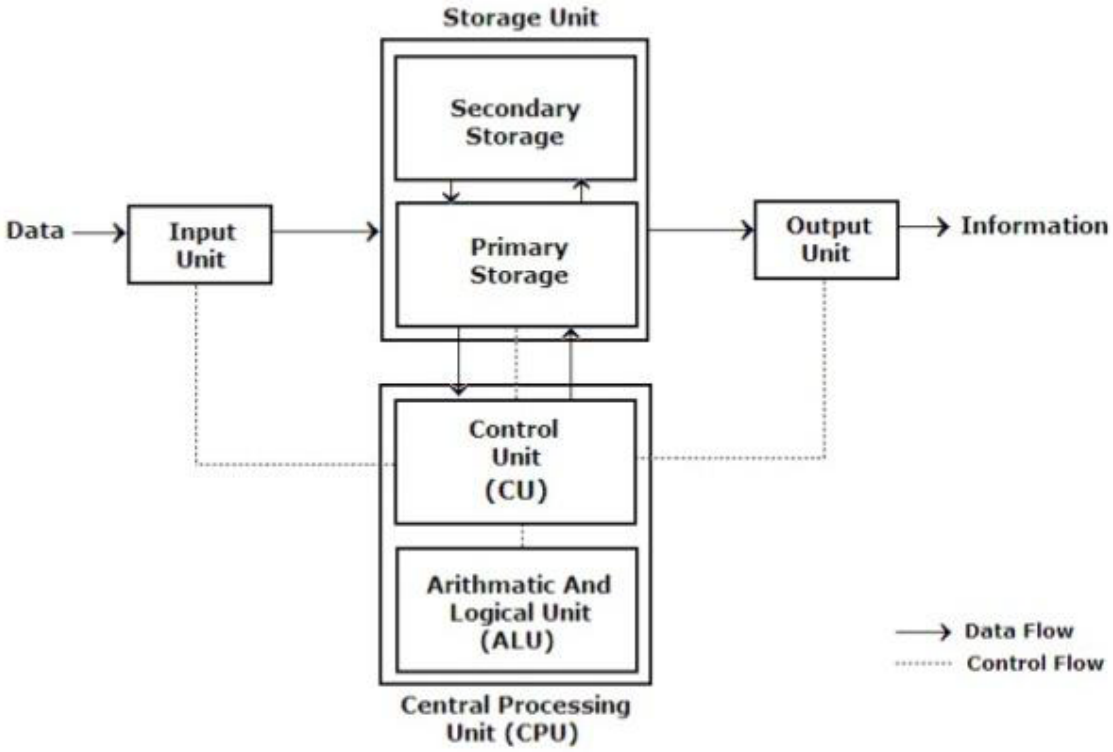
		Answer: ***(Note: any 2* uses *-4 mark)*** a. Used to measure light intensity. b. It is used in photography and video filming. c. Check intensity of lights in the automatic ON/OFF headlight system and automatic headlight dimming system.	
	B)	**Attempt any ONE**	06
	a)	**What is the power diode? How is it used in charging system?**	06
		Answer: *Note: (Description- 4 marks & sketch-2 marks)* **Power Diode:** The power semiconductor diode, known simply as the Power Diode, has a much larger PN junction area compared to its smaller signal diode cousin, resulting in a high forward current capability of up to several hundred amps (KA) and a reverse blocking voltage of up to several thousand volts (KV). **Power diode used as regulator in charging system-** 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 T2 will be switched on by a feed to its base through resistor R3. 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 R1 and R2 are a simple series circuit to set the voltage appropriate to the value of the ZD says 14.2 V. 6. Once ZD conducts transistor T1 will switch on and pull the base of T2 down to ground This switches T2 off and so the field current is interrupted causing output voltage to fall. 8. This will cause ZD to stop conducting T1 will switch off allowing T2 to switch back on and so the cycle will continue.	06

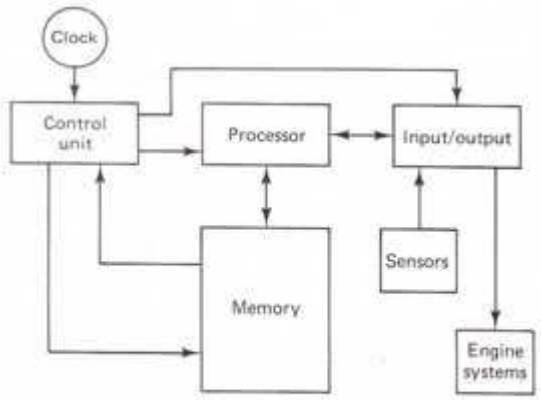


Power diodes are different from normal P-N junction diodes. It has a large current carrying capacity i.e. it can handle large power.
Power diodes are capable of passing as much as several hundred amperes of forward current. This makes it suitable for applications where larger current and higher voltages are required.
An example of use of power diodes in the charging system is shown in the figure:



We make use of six diodes which are used to supply the current to the field diodes required for the excitation of the field windings. Thus the current form the stator is used to excite the field windings with the help of power diodes.

	b)	**Draw a neat block diagram of a basic computer. Explain its various components**	06
		Answer:*(Note: Block diagram- 02 marks, explanation of any four components- 04marks)*  **1. Input Unit**: Data and instructions must enter the computer system before any computation can be performed on the supplied data. The input unit that links the external environment with the computer system performs this task. Data and instructions enter input units in forms that depend upon the particular device used. It accepts (or reads) the list of instructions and data from the outside world. It converts these instructions and data in computer acceptable format. It supplies the converted instructions and data to the computer system for further processing. **2. Output Unit**: The job of an output unit is just the reverse of that of an input unit. It supplied information and results of computation to the outside world. Thus it links the computer with the external environment. It accepts the results produced by the computer which are in coded form and hence cannot be easily understood by us. It converts these coded results to human acceptable (readable) form. It supplied the converted results to the outside world. **3. Storage Unit:** The data and instructions that are entered into the computer system through input units have to be stored inside the computer before the actual processing starts. The Storage Unit or the primary / main storage of a computer system is designed to do all these things. It provides space for storing data and instructions, space for intermediate results and also space for the final results. All the data to be processed and the instruction required for processing. Intermediate results of processing. Final results of processing before these results are released to an output device.	06

		4. Central Processing Unit: The main unit inside the computer is the CPU. This unit is responsible for all events inside the computer. It controls all internal and external devices, performs "Arithmetic and Logical operations". The operations a Microprocessor performs are called "instruction set" of this processor. The control Unit and the Arithmetic and Logic unit of a computer system are jointly known as the Central Processing Unit (CPU). The CPU is the brain of any computer system. in a computer system, all major calculations and comparisons are made inside the CPU and the CPU is also responsible for activating and controlling the operations of other units of a computer system. **5. Arithmetic and Logic Unit (ALU):** The arithmetic and logic unit (ALU) of a computer system is the place where the actual execution of the instructions takes place during the processing operations. All calculations are performed and all comparisons (decisions) are made in the ALU. The arithmetic and logic unit (ALU) is the part where actual computations take place. It consists of circuits that perform arithmetic operations (e.g. addition, subtraction, multiplication, division over data received from memory and capable to compare numbers (less than, equal to, or greater than). OR  Block diagram of a basic computer.	
2		**Attempt any FOUR.**	16
	a)	**List the four uses of LED**	04
		Answer: *(Note: any 4 uses -4 mark)* 1. Automotive Headlights 2. Ignition system 3. Automotive brake lights 4. Warning lights & Indicators in vehicles 5. It is used in light control panels 6. It is used in interior lighting system of the car.	04

	b)	**Describe binary number system.**	04
		Answer:*(Note: Explanation-4 marks)* **Binary number system:** 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 us 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.	04
	c)	**Describe working of idle speed actuator**	04
		Answer: *(Note: description -02 Marks; diagram 02 marks)* **Working of idle speed actuator:** 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. 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.	04

