

**MODEL ANSWER****SUMMER-2018 EXAMINATION****Subject Title: Autotronics**

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.

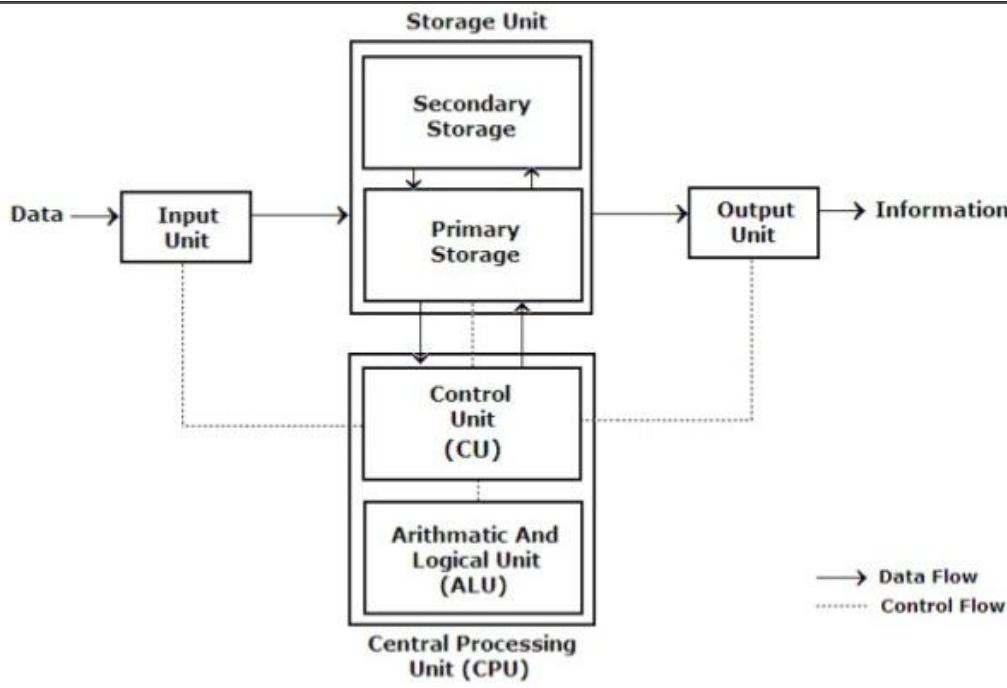
<b>Q. No.</b>	<b>Sub Q. N.</b>	<b>Answer</b>	<b>Markin g Scheme</b>
<b>1</b>	<b>a)</b>	<b>Attempt any THREE.</b>	<b>12</b>
	<b>a)</b>	<b>State the need of electronics in Automobile Engineering.</b>	<b>04</b>
	<b>Ans</b>	<p>Electronic systems have become an increasingly large component of an automobile. Electronic systems used in vehicles, including engine management, ignition, radio, and transmission, climate control, antilock braking, passive safety systems, navigation, and other functions.</p> <p>Electronics also found in trucks, motorcycles, off-road vehicles, and other internal combustion-powered machinery such as forklifts, tractors, and excavators.</p> <p>Related elements for control of relevant electrical systems are found on hybrid vehicles and electric cars as well.</p> <p>Hence electronic is needed in automobile to control various controls and systems.</p>	
	<b>b)</b>	<b>Draw neat block diagram of basic computer and describe it.</b>	<b>04</b>
	<b>Ans</b>	(Note: Block diagram- 02 marks, Explanation of any four components- 02marks)	<b>02</b>

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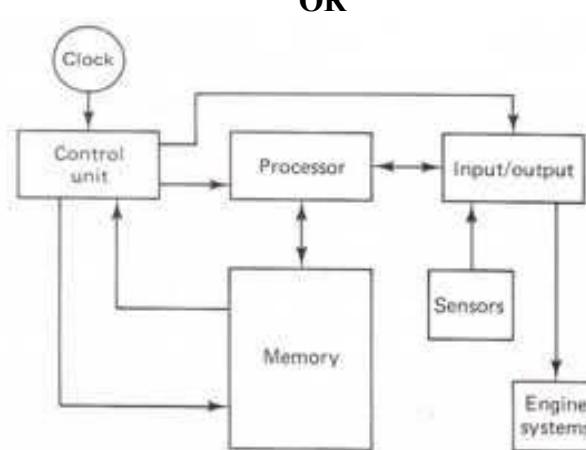
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02



Block diagram of a basic computer.

