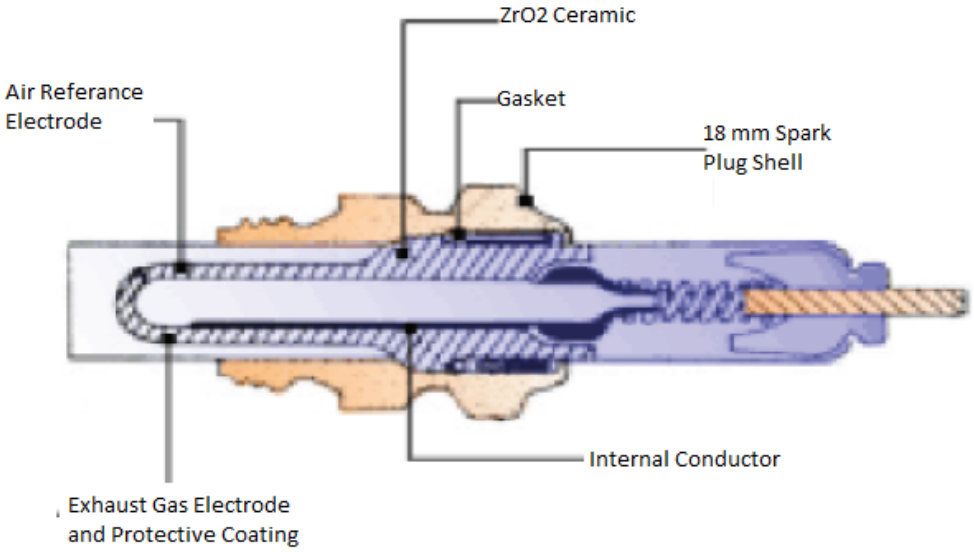
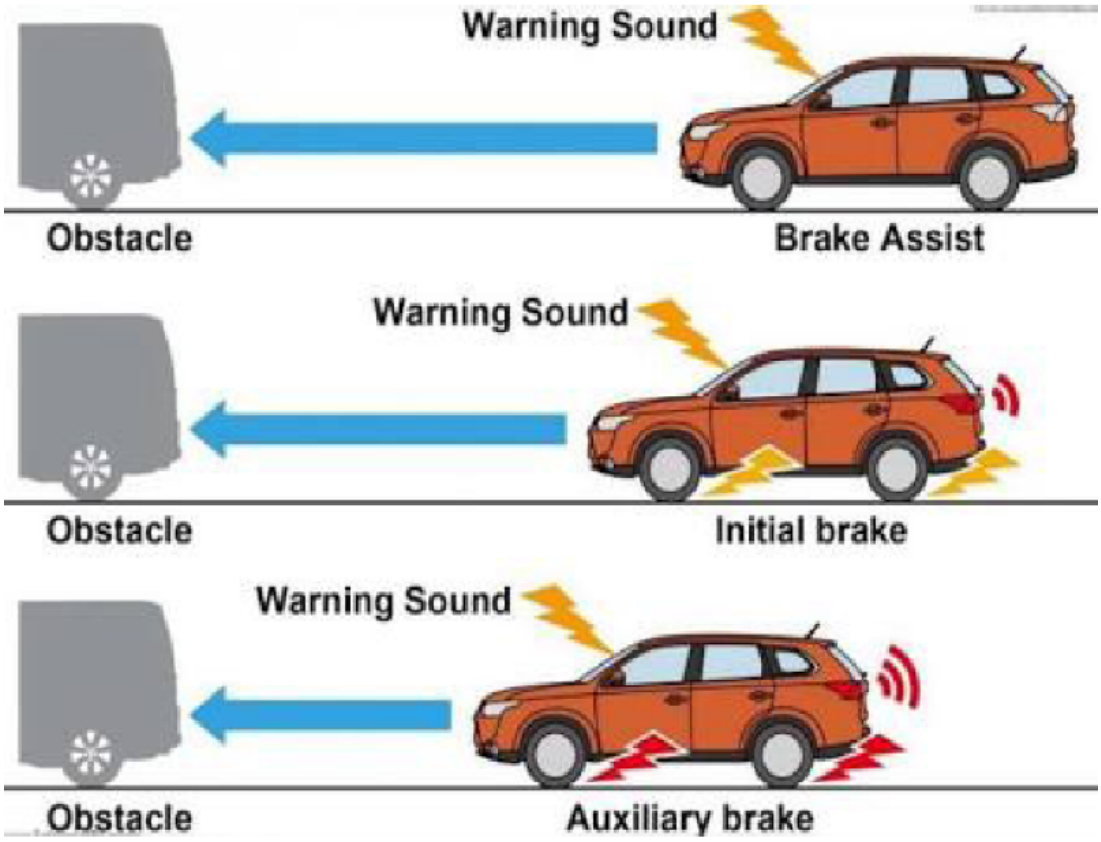
WINTER – 19 EXAMINATION

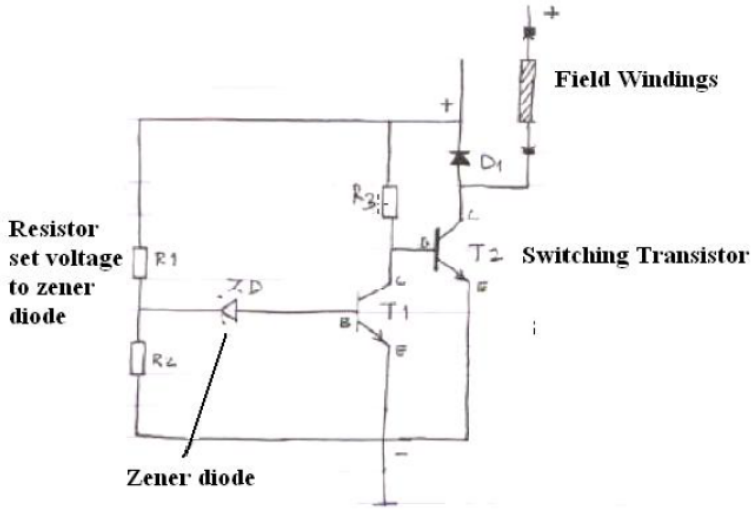
Subject Name: Autotronics **Model Answer** Subject Code 17619