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

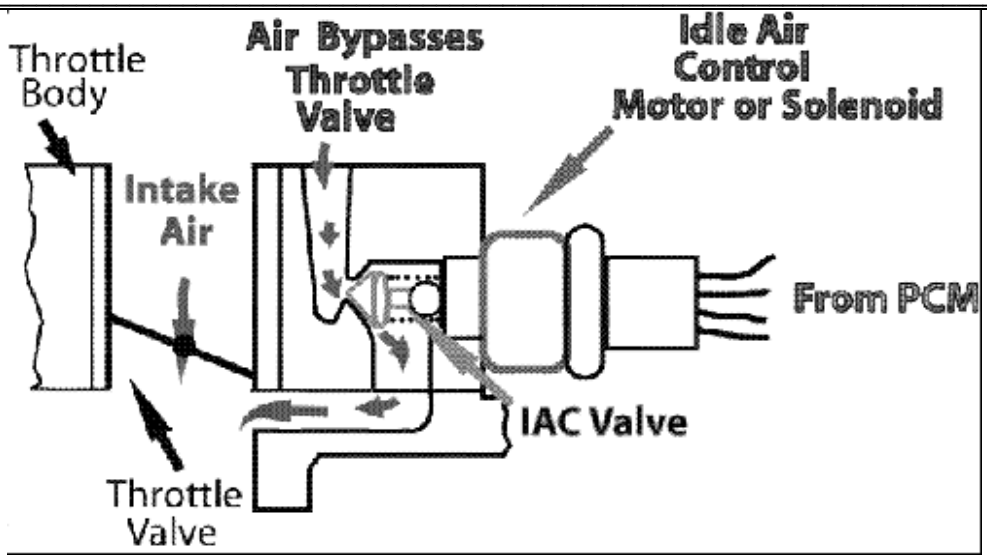


Fig : Idle Speed Actuator

	d)	**Explain the digital visual display**.	04
		Answer:*(Note: Description- 04 marks, credit should be given to block diagram)* **Digital visual display:** An example of digital visual display system is given below: Coolant temperature measurement The coolant temperature sensor used in most of the cars is a solid-state sensor called a thermistor. The resistance of this sensor decreases with increasing temperature. The sensor output voltage is converted to a binary number by the A/D converter and is sent to the CPU through the MULTIPLEXER (MUX). The computer compares this binary number to the one stored in memory that corresponds to the high temperature limit. If the coolant temperature exceeds the limit, an output signal is generated that activates the warning indicator. If the limit is not exceeded, the output signal is not generated and the warning message is not activated. A proportional display of the actual temperature is then displayed to the display via a DEMUX.	04

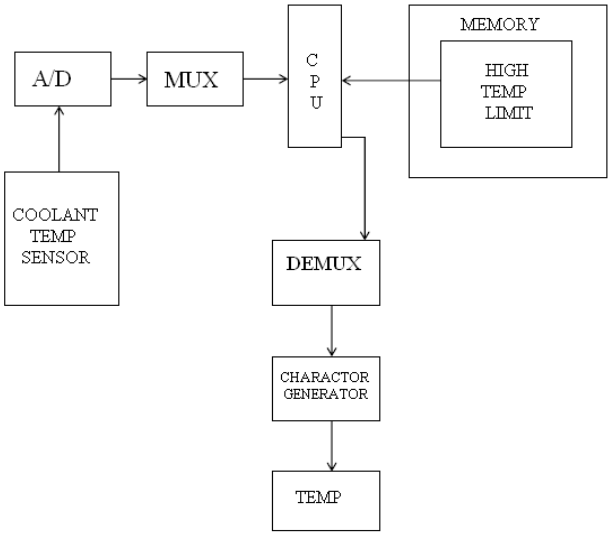
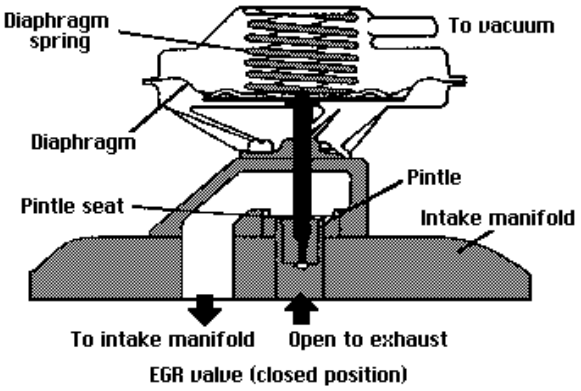
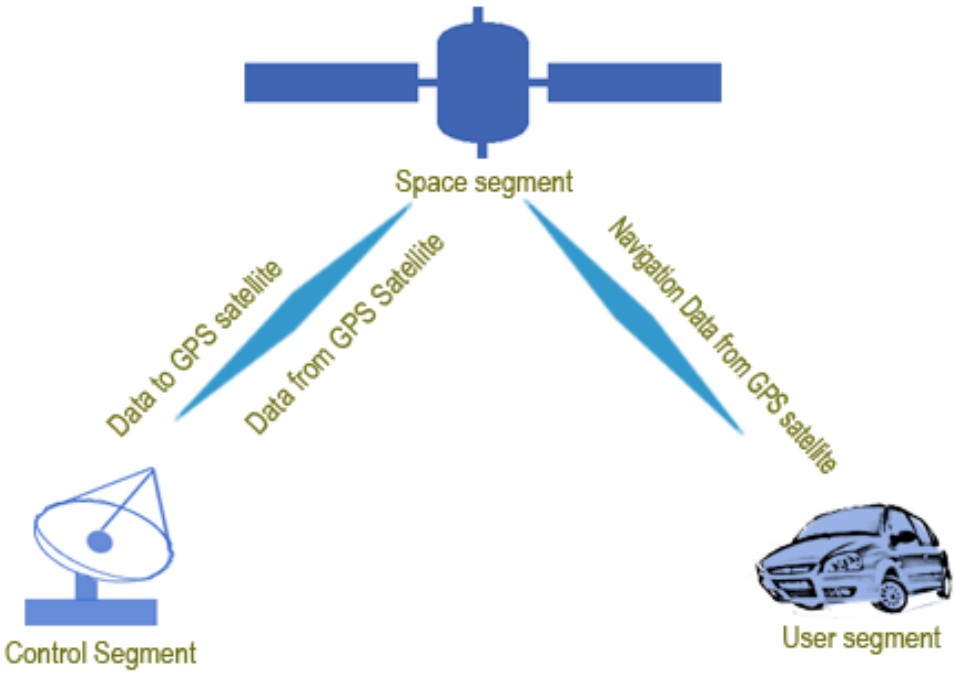