**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

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	<p>supplied the converted results to the outside world.</p> <p><b>3. Storage Unit:</b> 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.</p> <p><b>4. Central Processing Unit:</b> 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.</p> <p><b>5. Arithmetic and Logic Unit (ALU):</b> 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).</p>	
c)	<b>Explain the working of crank shaft position sensor with a neat sketch.</b>	<b>04</b>
Ans	<p>(Note: construction &amp; working - 3 marks and sketch-1 marks)</p> <p><b>Construction and working of crankshaft position sensor:</b> The principle elements of the sensor are:</p> <ol style="list-style-type: none"><li>1. An iron rotor with lobes on it</li><li>2. A permanent magnet</li><li>3. A metallic path ( the pole piece) for carrying the magnetic flux</li><li>4. A coil, wound around the metallic path, in which a voltage is induced.</li></ol> <p>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.</p>	<b>03</b>  <b>01</b>

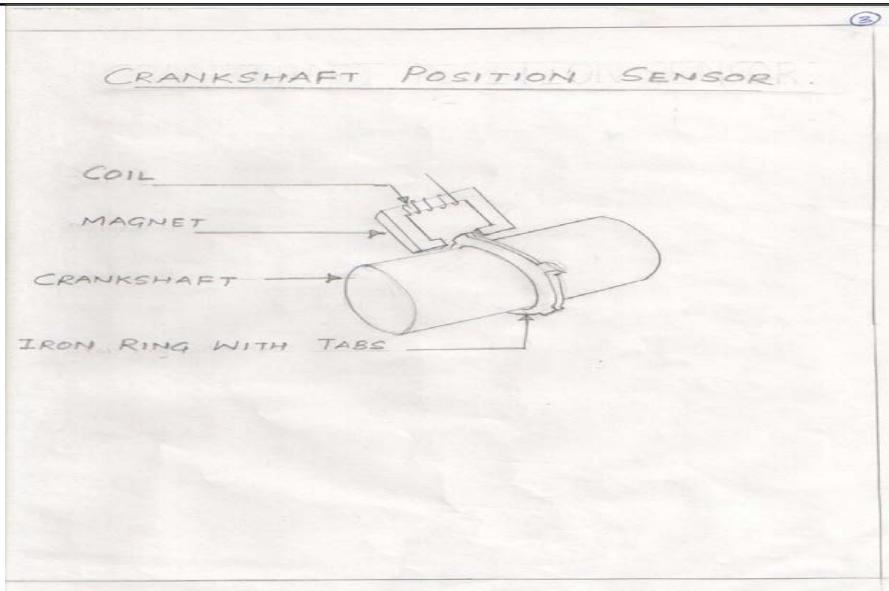


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d)	Explain electronic control system used in CRDI system.	04	
Ans	<p>(Description 2 marks block diagram 2 marks)</p> <p><b>Electronic control system used in CRDI</b></p> <p>In a CRDI system, the microprocessor works with input from multiple sensors. 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.</p>	02	02

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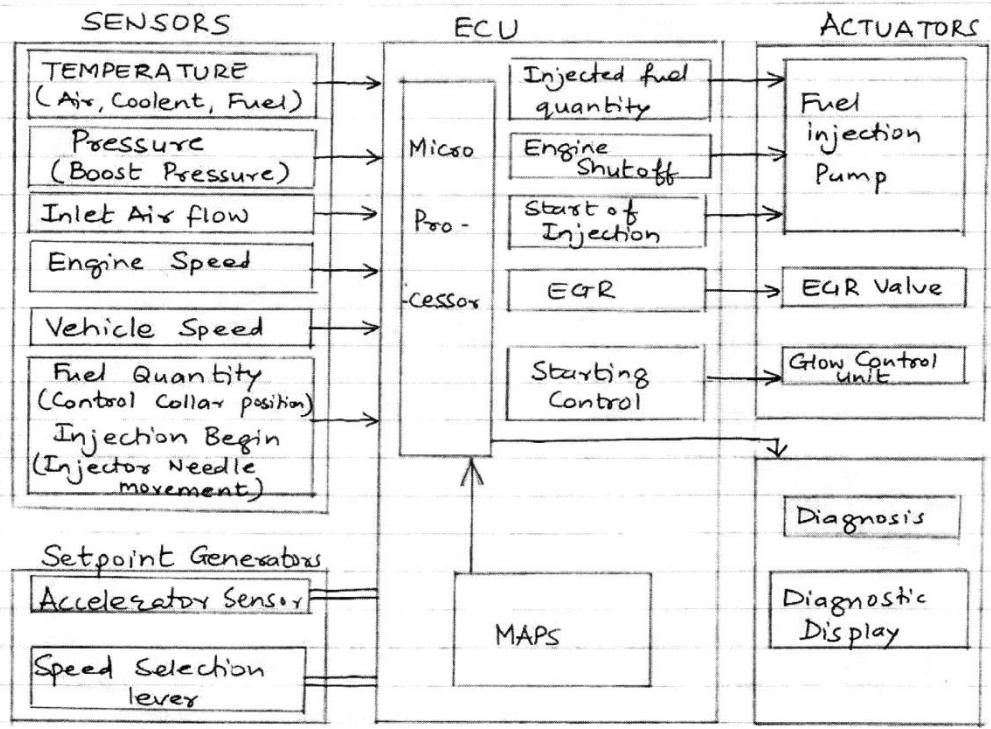
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\* EDC (ELECTRONIC DIESEL CONTROL UNIT) :-  
(BLOCK DIAG)



b) Attempt any ONE of the following.

6

a) Draw a neat block diagram and explain open loop control system.