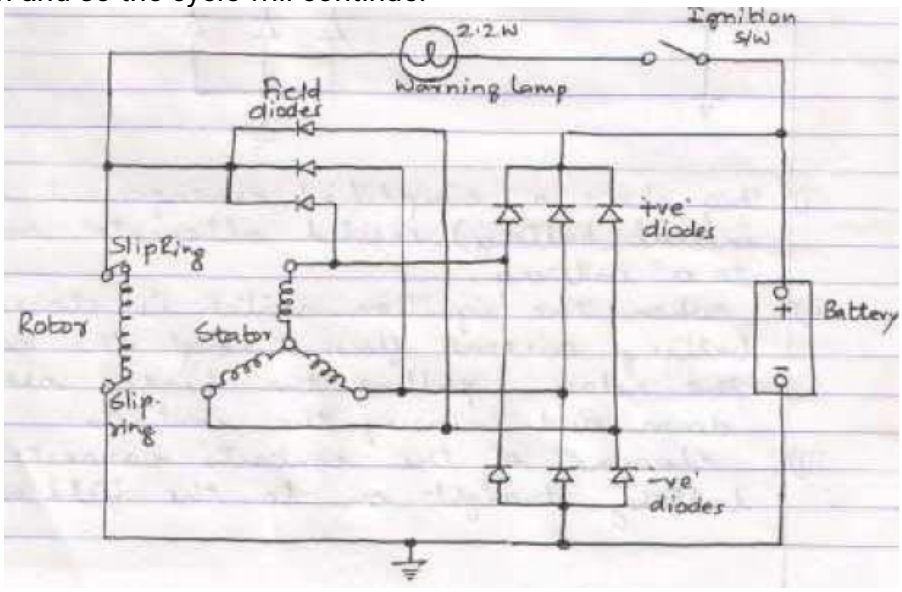
Important Instructions to examiners:

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.

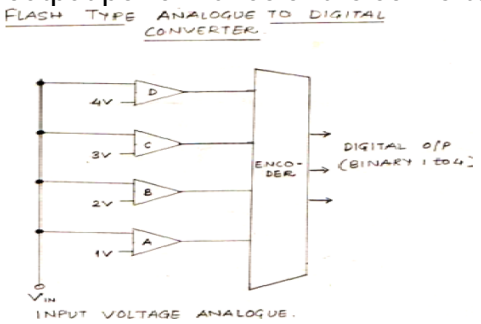
Q. No.	Sub Q. N.	Answer	Marking Scheme
1 (a)		**Attempt any THREE of the following:**	12
	i	**With neat sketch describe the working of oxygen sensor.**	04
	Ans	 **Figure: Oxygen Sensor** The oxygen sensor operates on the basis of a difference between the oxygen partial pressure of atmospheric air and 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	**Sketch 02 Marks & Explain 02 Marks**

		the e.m.f (voltage) of the sensor	
	ii	**Explain collision avoidance system.**	**04**
	Ans	 **Figure: Collision Avoidance System in Automobiles.** 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	**Sketch 02 Marks & Explain 02 Marks**

		can provide information or assist the driver in avoiding a potential accident.	
	iii	**Explain how to perform test to judge the condition of given diode using multimeter.**	**04**
	Ans	**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.	**01 Mark for Each Step**
	iv	**List the advantages of electronic suspension system.**	**04**
	Ans	**Advantages of Electronic Suspension System:** 1) increased efficiency; 2) improved dynamic behavior; 3) stability improvement; 4) accurate force control; 5) dual operation of the actuator	**01 Mark Each**
1 (b)		**Attempt any ONE of the following:**	**06**
	I	**Describe with a neat sketch use of power diodes in charging system of alternator.**	**06**
	Ans	**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	**02 Marks** **02 Marks**

		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. 7. 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.  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.	**02 Marks**
	ii	**Explain analog to digital and digital to analog signal conversion.**	**06**
	Ans	**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	**03 Marks**

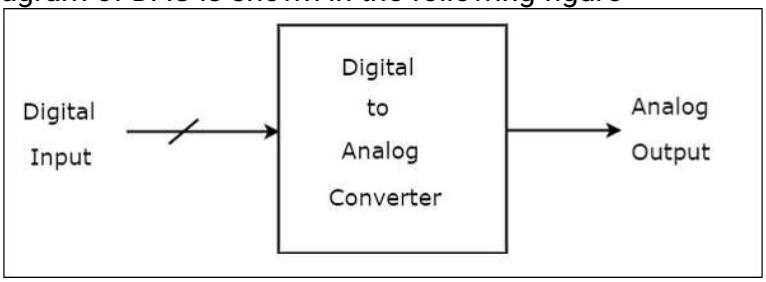
be done in a number of ways. Figure shows one type of A/D converter that is known as a 'flash' converter. The flash converter consists of four comparators and an encoder circuit which takes the comparator outputs and converts them into a binary code. An electronic comparator is a circuit which continuously 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

A Digital to Analog Converter (DAC) converts a digital input signal into an analog output signal. The digital signal is represented with a binary code, which is a combination of bits 0 and 1. This chapter deals with Digital to Analog Converters in detail.

The block diagram of DAC is shown in the following figure –



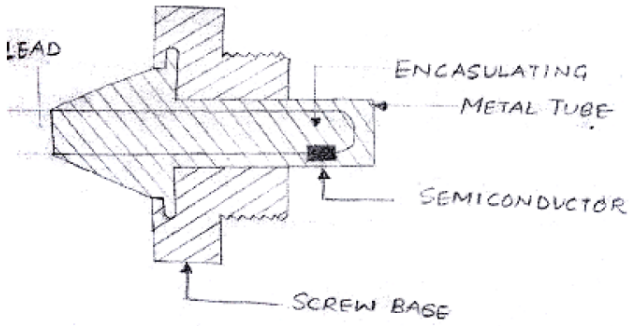
A Digital to Analog Converter (DAC) consists of a number of binary inputs and a single output. In general, the number of binary inputs of a DAC will be a power of two.