Fig: Digital visual display for coolant temperature measurement

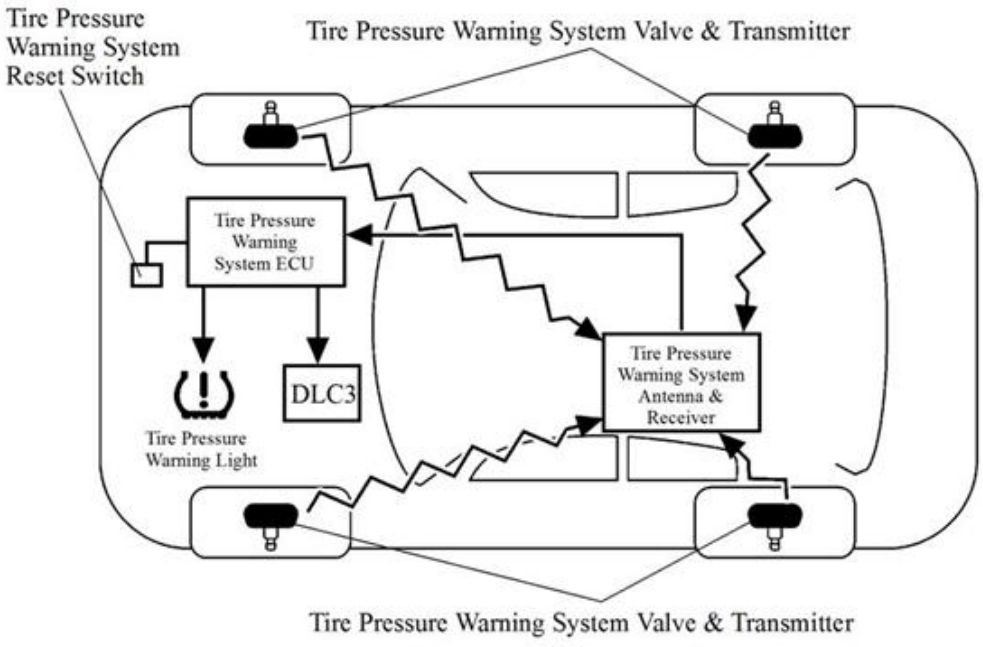
	e)	**Compare read only memory and random access memory.(*any four)***	04
		Answer: *(Note: any 4 point -4 mark)* **Read Only Memory(ROM)** / **Random Access Memory(RAM)** ROM can't be directly accessed by the processor / RAM is easily accessed by the processor ROM is non-volatile in nature as it never erased when there is any shutdown or restart of computer / RAM is volatile in nature as it automatically erased when computer shutdowns ROM memory is used to store permanent information and can't be deleted. / RAM is used to store the temporary information for short period of time ROM are generally the optical drivers that are made of magnetic tapes / RAM is a form of chip ROM are LESS expensive as compare to RAMs / RAMs are MORE expensive as compare to ROM types of ROM- PROM, EPROM and EEPROM / types of RAM- Static RAM and Dynamic RAM	04
	f)	**Describe the construction of EGR valve with neat sketch**.	04
		Answer: *(**Note: Explanation -2 mark, Equivalent diagram -2 mark)*  EGR valve (closed position) Most early EGR valves were vacuum-operated. A vacuum diaphragm opened and closed a valve, allowing and cutting off exhaust flow. An early refinement was a temperature-controlled shut-off in the vacuum source. This kept the EGR valve from opening when the engine was too cool. The cool engine did not require EGR and cutting it off made the engine run smoother. EGR flow is also undesirable at other times, for instance at idle. At very low speed, combustion temperature is naturally lower. Adding exhaust gas at low speed can cause rough idle. The positive back-pressure EGR valve helped solve this problem. Similar to a standard vacuum model, the positive back-pressure design has a hollow valve stem. This allows exhaust gas pressure to push against a spring loaded vacuum valve. When back pressure rises, such as on acceleration, exhaust pressure closes the spring-valve and seals the vacuum opening. This allows an engine vacuum to open the EGR valve. When back pressure is low, such as at an idle, the spring opens the vacuum port. Engine-vacuum is bled off and the EGR valve closes. The design change has caused many good EGR valves to be replaced needlessly.	04

3		**Attempt any FOUR.**	16
	a)	**List the six steps followed during component testing. Describe any one step**.	04
		Answer:*(Note: List - 3 marks and Description any one- 1 mark)* **Six step approach for components testing:- (Six- ½ mark each)** 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. **Six step approach for components testing:- (Any One- 1 mark)** **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.	04
	b)	**What is the correct way to test an injector with an ohmmeter**	04
		Answer- *(explanation 4 marks*) **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.	04

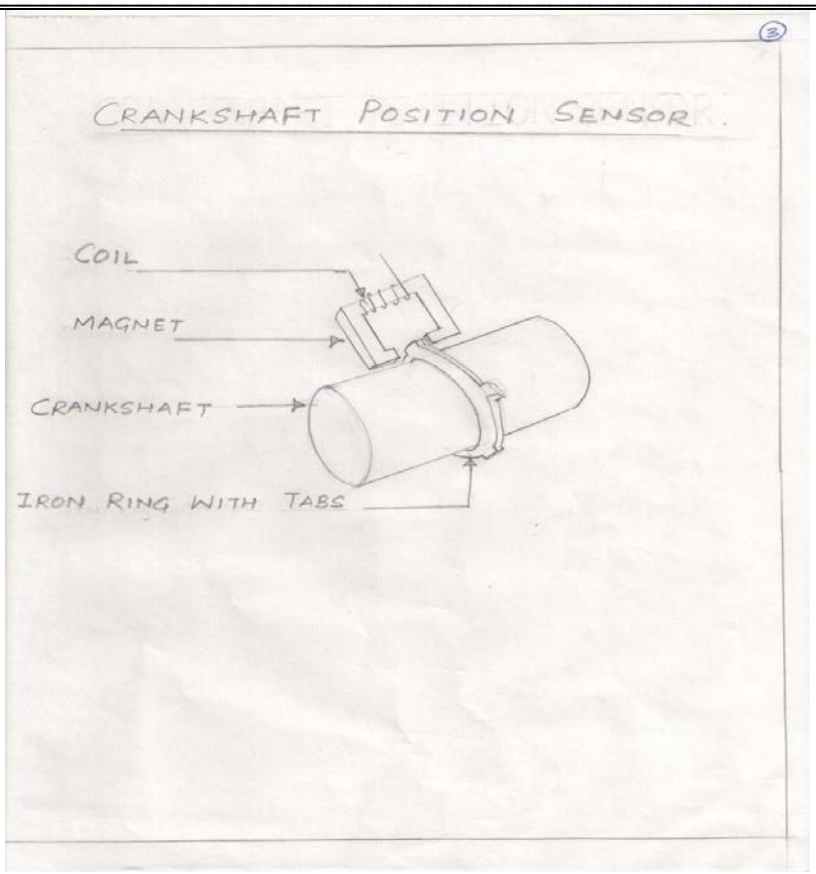
	c)	**Explain with block diagram open loop control system**	04
		Answer: (*Note: Explanation -2 mark, Equivalent diagram -2 mark)*  Fig1: Open loop control system If in a physical system there is no automatic correction of the variation in its output, it is called an open loop control system. That is, in this type of system, sensing of the actual output and comparing of this output (through feedback) with the desired input does not take place. The system on its own is not in a position to give the desired output and it cannot take into account the disturbances. In these systems, the changes in output can be corrected only by changing the input manually. These systems are simple in construction, stable and cost cheap. But these systems are inaccurate and unreliable. Moreover these systems do not take account of external disturbances that affect the output and they do not initiate corrective actions automatically. Any non-feedback control system can be considered as a feedback control system if it is under the supervision of someone. Although open loop control systems have economical components and are simple in design, they largely depend on human judgment. As an example, let us consider a home furnace control system. This system must control the temperature in a room, keeping it constant. An open loop system usually has a timer which instructs the system to switch on the furnace for some time and then switch it off. Accuracy cannot be achieved as the system does not switch on/off based on the room temperature but it does as per the pre-set value of time.	04
	d)	**State the four advantages of electronic power steering**	04
		Answer – *(any four advantage-4 marks)* 1. An electronically controlled power steering adjusts the steering boost adaptively to the driving conditions. 2. Using electronic control of power steering, the available boost is reduced by controlling a pressure relief valve on the power steering pump. 3. Reduce the driving efforts of the driver. 4. Reduce the fatigue of the driver. 5. To avoid under-steer & over-steer condition of the vehicle	04