6

**Ans** (Note: Explanation -4 mark, Equivalent diagram -2 mark)



02

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

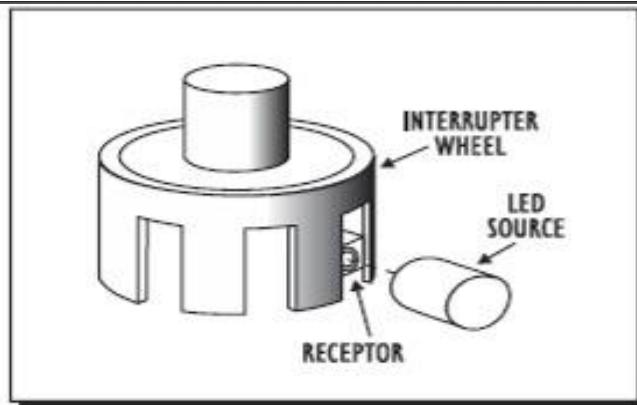
04

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	<p>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.</p>	
<b>b)</b>	<b>Describe construction and working of fuel pump.</b>	<b>06</b>
<b>Ans</b>	<p>(Note: sketchg-2 marks, working -4 marks, marks should be given to Equivalent diagram and working)</p> <p><b>Fuel Pump.</b></p> <p>This diagram illustrates a roller cell fuel pump. It shows a cylindrical motor armature at the top. Below it, a series of horizontal rollers are arranged within a housing. A green arrow points into the pump from the left, representing fuel entering through a filter. Another green arrow points out from the right, representing the high-pressure fuel output. A blue line labeled 'Non return valve' indicates a valve mechanism that prevents fuel from flowing back into the pump. A blue line labeled 'Pressure limiter' points to a small valve or relief valve component within the pump assembly.</p> <p>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 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.</p>	<b>02</b>
<b>2</b>	<b>Attempt any FOUR of the following.</b>	<b>16</b>
<b>a)</b>	<b>Explain with sketch the use of photodiode and LED in ignition system.</b>	<b>04</b>
<b>Ans</b>	<p>(Note: Operation 2 marks and figure 2 marks)</p>	

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**Operation:** An optical triggering mechanism consist of a light emitting diode (LED) and light sensitive photo transistor (photocell) and also a slotted disc called a light beam interrupter . The slotted disc is attached to the distributor shaft. The LED and photocell are situated over and under the slotted disc opposite of each other. As the slotted disc rotates between the LED and the photocell, light from LED shines through the slots. The intermittent flashes of the LED are translated into voltage pulses by the photocell. Where the voltage signal occurs, the control unit turns ON the primary circuit. When the disc interrupts the light and the voltage signal is not given the control system turns the primary circuit OFF causing the magnetic field in the primary coil to collapse and sending a high voltage current to spark plug through secondary winding.

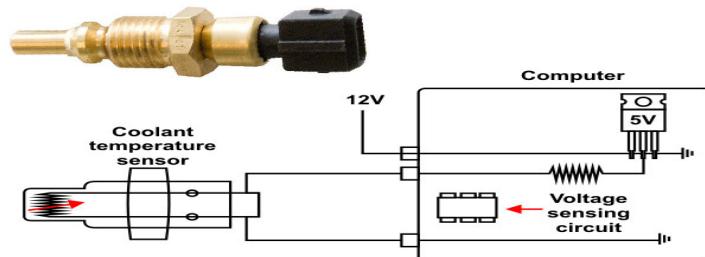
**b)** Differentiate between ROM and EPROM. (any four points)**04****Ans** Any four – 1 mark for each

Sr. No	ROM	EPROM
1	Read Only Memory	Erasable Programmable Read Only Memory
2	The ROM module has been programmed at manufacture stage and cannot be changed.	EPROM (ROM) is a special kind of ROM that has a small window that when exposed to UV rays, can be erased and reprogrammed.
3	ROM can not be changed by buyer as per codes of his choice.	The EPROM is programmed by the buyer with code of their choice.
4	Used for fixed programs such as computer operating system & programs for dedicated microprocessor application.	Used in Automobile ECU.
5	Storage capacity is less	Storage capacity is higher

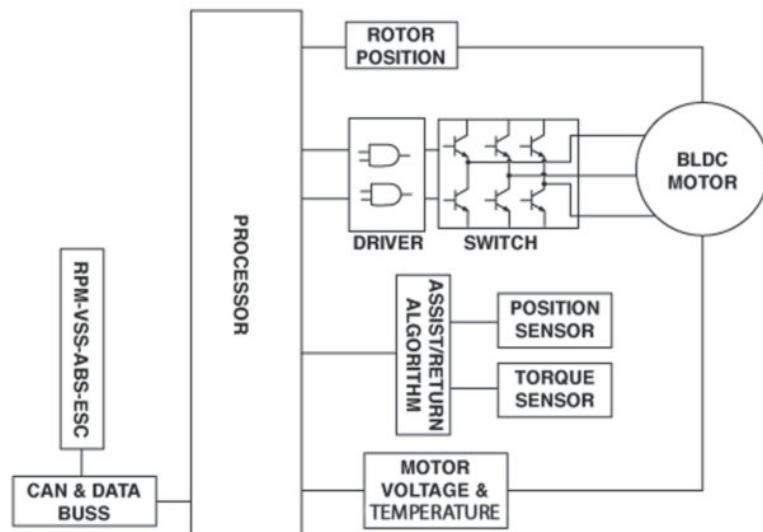
**c)** **Describe the use of temperature sensors in automobile.****04****Ans** (*Note- sketch 2 marks and working 2 marks.*)

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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.