There are two types of DACs

- Weighted Resistor DAC
- R-2R Ladder DAC

03 Marks

2		**Attempt any FOUR of the following:**	**16**
	A	**Explain the working of a engine coolant temperature sensor.**	**04**
	Ans	**Working of Coolant Temperature Sensor :**	**Sketch 02 Marks & Explain 02 Marks**

		 **Figure: Semiconductor Resistor 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. **Working:** 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. **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.	
	B	**Enlist the different types of communication system used in automobile. State the function of Bluetooth technology.**	**04**
	Ans	Types of communication system used in automobile 1. Bluetooth 2. Wi-Fi 3. CAN Bus 4. LIN Bus 5. GSM Network 6. Optic fibers. 7. Ethernet Function of Bluetooth Technology: Bluetooth is designed to support personal area network (PAN) to replace wired cable between nearby devices. Bluetooth is a used to pair mobile phones to vehicles. Such pairing enable hands free calling from the vehicle. It allows a vehicle embedded display unit to be used to control mobiles phones and allows a mobiles phone to use the vehicle embedded sound systems. It also enables making emergency calls during accidents, downloading digital contacts, travel information or software updates, and to access to internet.	Any Four- 1/2 mark each 02 Marks
	C	**Differentiate between digital visual display and analog visual display.**	**04**

Ans

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

Any Four Point 01 Mark Each

D **Explain GPS Navigation system used in automobile.** **04**

Ans

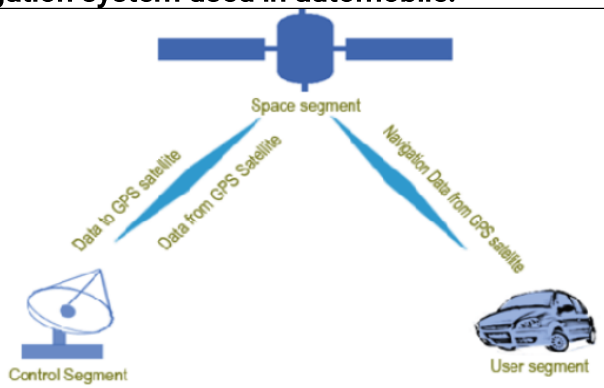


Figure : GPS System **01 Mark**

Global Positioning System (GPS):

The Global Positioning System (GPS) is a space-based navigation system That provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.

GPS systems are made up of 3 segments:-

1. Space Segment (SS) 2. Control Segment (CS) 3. User Segment (US)

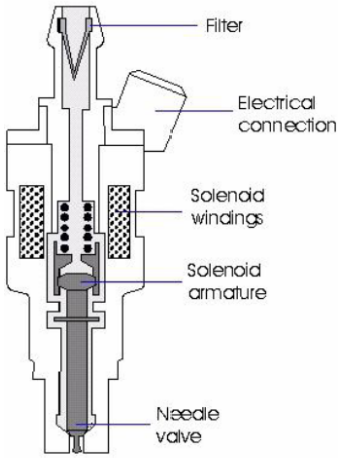
1. Space Segment: GPS satellites fly in circular orbits at an altitude of 20,200km and with a period of 12 hours. Powered by solar cells, the satellites continuously orient themselves to point their solar panels toward the sun and their antenna toward the earth. Orbital planes are centered on the Earth. Each plane has about 55^0 tilt relative to Earth's equator in order to cover the polar regions. Each satellite makes two complete orbits each side real day. Side real-Time it takes for the Earth to turn 360 degrees in its rotation. It passes over the same location on Earth once each day.

2. Control Segment : The CS consists of 3 entities:

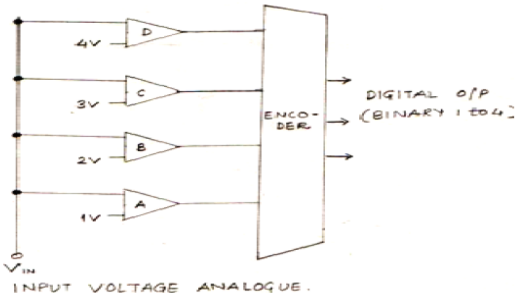
(i) Master Control Station:-The master control station, located at Falcon Air Force Base in Colorado Springs, Colorado, is responsible for overall management of the remote monitoring and transmission sites. **03 Mark**

(ii)Monitor station:- Each of the monitor stations checks the exact altitude, position, speed, and overall health of the orbiting satellites. The control segment uses measurements collected by the monitor stations to predict the behavior of each satellite's orbit and clock. The prediction data is up linked, or transmitted, to the satellites for transmission back to the users.

(iii) Ground Antennas:- Ground antennas monitor and track the satellites. They

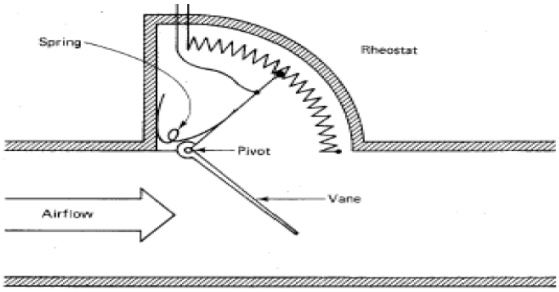
		also transmit correction information to individual satellites. 3. User Segment : The user's GPS receiver is the US of the GPS system. GPS receivers are generally composed of an antenna, tuned to the frequencies transmitted by the satellites, receiver - processors, and a highly – stable clock, commonly a crystal oscillator. They can also include a display for showing location and speed information to the user.	
	E	**Describe working of unit injector actuator.**	**04**
	Ans	**Electronic Fuel Injector (Unit Injector):**  Fig. Electronic Fuel 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.	**Sketch 02 Marks** **&** **Explain 02 Marks**
	F	**Describe the procedure of conversion of signals from analog to digital.**	**04**
	Ans	**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.	**Sketch 02 Marks & Explain 02 Marks**

FLASH TYPE ANALOGUE TO DIGITAL 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

3		**Attempt any FOUR of the following:**	**16**
	A	**Prove that $561_{(10)}$ = $1000110001_{(2)}$ are equivalent by stepwise converting decimal to binary and binary to decimal.**	**04**
	Ans	**Given Data,** **Illustration for Decimal To Binary:** **$561_{(10)}$ = 1000110001** **2 | 561 | 1** **2 | 280 | 0** **2 | 140 | 0** **2 | 70 | 0** **2 | 35 | 1** **2 | 17 | 1** **2 | 8 | 0** **2 | 4 | 0** **2 | 2 | 0** **1 | 1** **Illustration for Binary to Decimal:** **=(1 x 2^0) + (0 x 2^1) + (0 x 2^2) + (0 x 2^3) + (1 x 2^4) + (1 x 2^5) + (0 x 2^6) + (0 x 2^7) + (0 x 2^8) + (1 x 2^9)** **= 1 + 0 + 0 + 0 + 16 + 32 + 0 + 0 + 0 + 512** **=561**	**02 Marks For Decimal to Binary** **&** **02 Marks For Binary to Decimal**
	B	**Differentiate between CAN Bus and LIN Bus communication system.**	**04**
	Ans	**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 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	**Any Four Points 01 Mark Each**

		up to 125KBPS for the low speed CAN (CAN-B) iv. High reliability of data transfer **LIN Bus System:** 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	
	C	**Describe construction and working of any one type of sensor which is used to determine quantity of air entering the engine.**	**04**
	Ans	**Working of Air flow Sensor:**  **Figure: 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.	**Sketch 02 Marks & Explain 02 Marks**
	D	**Explain different types of errors in the measurement.**	**04**
	Ans	**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	**Any Two 02 Mark Each**