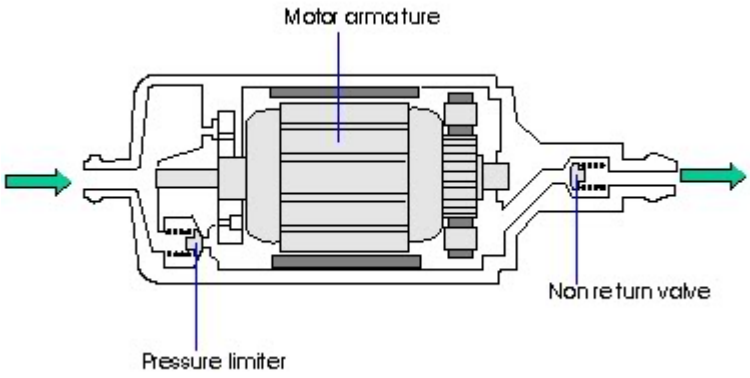
Q. No.	Sub Q. N.	Answer	Marking Scheme
	e)	**Draw the block diagram of Global positioning system and label it.**	04
		Answer:(*block diagram-3marks, labelling-1mark)*  	04
	f)	**List and explain the limitations of analog display**	04
		Answer:*(Note: List any 4 limitations - 4 marks)* **1.** An analog signal is any continuous signal for which the time varying feature of a signal is a representation of some other time varying quantity. 2. The reading is not precise. 3. Recording of the reading is not easy. 4. Convex errors may be present. **5.** Extension of the reading is not possible.	04
4	A)	**Attempt any THREE.**	12
	a)	**Explain the low pressure warning system.**	04
		Answer: *(Note:* Explanation *-4 marks, credit should be given to sketch)* **Low pressure warning system:** This system directly senses the air pressure of each tire through tire pressure warning system valve & transmitter that are attached to each wheel and illuminate the tire pressure warning light to inform the driver of the low air pressure. After tire replacement, firstly register tire pressure warning system valve & transmitter IDs into the tire pressure warning system ECU, and then store the appropriate tire pressure in the ECU using the tire pressure warning system reset switch. **1. Combination Meter:** Transmits the vehicle speed signal to the tire pressure warning system ECU for	04

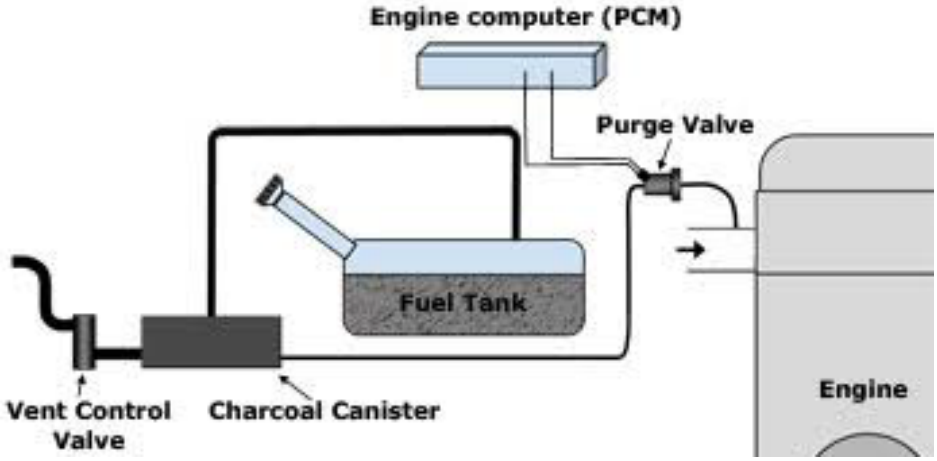
vehicle speed correction.
2. **Tire Pressure Warning Light:** Turns ON or blinks to warn the driver in accordance with the signal from the tire pressure warning system ECU, Displays the 2-digit DTC (Diagnostic Trouble Code).
3. **Tire Pressure Warning System Reset Switch:** The appropriate air pressures of the tires currently mounted on the vehicle are stored in the tire pressure warning system ECU by operating the tire pressure warning system reset switch.
4. **Tire Pressure Warning System Valve & Transmitter:** Detects the inflation pressure and internal temperature of the tire and transmits the measured value and the ID number to the tire pressure warning antenna & receiver.
5. **Tire Pressure Warning System Antenna & Receiver:** Receives the tire pressure warning system valve & transmitter signal and transmits this data to the tire pressure warning system ECU.
6. **Tire Pressure Warning System ECU:** Receives the data from the tire pressure warning system antenna & receiver and monitors the tire inflation pressure. When the tire pressure warning system ECU detects a drop in the tire inflation pressure or a system malfunction, it outputs the respective signal to the combination meter.



	b)	**Describe the construction and working of crankshaft position sensor.**	04
		Answer: ***(Note:*** construction ***&working - 3 marks and sketch-1 marks)*** **Construction and working of crankshaft position sensor:** 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. 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.	04

			
	c)	**State types of errors and explain error compensation**	04
		Answer: (*Note- Any Two Types of errors - 02 marks, error compensation-2marks)* **Types of error:- (Any Two)** 1) Gross error 2) Systematic error 3) Random error **Error Compensation** error in computation or in recording of accounting data ,that is neutralized (counter balanced) by an equal and opposite error .since compensating errors do not show up in the total , they are difficult to locate through statistical methods .	04
	d)	**Draw a neat sketch of fuel pump and explain its working**.	04
		Answer: *(Note: drawing-2marks, working -2 marks, marks should be given to Equivalent diagram and working)* **Electric Fuel Pump**. This type of high pressure fuel pump is called as a roller cell pump, with the fuel entering the pump and being compressed by rotating cells that force it through the pump at high pressure. The pump is capable of producing a pressure of 8 bar with a delivery rate of approximately 4 to 5 liters per minute. Within the pump is a pressure relief valve that lifts off its seat at 8 bar to arrest the pressure should the filter, fuel lines or other eventualities cause it to become obstructed. The other end of the pump (output) is a non-return valve that, when the voltage to the pump is removed, closes the return and	04