**d) Explain the concept of electronic power steering****04****Ans** **Answer: (Note: equivalent sketch -2 marks and explanation - 2 marks )****02**

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

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	<p>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.</p> <p>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.</p> <p>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 counterclockwise it is CBA (<b>shown in figure</b>).</p> <p>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 powertrain communications. This data buss supplies vehicle speed, engine speed, ABS and ESC information. The controller has adaptive memory and diagnostics.</p>	<b>02</b>
e)	<b>Explain control of ABS system in vehicle.</b>	<b>04</b>
Ans	<p>(Note: Figure 2 marks and explanation 2 marks)</p> <p>The diagram illustrates the control of an Anti-lock Braking System (ABS). It shows two wheels, labeled 'Front brakes' and 'Rear brake'. Each wheel is connected to a 'Valve Unit', which is further connected to a 'Power Unit'. Both the Valve Units and Power Units are connected to a central Electronic Control Unit (ECU). The ECU is also connected to a 'Hand Lever' and a 'Foot Lever', which likely provide input for the system. Arrows indicate the flow of control signals from the ECU through the valve units and power units to the individual wheel brakes.</p> <p><b>Working:</b> There are four main components to an ABS system:</p> <ol style="list-style-type: none"><li><b>Speed Sensors:</b> 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.</li><li><b>Valves:</b> There is a valve in the brake line of each brake controlled by the ABS. On some systems, the valve has three positions.</li><li><b>Pump:</b> 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.</li><li><b>Controller:</b> The controller is a computer in the car. It watches the speed sensors and controls the valves. The controller monitors the</li></ol>	04

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		<p>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</p>	
	f)	<b>Describe use of battery testers while checking signal for system diagnosis.</b>	<b>04</b>
	Ans	<b>Battery testers used for testing the various parameters &amp; conditions of the battery while checking signal for system diagnosis as follows:</b> a. Voltage measurement. b. Resistance measurement. c. CCA value Measurement. d. Battery condition. e. Battery load test etc	<b>04</b>
3.		<b>Attempt any FOUR of the following.</b>	<b>16</b>
	a)	<b>Explain binary number system with the help of suitable example.</b>	<b>04</b>
	Ans	<b>Answer : ( Description 3 marks and example 1 marks)</b> Most modern computer systems operate on the binary logic. A binary number system use only two digits namely 0 and 1. It uses a base 2 system. The binary digits (0 and 1) are also called as bits. Thus the binary system is a two bit system. The left most bit in a given binary number with the highest weight is called as the most significant bit (MSB) whereas the rightmost bit in a given number with the lowest weight is called as the least significant bit (LSB). It is represented as (0, 1) In the binary system, whole numbers are grouped from right to left. Because the system uses only two digits. The first portion must equal a 1 or a 0. To write the value of 2, the second position must be used. In binary, the value of 2 would be represented by 10 (one two and zero ones). To continue, a 3 would be represented by 11 (one two and one one). Figure illustrates the conversion of binary numbers to digital base ten numbers. For example, if a thermistor is sensing 150 degrees, the binary code would be 10010110. If the temperature increases to 151 degrees, the binary code changes to 10010111	<b>03</b>  <b>01</b>

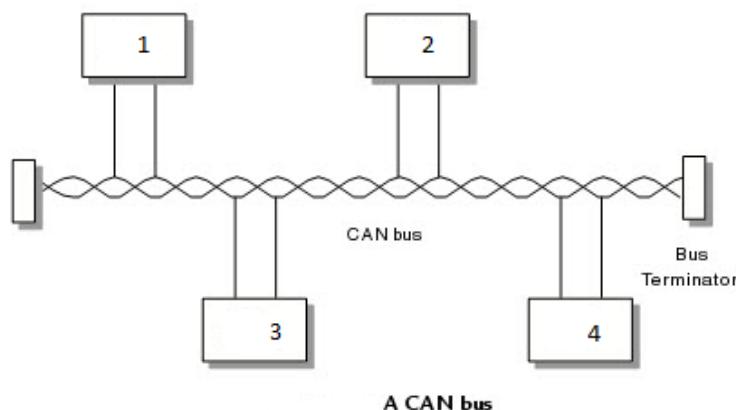
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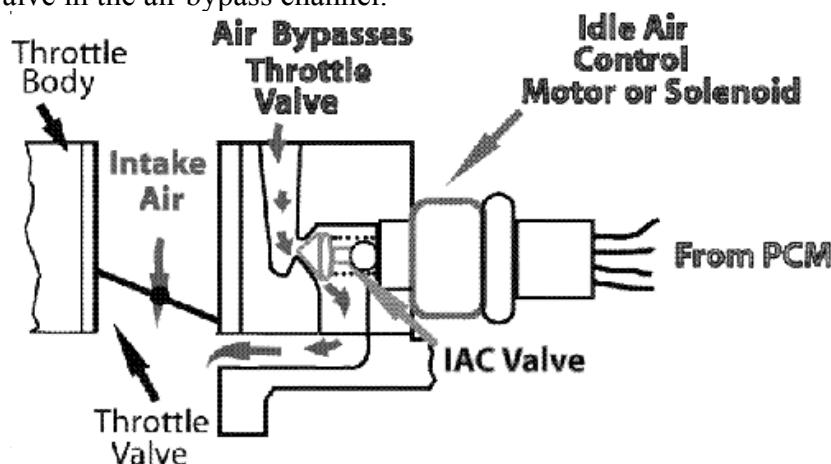
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Decimal number	Binary number code 8 4 2 1	Binary to decimal conversion
0	0000	= 0 + 0 = 0
1	0001	= 0 + 1 = 1
2	0010	= 2 + 0 = 2
3	0011	= 2 + 1 = 3
4	0100	= 4 + 0 = 4
5	0101	= 4 + 1 = 5
6	0110	= 4 + 2 = 6
7	0111	= 4 + 2 + 1 = 7
8	1000	= 8 + 0 = 8