		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. 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.	
	E	**Describe diagnosis methods for fuel injector.**	**04**
	Ans	**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. e. When the injector clicking noise is erratic the injector plunger may be sticking. f. 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's 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.	**02 Marks** **02 Marks**
4 (a)		**Attempt any THREE of the following:**	**12**
	I	**Explain use of LED in automotive display.**	**04**
	Ans	**Light Emitting Diode (LED):** A light emitting diode (LED) is similar in operation to the diode, except the LED emits light when it is forward biased. It has a small lens built into it so light can be seen when current flows through the diode. When the LED is forward biased, the holes and electrons combine and current is allowed to flow through it. The energy is generated is released in the form of light. Normally LED requires 1.5 to 2.2 volts to light.	**02 Marks**

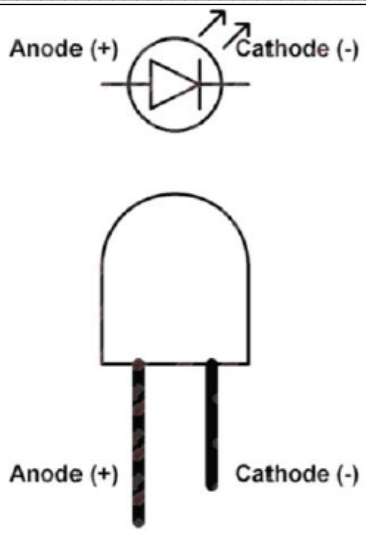


Figure: Symbol and Sketch of LED

Uses of LED :-

i. It is used in head lamps and tail lamps system of vehicles.
ii. It is used in light control panel.
iii. It is used in interior light system of the car.
iv. It is used in indicator lights of a car.

Any Two 01 mark each

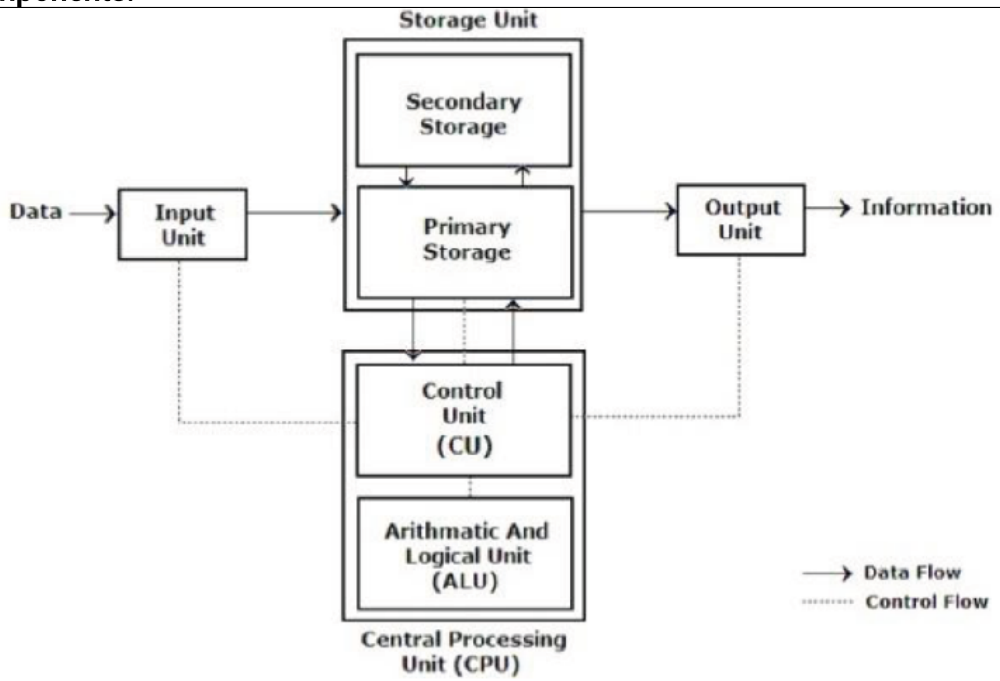
	ii	**Draw block diagram of automotive computer. State the function of any four components.**	**04**
	Ans		**Sketch 02 Marks**

Figure: Block Diagram of Automotive Computer.