		maintains pressure within the system, as illustrated in figure. The normal operating pressure within this system is approximately 5 bar and at this pressure the current draw on the pump is 5 to 8 amps. Some systems operate a small lift pump situated inside the tank. The supply voltage to the pump in the majority of cases is 12 volts. The voltage supply to the pump is via the fuel pump relay. Roller cell fuel pump  Figure shows a cross section of an electric fuel pump.	
	e)	**Describe the working of purge control valve.**	04
		Answer: *(Note: working -4 marks, marks should be given to Equivalent diagram)* The purge valve is the part of the vehicle Evaporative Emission Control (EVAP) system. The EVAP system prevents fuel vapors in the fuel tank from escaping into the atmosphere. The EVAP system traps fuel vapors from the fuel tank and temporarily stores them in the charcoal canister, see the diagram. When the engine is running under certain conditions, the fuel vapors are purged from the canister and burned inside the engine. The purge valve precisely controls the amount of fuel vapor that is purged from the charcoal canister. In modern cars, the purge valve is an electrically-operated solenoid that is controlled by the engine computer. When the engine is off, the purge valve is closed. When the engine is running and fully warmed up, the engine computer gradually opens the purge valve to allow some amount of fuel vapor to be moved from the charcoal canister to be burned in the engine. The purge flow is monitored by a number of sensors. If the purge flow is less or more than is expected under the conditions, the computer illuminates the "Check Engine" light.	04

			
	B)	**Attempt any one.**	06
	a)	**Describe the construction and working of unit injector with neat sketch**.	06
		Answer: ***(Note:*** **construction and working** ***-4 marks, Equivalent diagram -2mark.)*** **Electronic Fuel Injector (Unit Injector):** A vacuum –powered fuel pressure regulator at the end of the fuel rail ensures that the fuel pressure in the rail remains constant relative to the intake pressure. For a gasoline engine, fuel pressure is usually on the order of 35-50 psi. Fuel injectors connect to the rail, but their valves remain closed until the ECU decides to send fuel into the cylinders. Usually, the injectors have two pins. One pin is connected to the battery through the ignition relay and the other pin goes to the ECU. The ECU sends a pulsing ground to the injector, which closes the circuit, providing the injectors solenoid with current. The magnet on top of the plunger is attracted to the solenoids magnetic field, opening the valve. Since there is a high pressure in the rail, opening the valve sends fuel at a high velocity through the injectors spray tip. The duration that the valve is open and consequently the amount of fuel sent into the cylinder depends on the pulse width (i.e. how long the ECU sends the ground signal to the injector). When the plunger rises, it opens a valve and the injector sends fuel through the spray tip and into either the intake manifold, just upstream of the intake valve, or directly into the cylinder.	

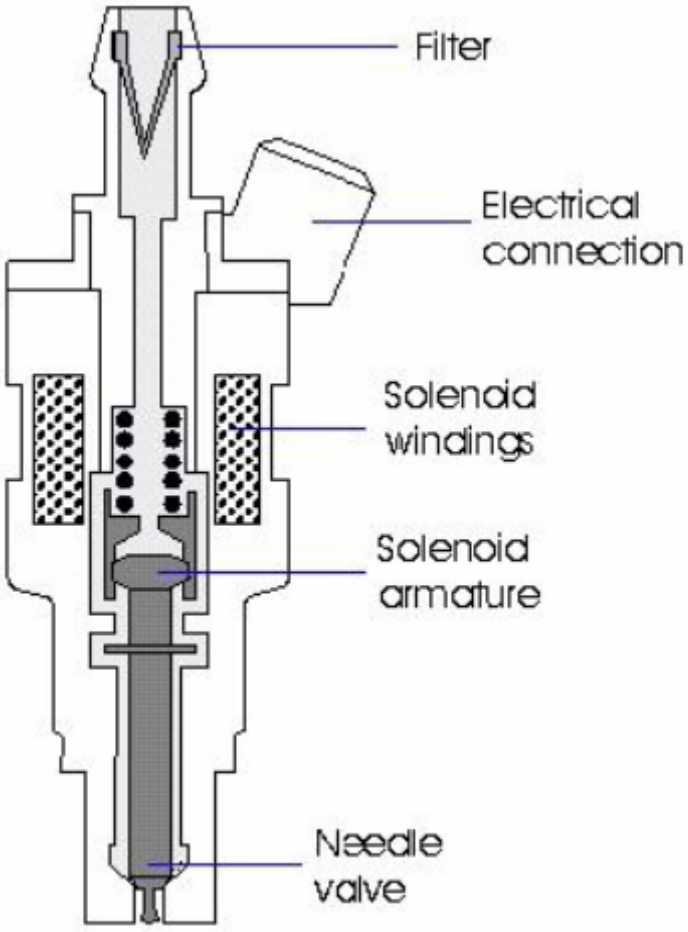


Fig. Electronic Fuel Injector

	b	Explain the working of ABS system with neat sketch. State the four advantages of ABS system	06
		Answer: ***(Note: Working -2 marks and equivalent sketch - 2 marks,*** four advantages-***2 marks)***	06

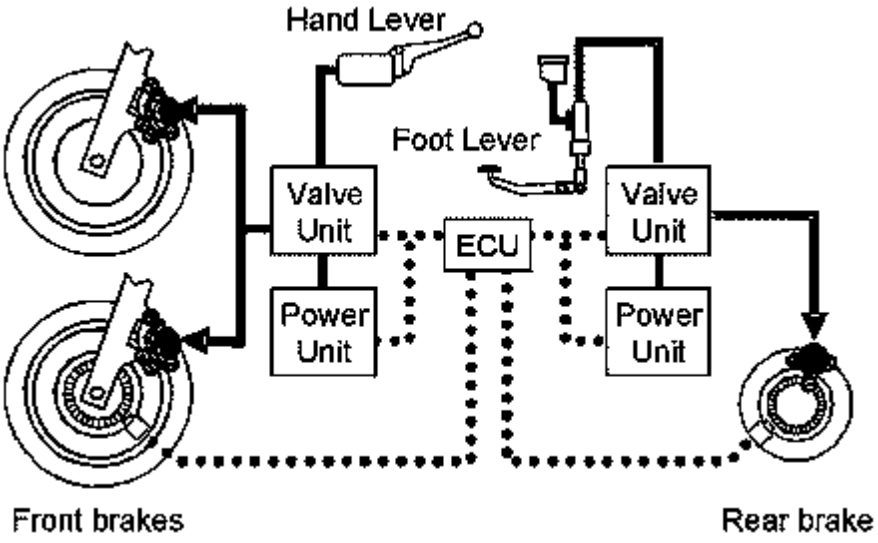


Figure of ABS system

Working: There are four main components to an ABS system:

i. **Speed Sensors:** The anti-lock braking system needs some way of knowing when a wheel is about to

lock up. The speed sensors, which are located at each wheel, or in some cases in the differential, provide this information.

ii. **Valves:** There is a valve in the brake line of each brake controlled by the ABS. On some systems, the valve has three positions.

iii. **Pump:** Since the valve is able to release pressure from the brakes, there has to be some way to put that pressure back. That is what the pump does; when a valve reduces the pressure in a line, the pump is there to get the pressure back up.

iv. **Controller:** The controller is a computer in the car. It watches the speed sensors and controls the valves.

The controller monitors the speed sensors at all times. It is looking for decelerations in the wheel that are out of the ordinary. Right before wheel locks up, it will experience a rapid deceleration. If left unchecked, the wheel would stop much more quickly than any car could. It might take a car five seconds to stop from 60 mph (96.6 kph) under ideal conditions, but a wheel that locks up could stop spinning in less than a second.