b)	<b>Draw and explain CAN bus system used in automobiles and explain in brief.</b>	<b>04</b>
Ans	<p><i>(Note: Description of CAN Bus system 02 marks &amp; Block diagram – 02 marks)</i></p> <p><b>CAN bus system:</b> 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.</p> <p>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:</p> <ol style="list-style-type: none"><li>Priority controlled message transmission.</li><li>Low costs through the use of a low cost twisted two wire cable and use of simple protocol with low power demand.</li><li>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)</li><li>High reliability of data transfer</li></ol> <p><b>Block Diagram of CAN Bus System:</b> A typical example of the CAN bus system used in Rover vehicle is described below. A Two wire CAN bus that can operate at high data transmission speeds of up to 500k band (500000bits/sec) is shown in the below figure.</p> <ol style="list-style-type: none"><li>Automatic transmission control unit</li><li>Engine control module</li><li>ABS/ Traction control ECU</li><li>Instrument Pack.</li></ol>	<b>02</b>

**MODEL ANSWER****SUMMER-2018 EXAMINATION****Subject Title: Autotronics****Subject Code:****17619****c) Describe construction and working of idle speed actuator****04****Ans***(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 signals the IAC motor to extend or retract the idle air control valve in the air bypass channel.

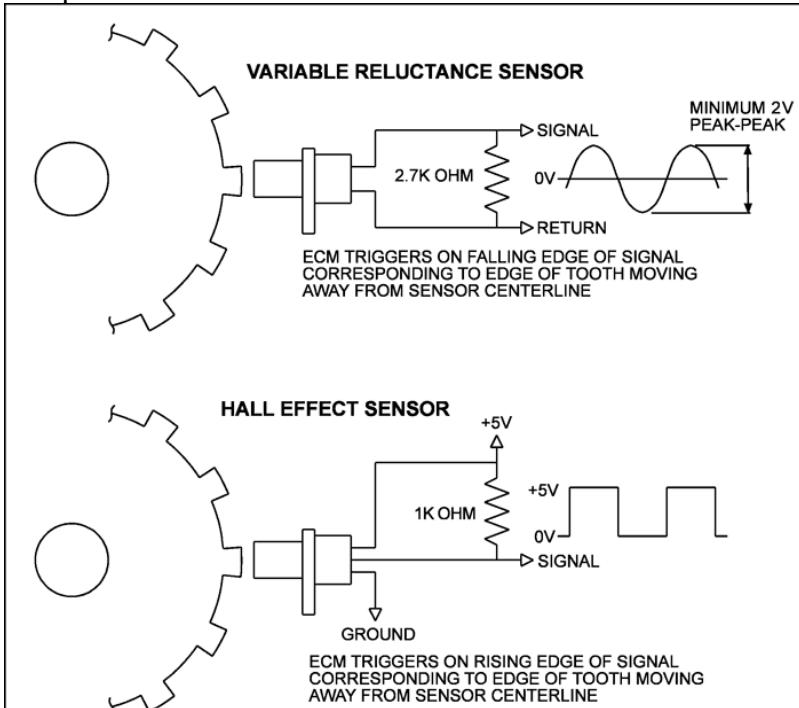
**Fig : Idle Speed Actuator****02****02****d) State types of error and error compensation.****04****Ans***(Note- Any Two Types of errors - 02 marks, error compensation-2marks)***Types of error:- (Any Two)**