OR

&

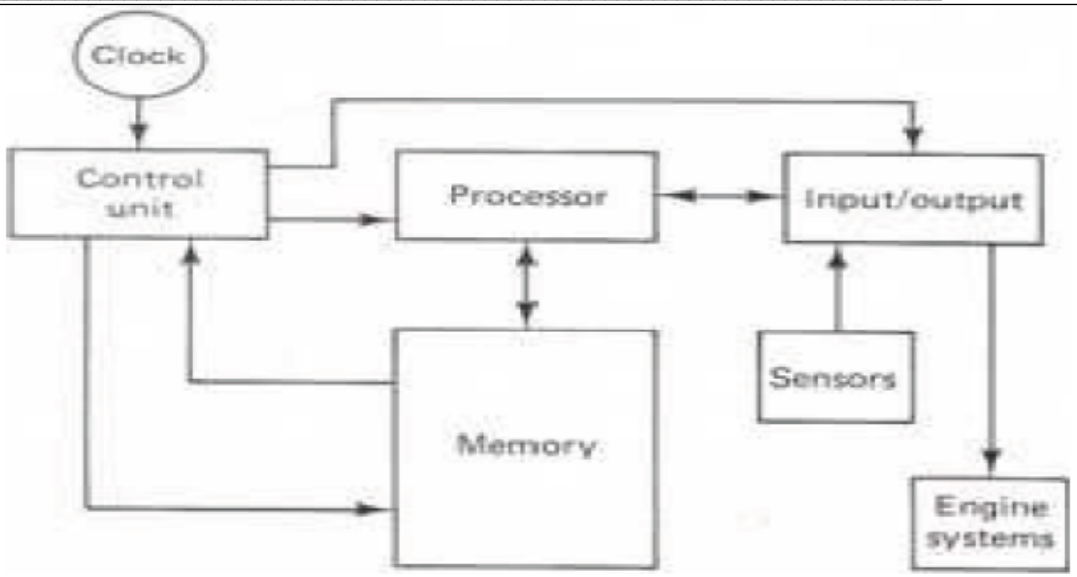
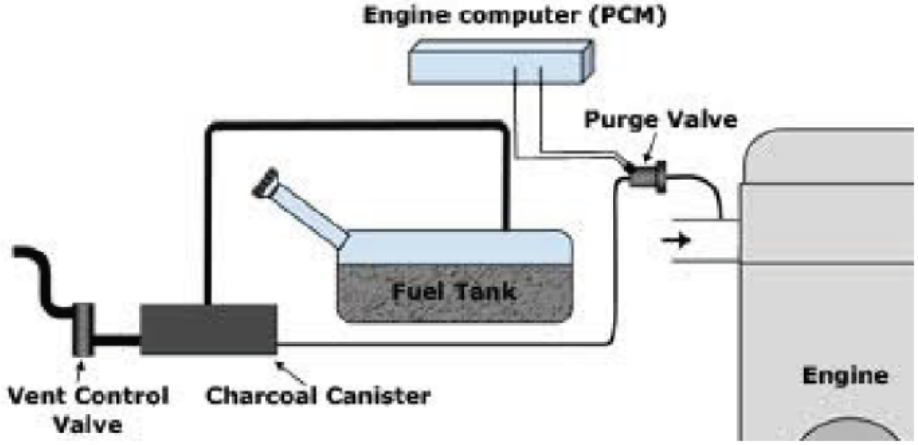
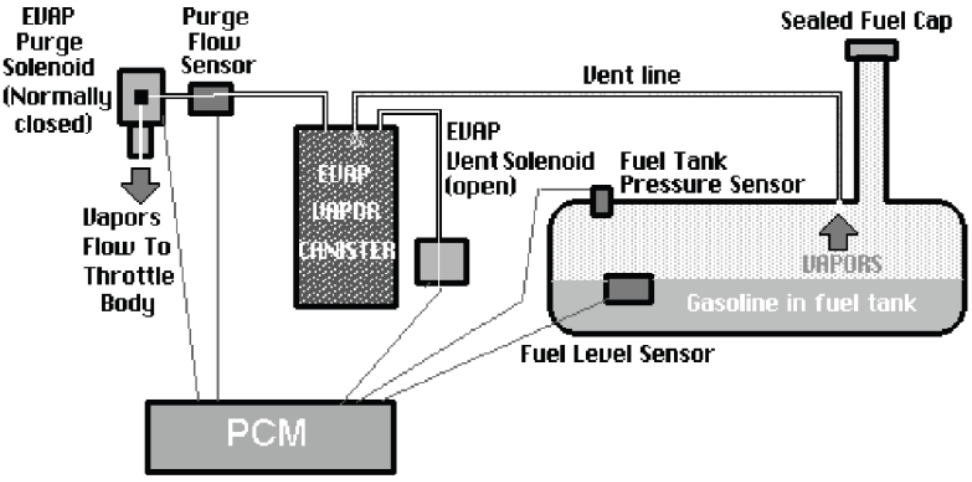
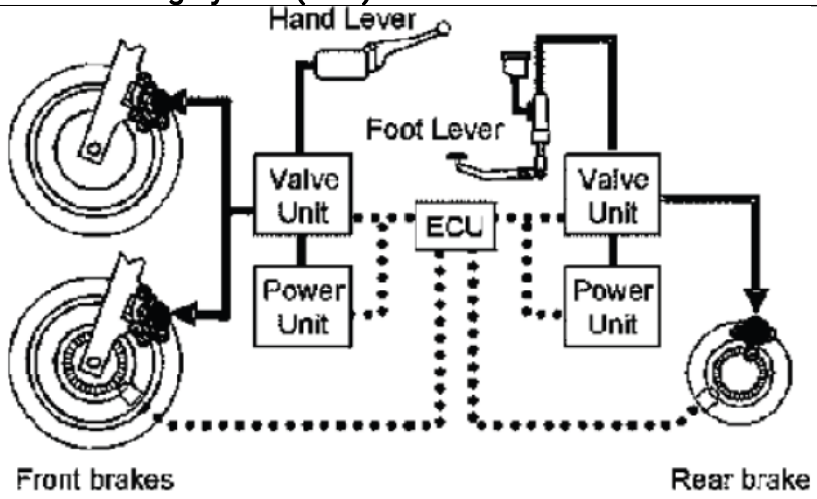