The ABS controller knows that such a rapid deceleration is impossible, so it reduces the pressure to that brake until it sees acceleration, then it increases the pressure until it sees the deceleration again. It can do this very quickly, before the tire can actually significantly change speed. The result is that the tire slows down at the same rate as the car, with the brakes keeping the tires very near the point at which they will start to lock up. This gives the system maximum braking power

Advantages of ABS system:

1. Anti-lock braking system (ABS) guarantees stable braking characteristics on all road surfaces, hence avoids overturning of the vehicle.
2. ABS reduces friction on wheels and road, thus increases the efficiency of tires (up to 30%).
3. The Vehicle with ABS can be stopped at a lesser distance than a non ABS vehicle.
4. Steering control is effective, i.e., the vehicle can be steered smoothly while braking. Thus minimizes the accidents.
5. A driver without experience can drive ABS vehicle effectively, then an experienced driver on the non-ABS vehicle

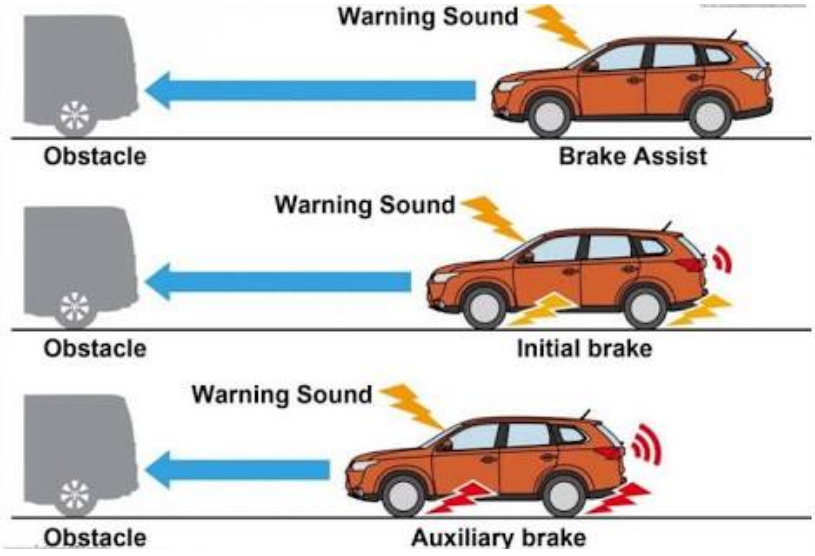
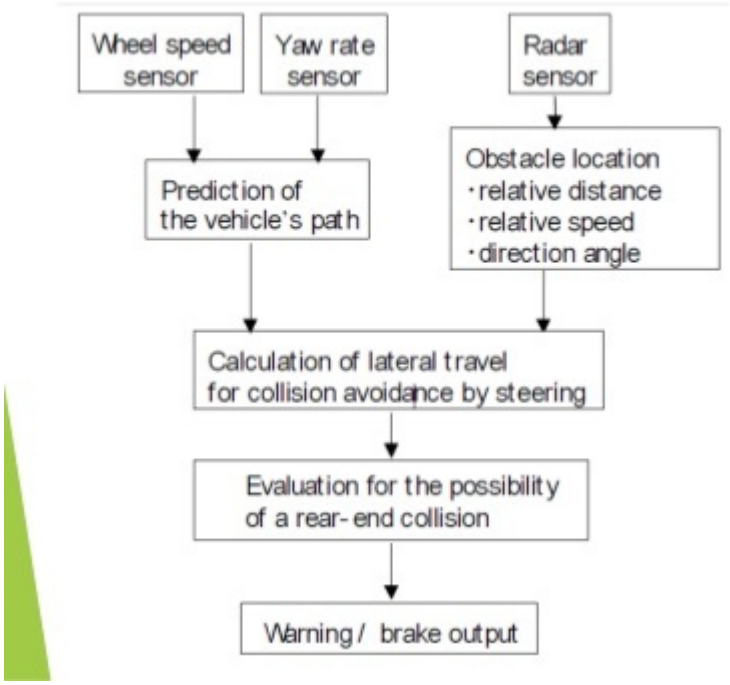
5)		**Attempt any four**	16
	a)	**Describe the working of** collision avoidance system	04
		Answer: ***(Note: working - 2 marks, diagram -2 mark , equivalent diagram should be considered)*** 	04

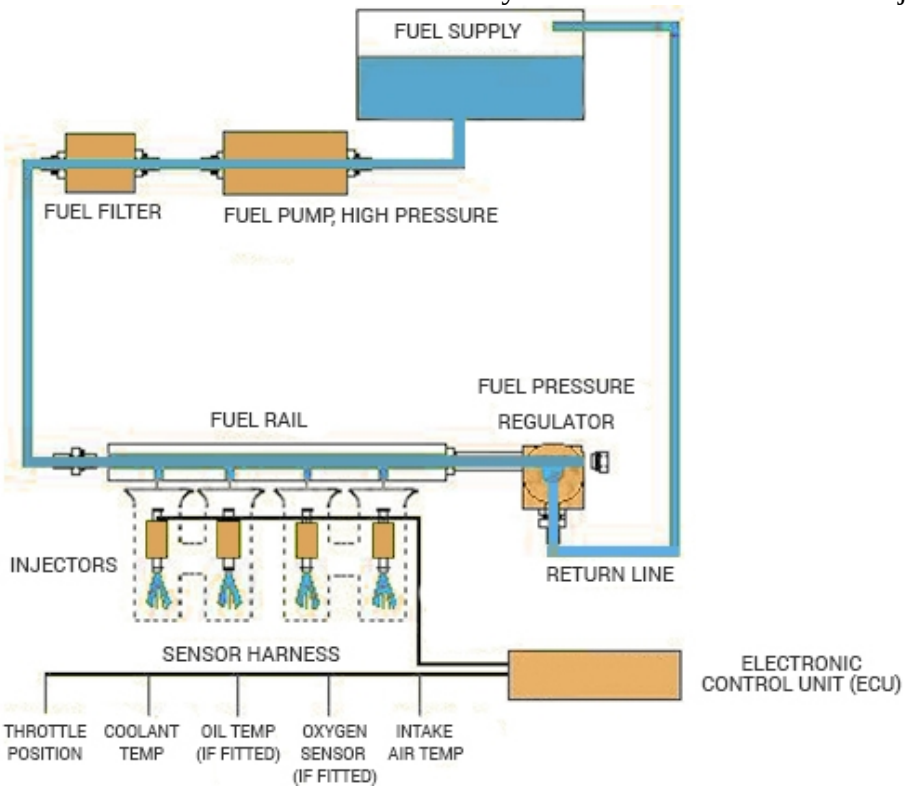
Fig. Collision avoidance system

Working collision avoidance system: A collision avoidance system is an automobile safety system designed to reduce the severity of a collision. It is also known as a pre-crash system, forward collision warning system, or collision mitigating system. It uses radar (all-weather) and sometimes laser (LIDAR) and camera (employing image recognition) to detect an imminent crash. GPS sensors can detect fixed dangers such as approaching stop signs through a location database. Once the detection is done, these systems either provide a warning to the driver when there is an imminent collision or take action autonomously without any driver input (by braking or steering or both). Collision avoidance by braking is appropriate at low vehicle speeds (e.g. below 50 km/h), while collision avoidance by steering is appropriate at higher vehicle speeds. Cars with collision avoidance may also be equipped with adaptive cruise control, and use the same forward-looking sensors.