1) Gross error

**02**

2) Systematic error

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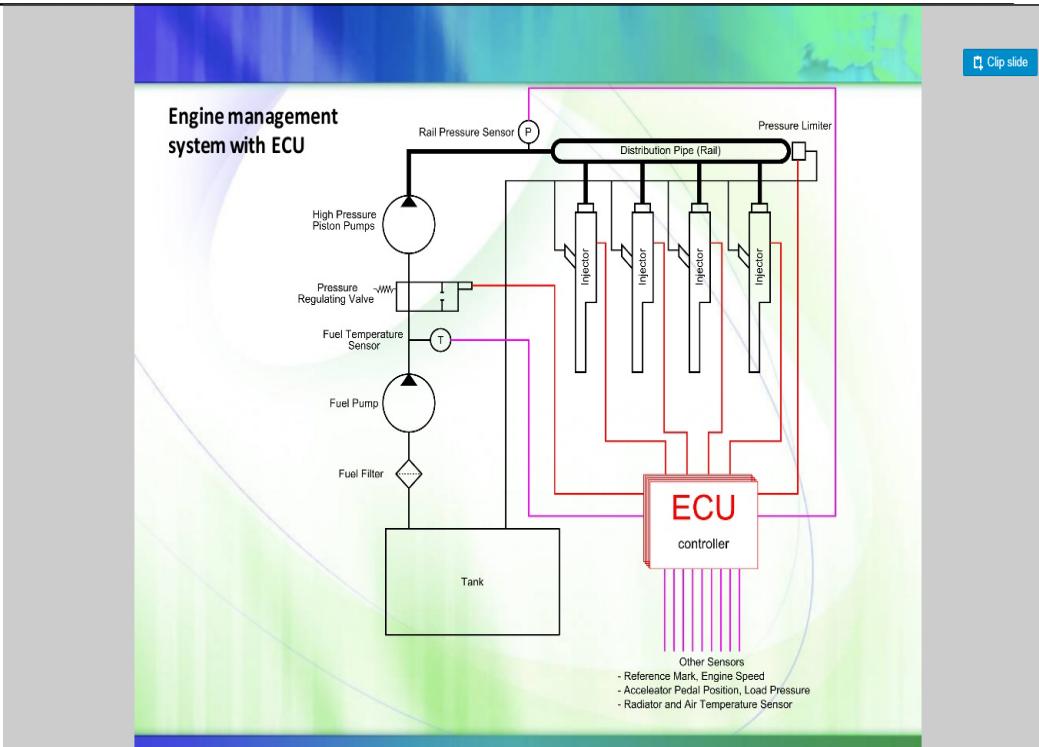
		3) Random error  <b>Error Compensation:</b> error in computation or in recording of accounting data ,that is neutralized (counter balanced ) by an equal and opposite error .since compensating errors do not show up in the total , they are difficult to locate through statistical methods	<b>02</b>
	e)	<b>Describe use of oscilloscope while checking signals.</b>	<b>04</b>
	<b>Ans</b>	<b>Checking the speed sensor output signal using oscilloscope:</b> Connect an oscilloscope to the two output wires. While taking a scope readings spin the tyre (at least once per second) and look for a uniform sine wave. Typical VR and Hall Effect sensor waveforms are shown below. The VR sensor generates a sine wave signal with amplitude proportional to RPM. It does not require an external power source. Minimum signal requirement to trigger the ECM is 1 volt peak-peak with a 2.7K Ohm load on the sensor output. Hall Effect sensors always require an external power supply and pull-up resistor. Hall Effect sensors are capable of zero-speed sensing and the signal output is a square wave with amplitude independent of RPM. 	<b>04</b>
4.	a)	<b>Attempt any THREE of the following.</b>	<b>12</b>
	a)	<b>Explain the need of conversion of analog to digital and digital to analog in automobiles.</b>	<b>04</b>
	<b>Ans</b>	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).	<b>02</b>

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	<p>Conversion from an analog voltage to a digital code can be done in a number of ways.</p> <p>The computer or ECU of an automobile will have two interface circuits: input and output. The digital ECU cannot accept analog signals from the sensors and requires an input interface to convert the analog signal to digital. The analog to digital (A/D) converter continually scans the analog input signals at regular intervals. For example, if the A/D convertor assigns a numeric value to signal at 5V the A/D converter assigns a numeric value to this specific voltage. The A/D converter then changes this numeric value to binary code.</p> <p>Actuator needs the analog signal for its operation hence signal sent by ECU needs to be converted from digital to analog using D/A convertor.</p>	02
b)	<b>Explain working of oxygen sensor with a neat sketch</b>	04
Ans	<p><i>(Note:figure-2 mark and Working-2 mark)</i></p> <p><b>Working of Oxygen sensor:</b> 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 act as 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</p>	02
	<p>Figure: oxygen sensor</p>	02
c)	<b>Explain how control is operated in GDI system.</b>	04
Ans		

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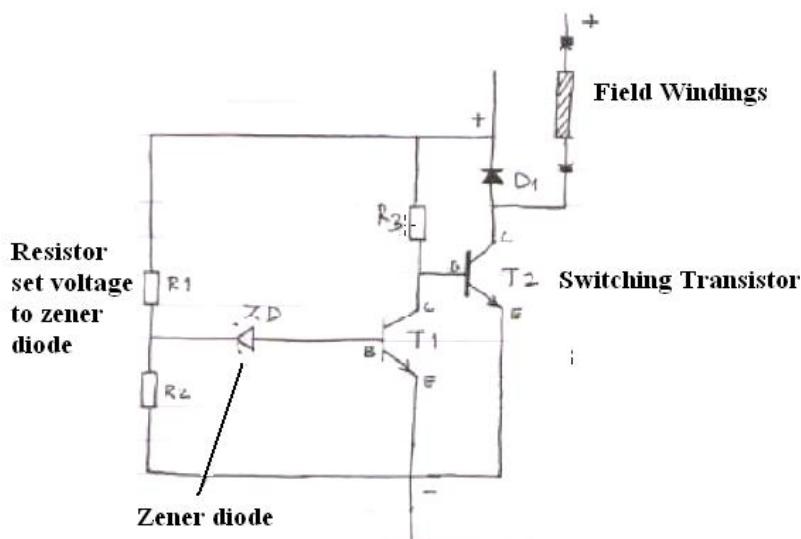
GDI is Ideal for implementation of Turbocharger- fuel injection is operated by ECU. Turbocharger comprises of TURBINE COUPLED COMPRESSOR. Downsizing can be easily achieved by TC, without compromising with Power output. Engine ECU. The engine ECU is designed to have total control of the actuators. Run the engine under optimal conditions based on various sensor signals transmitted under the ever- changing driving conditions of a vehicle Integrated with an injector driver unit. This can be managed by engine management system by ECU.