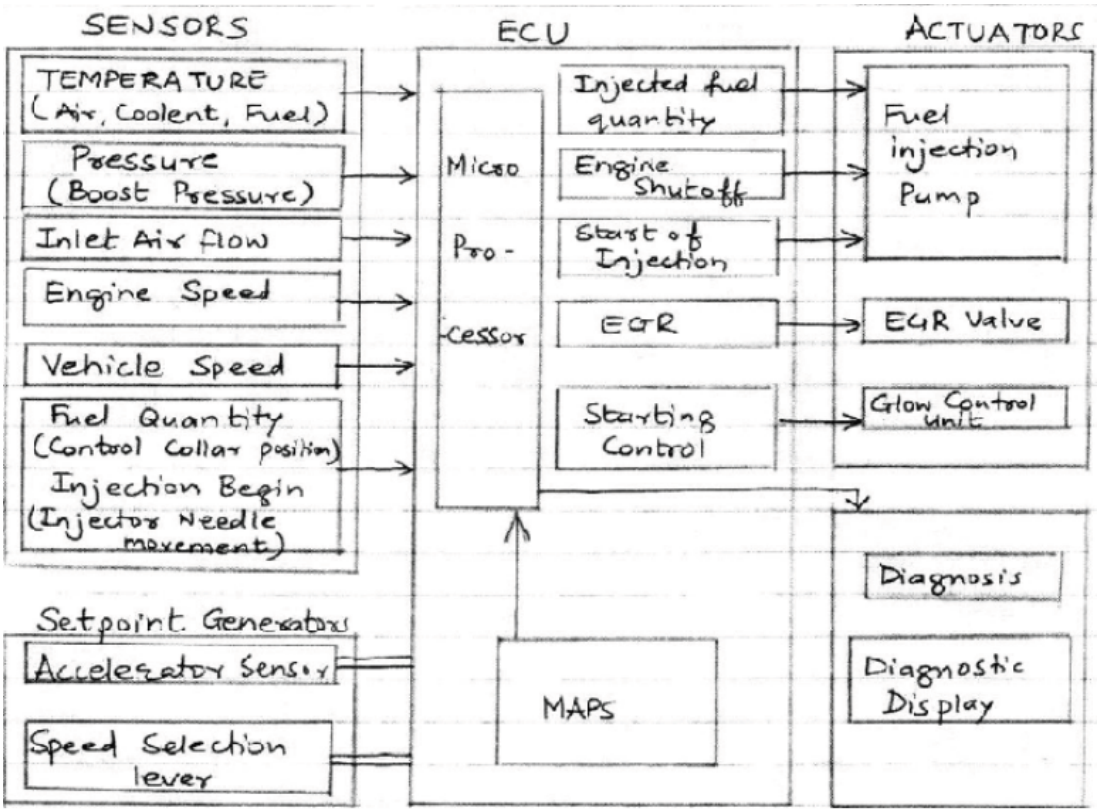
Figure: Block Diagram of Automotive Computer.

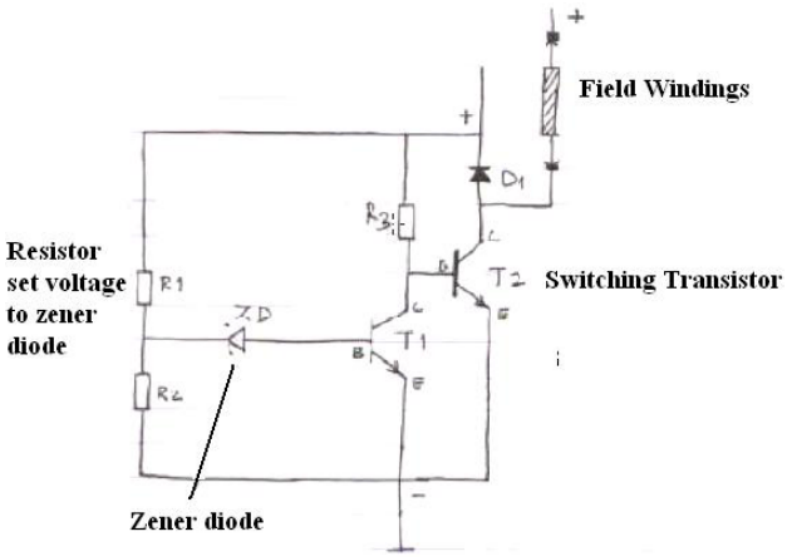
Function of any Four ½ Mark Each

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 informs 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 in formation 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.
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

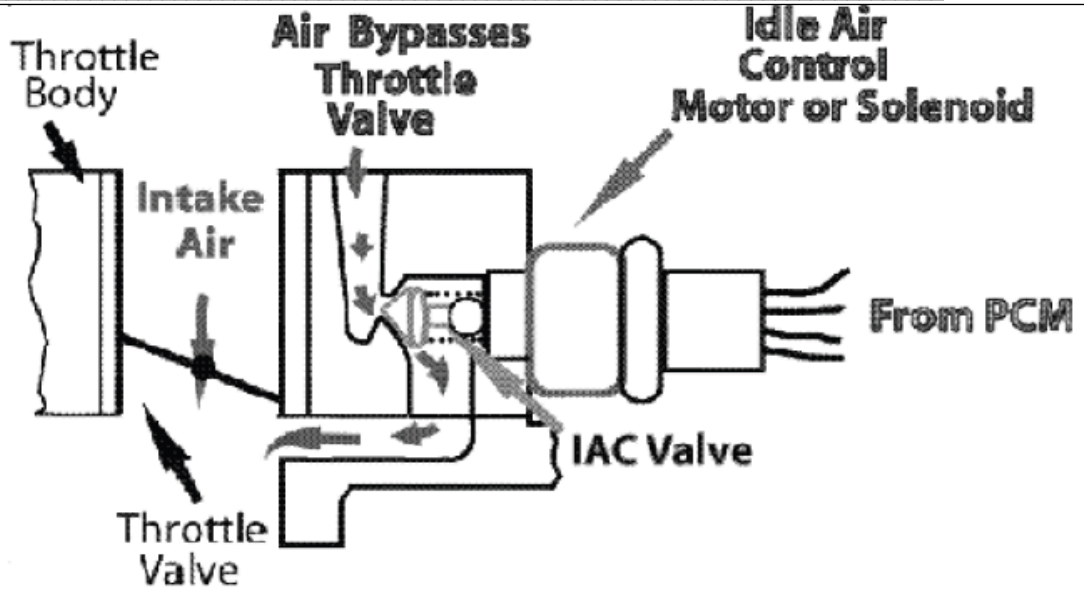
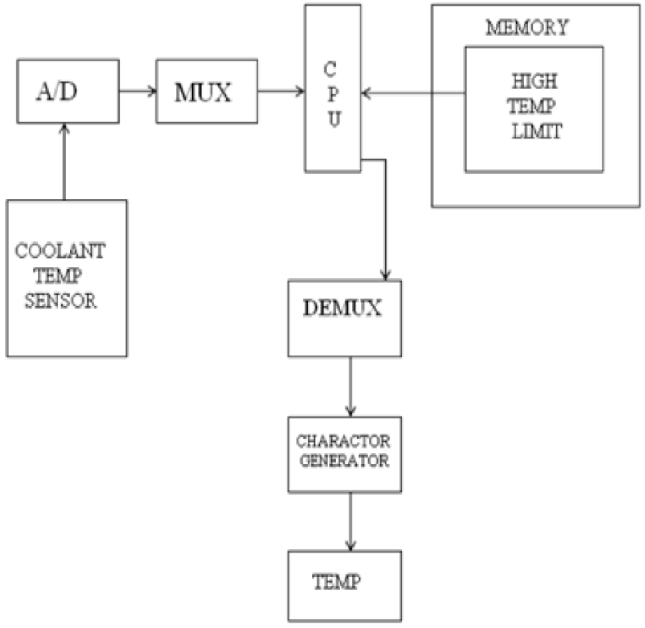
		controlling the operations of other units of a computer system. 5. **Arithmetic and Logic Unit(ALU):**The arithmetic and logic unit (ALU) of a computer system is the place where the actual execution of the instructions takes place during the processing operations. All calculations are performed and all 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).	
	iii	**Describe working of purge control actuator.**	**04**
	Ans	 **Figure : Purge Control Actuator.** **OR**  **Figure : Purge Control Actuator.** 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	**Sketch 02 Marks** **&** **Desc. 02 Marks**