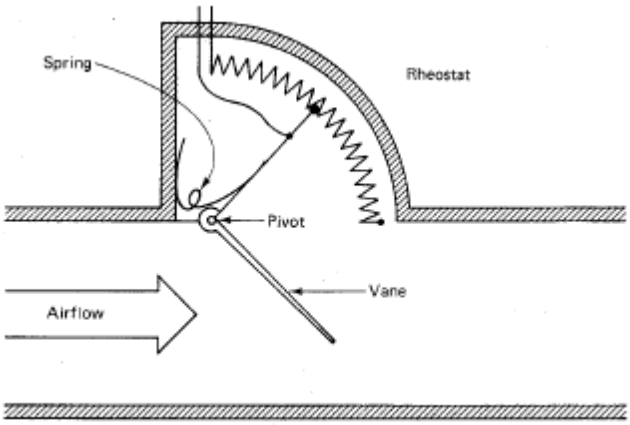
OR

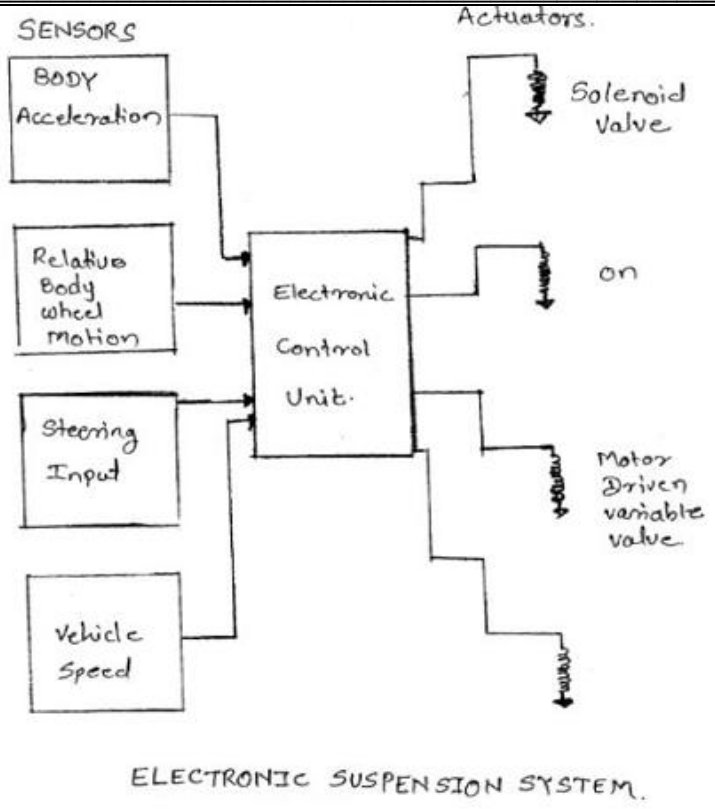
Collision avoiding Systems: Collision avoiding systems place small radar detectors up near the front of the car, usually within the grill, where they constantly send out quick bursts of high-frequency radar waves. These waves will bounce off the nearest objects and return to the sensor, where a separate unit connected to the sensor calculates how long it took for the signal to leave and bounce back. With this information, a PCS unit can determine another car's position, distance, speed and relative velocity almost immediately, and if any sudden changes in those factors could potentially cause a collision, the system can provide information or assist the driver in avoiding a potential accident.



	b)	**Explain MPFI system with neat sketch**	04
		Answer: *(Note: explanation - 2 marks, diagram -2 mark ,equilavant diagram should be considered)* **MPFI system** New engines are equipped with MPFI system. MPFI have a fuel injector for each cylinder. MPFI spray right at the intake valve and provide more accurate fuel metering and quicker response. **Working of MPFI** When you step on the gas pedal, the throttle valve opens up more, letting in more air. The engine control unit (ECU, the computer that controls all of the electronic components on your engine) "sees" the throttle valve open (with the help of Mass airflow sensor) and increases the fuel rate in anticipation of more air entering the engine. It is important to increase the fuel rate as soon as the throttle valve opens; otherwise, when the gas pedal is first pressed, there may be a hesitation as some air reaches the cylinders without enough fuel in it. Sensors monitor the mass of air entering the engine, as well as the amount of oxygen in the exhaust. The ECU uses this information to fine-tune the fuel delivery so that the air-to-fuel ratio is just right.  **Fig. MPFI system**	04
	c)	**What is a CAN bus and LIN Bus? Explain in brief.**	04
		Answer: *(Note: explanation of each point - 4 marks)* **CAN bus system:** CAN (Controller Area Network) is an example of an automotive digital data system. It was developed by the Robert Bosch Company in Germany. CAN is a serial synchronous communication protocol that connects electronic control modules, sensors and actuators The twisted pair of the CAN bus system minimizes electrically initiated interference and virtually	04

		eliminates the possibility of messages becoming corrupted. The major feature of the CAN bus system are: i. Priority controlled message transmission. ii. Low cots through the use of a low cost twisted two wire cable and use of simple protocol with low power demand. iii. A data transfer rate up to 1MBPS for the high speed CAN (CAN-C) and up to 125KBPS for the low speed CAN (CAN-B) iv. High reliability of data transfer **LIN bus :** The role of the LIN bus is to complement the CAN bus, not replace it. It is an inexpensive serial communications protocol that supports remote and non-critical applications in a car's network. Unlike CAN, LIN works on a master-slave topology. Typically the network comprises one master and up to 16 slaves. All communication is initiated by the master node. Because all the nodes are clocked by the master, a precision clock is required only in the master node. This is one of the reasons that LIN is less expensive than CAN Features and benefits of LIN i. Complementary role – As already stated the role of LIN is not to replace CAN but to complement it. This feature helps CAN to extend to remote hierarchical sub-networks within applications. ii. Single-wire implementation – LIN's low-cost, single-wire implementation (contrary to CAN's twisted pair implantation) reduces cost considerably. iii. Data rate – Data rates are limited to 20Kbps (for EMI control reasons). This helps maintain the reliability of the network. iv. Broadcast serial network - The LIN network can have one master and up to 16 slave nodes. All messages originate at the master and at most one slave responds, based on the message identifier. v. Self-synchronization - No crystal or resonator is required, thus lowering implementation cost significantly. vi. Latency time - LIN networks provide guaranteed latency times, making it a more predictable network	
	d)	**Describe diagnostic procedure for Throttle position sensor.**	04
		Answer: ***(Note: testing procedure - 4 marks)*** **Testing 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.	04

	e)	**Describe the construction and working of air flow measurement sensor**	04
		Answer:(*construction and working-2marks,diagram-2marks)*  Fig. Air flow measurement sensor **Air Flow Measurement 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.	04
	f)	**Explain the electronic control of suspension.**	04
		Answer:(Note: Description with equivalent sketch- 04 marks) **Electronic control of suspension:** It 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 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. (Unsprung or sprung mass) the steering wheel input and vehicle speed. The body acceleration measurement can be used to evaluate ride quality. 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.	04



ELECTRONIC SUSPENSION SYSTEM.