	<b>d)</b> <b>Describe the procedure of diagnosing MPFI system</b>	<b>04</b>
	<b>Ans</b> Following procedure shall be followed for diagnosing MPFI system: <ol style="list-style-type: none"><li>1) Connect the Bosch KTS 180 scanner with the pin connector of ECM.</li><li>2) Start diagnostic procedure as per recommended procedure.</li><li>3) Check the actual value of sensor for desired voltage resistance.</li><li>4) Go in the error memory to check for errors or the DTCs.</li><li>5) The SAE J 2012 standards are used for finding a particular DTC (diagnostic Trouble Codes).</li></ol>	
4	<b>b)</b> <b>Attempt any <u>ONE</u> of the following.</b>	<b>06</b>
	<b>a)</b> <b>Explain the use of power diode in alternator charging system.</b>	<b>06</b>

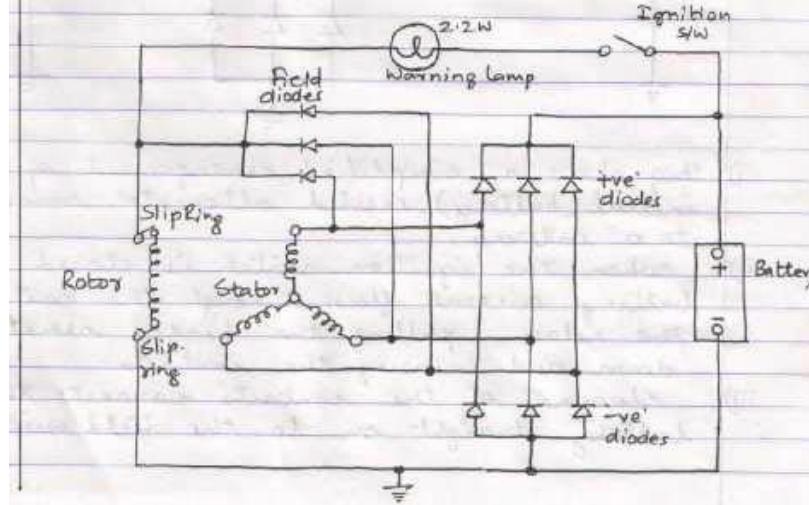
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**Power Diode:** The power semiconductor diode, known simply as the Power Diode, has a much larger PN junction area compared to its smaller signal diode cousin, resulting in a high forward current capability of up to several hundred amps (KA) and a 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 provided by the modern electronic regulator. The regulator maintains 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. Figure shows a simplified diagram of electronic voltage regulator. This regulator operates as follows:- 1. When the alternator first increases its speed the output will be below the prescribed 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.



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 si

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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 from the stator is used to excite the field windings with the help of power diodes.

**b)****Explain six step approach for component testing.****06****Ans****Answer Description each step - 1 mark)****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:- (each 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

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a good basic knowledge of the make-up of the system is invaluable.

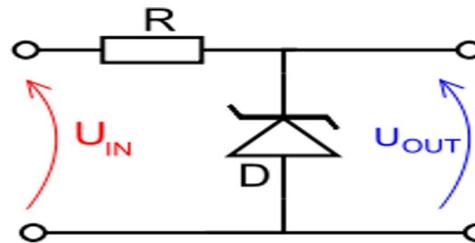
**4. Find the cause of the fault and remedy it-** With electronic system repair it is often the case that a replacement unit must be fitted. However, this may not be the end of the matter. If the unit has failed because of some fault external to it, it is important that this cause of failure is found and remedied before fitting the new unit. It is often not just a matter of fitting a new unit.

**5. Give the system a thorough test** -Testing after repair is an important aspect of vehicle work and especially so where electronically controlled systems are concerned. In the case of intermittent faults, such testing's may need to be extended because the fault may only occur when the engine is hot and the vehicle is being used in a particular way.

**6. Test the system to verify that repair is correct-** It is mandatory to test the system so that it will verify that the steps followed during the testing are correct. However we can come across any fault then we have to follow the stepwise procedure of testing.