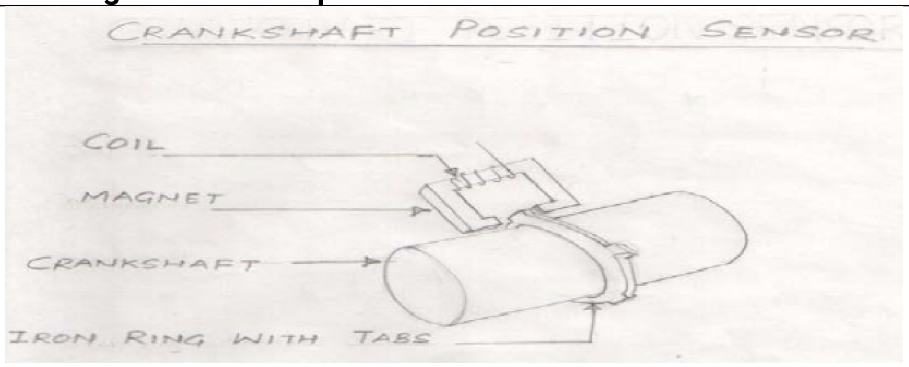
		vapor to be moved from the charcoal canister to be burned in the engine. The purge flow is monitored by a number of sensors. If the purge flow is less or more than is expected under the conditions, the computer illuminates the "Check Engine" light.	
	iv	**Explain Antilock Braking System(ABS)**	**04**
	Ans	 **Figure : ABS System** 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 60mph (96.6kph) 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.	**Sketch 02 Marks** **&** **Expl. 02 Marks**
4 (b)		**Attempt any ONE of the following:**	**06**
	I	**With the help of neat sketch explain electronic control system used in CRDI.**	**06**
	Ans	**Electronic Control System used in CRDI:** 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.  **Figure: Block Diagram of Electronic Control System used in CRDI.**	**Sketch 03 Marks** **&** **Explain 03 Marks**
	ii	**Describe the six step approach for component testing.**	**06**
	Ans	**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. **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.	**Six- ½ mark each** **&**

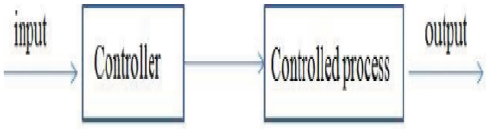
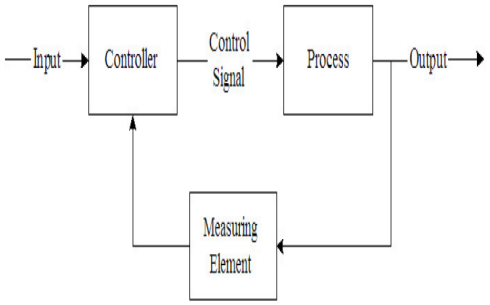
		2. Analyze Evidence-In the case of poor compression on one cylinder, given above as an example, the analysis would take the form of tests to determine the cause of low compression, E.g. burnt valve, blown head gasket etc. The analysis of evidence that is performed will vary according to the system under 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.	**Explanation Any Three 01 mark Each**
5		**Attempt any FOUR of the following:**	**16**
	A	**Explain application of diode as voltage regulator.**	**04**
	Ans	**Voltage regulator of 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	**Sketch 02 Marks** **Desc.**

		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 value 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.	**02 marks**
	B	**State different types of computer memories. Enlist the function of Read Only Memory.**	**04**
	Ans	**Types of Computer Memories:** 1. Read only memory (ROM) 2. PROM: (Programmable Read only Memory) 3. EPROM: Erasable Programmable read only memory 4. EEPROM: Electrically Erasable Programmable read only memory 5. RAM: Random access memory 6. Keep Alive memory(KAM) **Function of Read only memory(ROM):** i. It contains a fixed pattern of 1s and 0s that represent permanent stored information. **ii.** 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. **iii.** ROM memory is not lost when power to the computer is lost	**Any Four 1/2 Mark Each & 02 Marks**
	C	**Describe working of idle speed actuator.**	**04**

	Ans	 **Figure: Idle Speed Actuator.** **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 by pass channel.	**Sketch 02 Marks** **&** **Desc. 02 Marks**
	D	**Draw a neat block diagram, to indicate measurement of temperature in vehicle instrumentation.**	**04**
	Ans	 **Figure: Temperature Measuring Instruments.**	**Neat Labeled Sketch 04 Marks**
	e	**Write diagnosis procedure for Throttle Position Sensor.**	**04**
	Ans	**Testing of Throttle position (TP) sensor:-** Following procedure is followed to diagnose a TP sensor:	**Any four Points**

		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.	**01 Mark Each**
6		**Attempt any FOUR of the following:**	**16**
	a	**Describe diagnosis use of battery tester and lux meter.**	**04**
	Ans	**Battery testers** used for testing the various parameters & conditions of the battery while checking signal for system diagnosis as follows: a. Voltage measurement. b. Resistance measurement. c. CCA value Measurement. d. Battery condition. e. Battery load test etc Uses of **Lux Meter:** 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.	**Any Two Uses of Each 01 Mark Each**
	b	**Explain working of crankshaft position sensor with a neat sketch.**	**04**
	Ans	 **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.	**Sketch 02 Marks & Explain. 02 Marks**

	c	**Compare open loop and close loop control system.**	**04**
	Ans		**Any Four Points 01 Mark Each**

Open Loop Control System	Close Loop Control System
	
Automatic correction in its output, is not possible , it is called an open loop control system.	Automatic correction in its output, is possible, it is called an close loop control system.
There is no automatic correction of the variation in its output, it is called an open loop control system.	This feedback automatically makes the suitable changes in the output due to external disturbance.
Comparing of output (through feedback) with the desired input does not take place on its own	Feedback is taken from output and fed in to input.
Gain is uncontrolled in open loop system	Gain can be controlled in close loop system.
More errors	More Accurate
Output may be oscillatory/ damped	Output is more stable
Less Expensive	More Expensive
Simple in Construction	Complicated in construction.