6)		Attempt any four:	16
	a)	How GSM network works?	04
		Answer: ***(Note: working- 4 marks. Credit should be given to Sketch)***	04

GSM network-

GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM). It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates.

There are various cell sizes in a GSM system such as macro, micro, pico and umbrella cells. Each cell varies as per the implementation domain. There are five different cell sizes in a GSM network macro, micro, pico and umbrella cells. The coverage area of each cell varies according to the implementation environment

GSM network consists of the following components:

A Mobile Station: It is the mobile phone which consists of the transceiver, the display and the

		processor and is controlled by a SIM card operating over the network. **Base Station Subsystem**: It acts as an interface between the mobile station and the network subsystem. It consists of the Base Transceiver Station which contains the radio transceivers and handles the protocols for communication with mobiles. It also consists of the Base Station Controller which controls the Base Transceiver station and acts as a interface between the mobile station and mobile switching centre. **Network Subsystem**: It provides the basic network connection to the mobile stations. The basic part of the Network Subsystem is the Mobile Service Switching Centre which provides access to different networks like ISDN, PSTN etc. It also consists of the Home Location Register and the Visitor Location Register which provides the call routing and roaming capabilities of GSM. It also contains the Equipment Identity Register which maintains an account of all the mobile equipments wherein each mobile is identified by its own IMEI number. IMEI stands for International Mobile Equipment Identity.	
	b)	Describe the working of temperature sensor used in automobile.	04
		Answer :*(Note- working- 4 marks. Credit should be given to Sketch)* **Working of temperature sensor** On most vehicles, the coolant temperature sensor (CTS) can be found somewhere near the engine thermostat, which allows it to function optimally. The tip of the CTS is probably located right next to the engine coolant. The sensor works by measuring the temperature that's being given off by the thermostat and/or the coolant itself. The temperature is then sent to the on-board control system. From there, your vehicle's computer will use this temperature information to either continue operating or adjust certain engine functions, always working to keep the engine temperature at an ideal level. As the control system receives the temperature from the CTS, it may trigger the cooling fan to either shut off or turn on. Additionally, it may signal the need for a richer fuel mixture or open the exhaust gas recirculation. **OR**	04

TEMPERATURE SENSOR :-

A commonly used device used for sensing temperature is the thermistor.

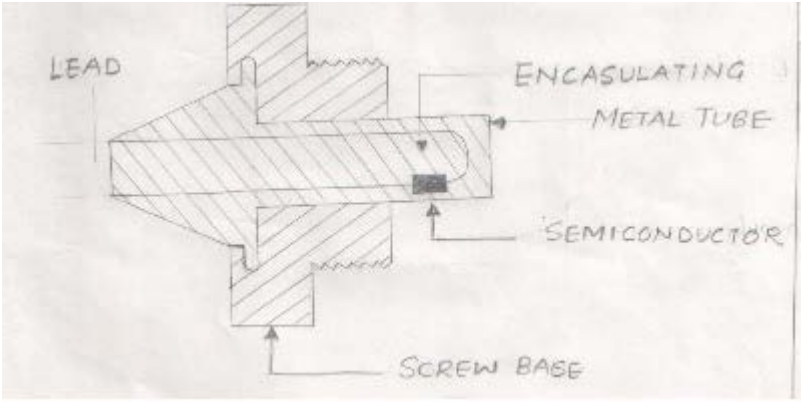
A thermistor utilizes the concept of negative temperature coefficient. i.e. its resistance gets lower as its temperature increases and this is a characteristic of semiconductor material.

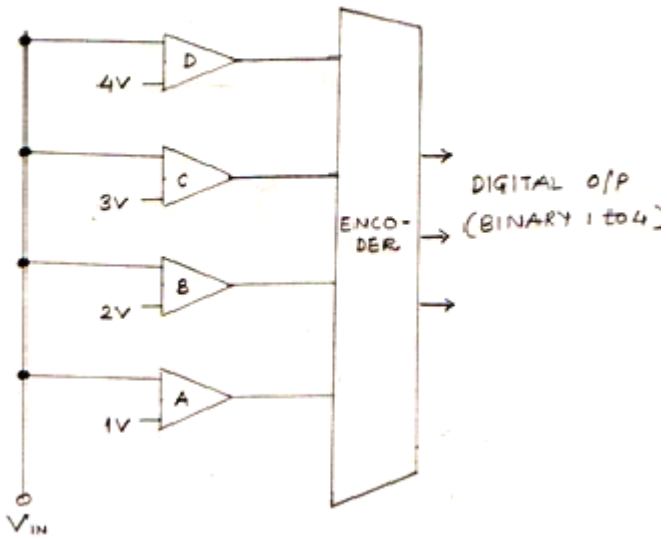
CONSTRUCTION & WORKING :-

A typical coolant sensor is shown in the figure. It consists of a thermistor (semiconductor material) mounted in a housing that is designed to be inserted in the coolant stream. This housing is typically threaded with pipe threads that seal the assembly against coolant leakage.

A thermistor is made of semiconductor material whose resistance varies inversely with temperature. For example, at -40°C a typical coolant sensor has a resistance of 100,000 ohms. The resistance decreases to about 70,000 ohms at 130°C. The change in current is the sensor signal.

SEMICONDUCTOR RESISTOR TEMPERATURE SENSOR



	c)	Explain the process of **Analog to Digital Conversion.**	04
		Analog to Digital Conversion: 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.	04
		FLASH TYPE ANALOGUE TO DIGITAL CONVERTER.	
			
		INPUT VOLTAGE ANALOGUE.	
		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)	**What is the correct procedure for checking an oxygen sensor with a digital multimeter?**	04
		Answer: *(Note: testing procedure - 4 marks)* **Testing of Oxygen Sensor with a digital multimeter: -** Following procedure is followed to diagnose an oxygen sensor. 1. Disconnect the connector of the oxygen sensor. 2. Start the engine and warm-up for 2 minutes at 3000 rpm under no load conditions. 3. Raise the engine speed to 4000 rpm and release the throttle suddenly for at least 5 times. 4. Within one minute after the engine has been warmed up, measure the voltage between the connector terminal and body ground.	04

		5. The voltage should be below 0.4 Volts. 6. Replace the oxygen sensor if the voltages are out of the above range.	
	e)	**Describe diagnostic procedure for diode.**	04
		Answer: *(Note: testing procedure - 4 marks)* **Testing of diode with a digital multimeter** i. From the multimeter connect the BLACK test connector to the RED wire coming from the regulator rectifier. ii. Then from the multimeter connect the RED test connector to ONE of the YELLOW wires coming from the regulator rectifier. iii. The readout should show between 0.400-0.600 along with a single audible beep iv. Continue by testing the remaining YELLOW wires following the same test procedure. **When a diode is bad:** You'll hear a continuous tone with a readout of 0.000 *Or* the readout will indicate any number value other than 0.400-0.600 *Or* the readout with indicate **"OL"** **OR** **TESTING OF DIODES (RECTIFIER BRIDGE)** As the diode allows the current to flow in only one direction, it must be tested for continuity in both directions. Using the ohmmeter connect the test leads to the diode lead and the case. Read the ohmmeter scale. If the diode is good it will show high resistance in one direction and low resistance in the opposite direction. If both readings are low the diode is short. If there is high resistance in both directions, the diode is open. Test all six diodes and replace any that are defective.	04