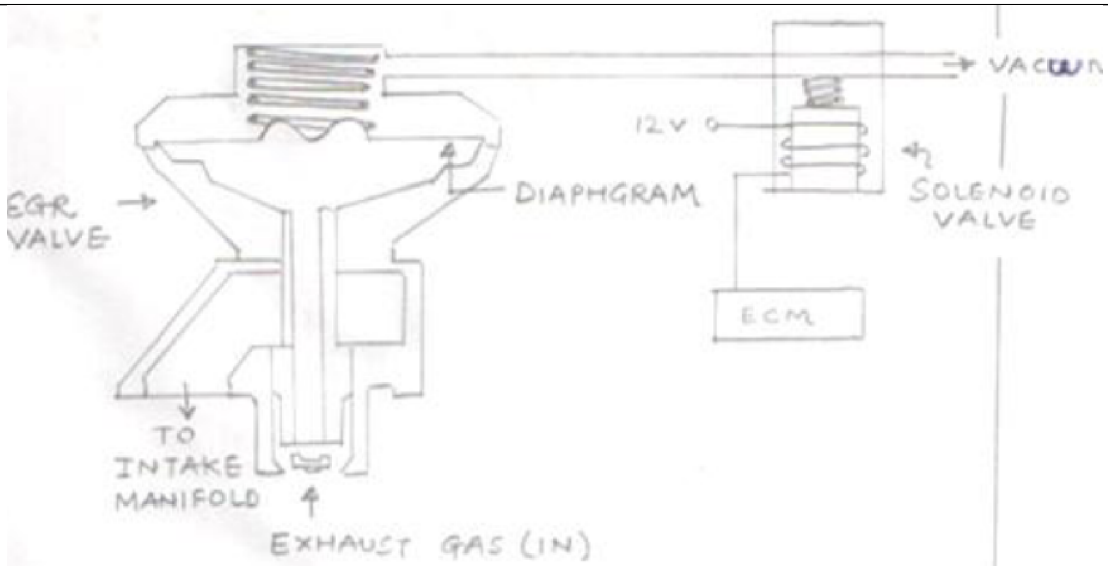
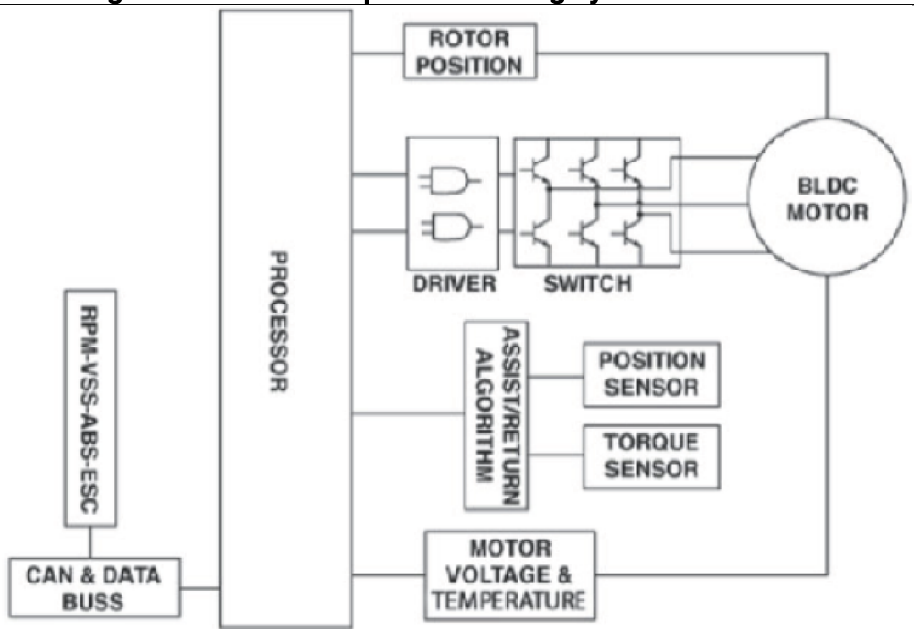
	d	**Describe EGR valve actuator.**	**04**
	Ans		

Figure : EGR Valve Actuator

EXHAUST GAS RECIRCULATION (EGR) CONTROL: The ECM controls a vacuum solenoid valve that is used to open close the vacuum circuit to EGR valve. When solenoid is energized, it shuts off vacuum to EGR valve. When solenoid is de-energized, it allows vacuum to pass through the solenoid to the EGR system.

		The solenoid valve is energized when coolant temperature is below 60°C, at speed below 1200 rpm, under heavy load or at wide open throttle. During all other engine operating i.e. part throttle conditions with coolant temperature above 65°C the ECM de-energizes the solenoid valve and allows the vacuum to open the EGR valve. .	
	e	**Draw block diagram of electronic power steering system.**	**04**
	Ans	 **Figure : Block Diagram of Electronic Power Steering Unit** An Electronic Power Steering (EPS) system's advantage over a hydraulic system is if the engine stalls, you will still have steering assist. This advantage can also be a disadvantage if the system should shut down while the engine is running you lose steering assist. Electronic power steering systems eliminate the need for a pump, hoses and a drive belt connected to the engine using variable amounts of power. The configuration of an EPS system can allow the entire power assist system to be packaged on the rack and pinion steering gear or in the steering column. The system does not drag on the engine from either a power steering pump or alternator because it will not provide assist until required by driver input. Also, there is no hydraulic fluid. The rotor direction is determined by the sequence in which voltage is applied to coil A, B or C and returned to ground through an attached pair. The sequence for clockwise is ABC and for counter-clockwise it is CBA (shown in figure). The primary purpose of the EPS controller is to provide motor control. The processor is the heart of the controller for input and output. Processor output drives the three pairs of transistors that control the rotation of the motor. Primary input to the processor comes from the torque sensor and hand wheel speed and position sensor. The processor also is an integral part of the controlled area network (CAN) and vehicle data buss for chassis and power train communications. This data buss supplies vehicle speed, engine speed, ABS and ESC information. The controller has adaptive memory and diagnostics.	