**5**      **Attempt any FOUR of the following:**

- a) Explain the working of semiconductor diode as voltage regulator in charging system. **04**

**Ans****Zener Diode Circuit****Zener Diode Voltage Regulator**

Use of semiconductor diode in voltage regulation: To prevent the vehicle battery from being overcharged the regulated system voltage should be kept below the gassing voltage of the lead-acid battery. Accurate voltage control is vital with the ever-increasing use of electronic systems. Voltage regulation is a difficult task on a vehicle alternator because of the constantly changing engine speed and loads on the alternator. The output of an alternator without regulation would rise linearly in proportion with engine speed. Zener diode is used as the sensing element in an electronic regulator. A Zener diode is designed to operate in the break-down region. At the point that Zener voltage is reached, a large current flows in reverse bias. This prevents voltage from climbing any higher. This makes the Zener diode an excellent component for regulating voltage. If the Zener diode is rated at 15 volts, it will not conduct in the reverse direction when the voltage is below 15 volts. At 15 volts it will conduct and the voltage will not increase over 15 volts. If a semi-conductor diode is reverse-biased it will not conduct current. However, if the reverse voltage is increased, a voltage level will be reached at which the diode will conduct in the reverse direction. This voltage is called Zener voltage. Reverse current can destroy a simple PN-type diode, but the diode can be dropped with

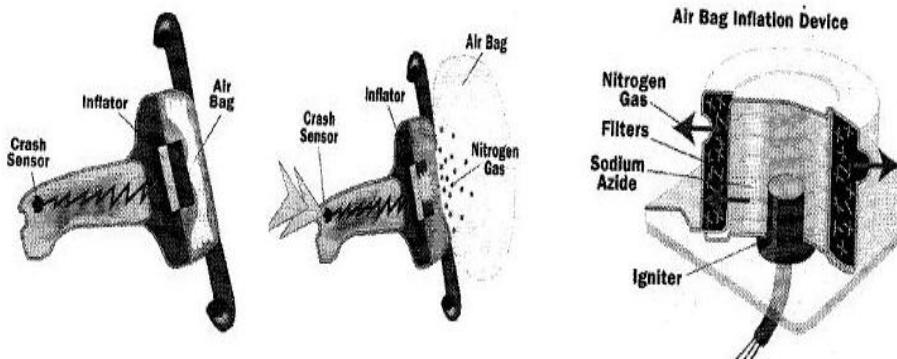
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	materials that will withstand reverse current.	
<b>b)</b>	<b>Give examples of volatile memory and explain any one.</b>	<b>04</b>
Ans	<p>There are two kinds of volatile RAM: dynamic and static. Even though both types need continuous electrical current to retain data, there are some important differences between them.</p> <p><b>Dynamic RAM (DRAM)</b> is very popular due to its cost effectiveness. DRAM stores each bit of information in a different capacitor within the integrated circuit. DRAM chips need just one single capacitor and one transistor to store each bit of information. This makes it space efficient and inexpensive.<sup>[2]</sup></p> <p>The main advantage of static RAM (SRAM) is that it is much faster than dynamic RAM. Its disadvantage is its high price. SRAM does not need continuous electrical refreshes, but it still requires constant current to sustain the difference in voltage. In general, SRAM needs less power than DRAM, even though the power requirements differ based on the computer's clock speed. At moderate speeds SRAM usually requires just a fraction of the power used by DRAM. When idle, the power requirements of static RAM are low. Every single bit in a static RAM chip needs a cell of six transistors, whereas dynamic RAM requires only one capacitor and one transistor. As a result, SRAM is unable to accomplish the storage capabilities of the DRAM family. SRAM is most commonly used in networking devices, like switches, routers, cable modems, etc., for buffering the transmitted information.</p>	
<b>c)</b>	<b>Describe construction and working of EGR valve.</b>	<b>04</b>
Ans	<p>(Note: Explanation -2 mark, Equivalent diagram -2 mark)</p> <p><b>EGR valve (closed position)</b></p> <p>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,</p>	

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	<p>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.</p>	
<b>d)</b>	<b>State the need and working of air bags as safety system.</b>	<b>04</b>
Ans	<p><i>(Note: Working -2mark &amp; Equivalent Sketch – 2 mark)</i></p> <p>Working of Air bags: The goal of an air bag is to slow the passenger's forward motion as evenly as possible in a fraction of a second.</p> <p>There are three parts to an airbag that help to accomplish this feat:-</p> <ol style="list-style-type: none"><li>1. The bag itself is made of a thin nylon fabric, which is folded into the steering wheel or dash board or, more recently the seat or door.</li><li>2. The sensor is the device that tells the bag to inflate. Inflation happens when there is collision force equal to running into a brick wall at 10 to 15 miles per hour (16 to 24 Km per hour). A mechanical switch is flipped when there is a mass shift that closes an electrical contact, telling the sensor that a crash has occurred. The sensors receive information from an accelerometer built into a microchip.</li><li>3. The airbag's inflation system reacts sodium azide (<math>\text{NaN}_3</math>) with potassium nitrate (<math>\text{KNO}_3</math>) to produce nitrogen gas. Hot blasts of the nitrogen inflate the airbag.</li></ol>  <p>Fig. Air Bag</p>	
<b>e)</b>	<b>Explain GPS with the help of block diagram.</b>	<b>04</b>
Ans	<p><i>Answer:(Note: Explanation-2 marks and diagram 2 marks Credit should be given to Equivalent sketch)</i></p> <p><b>Global positioning system (GPS):</b> 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:-</p> <ul style="list-style-type: none"><li>• Space Segment (SS)</li><li>• Control Segment (CS)</li><li>• User Segment (US)</li></ul>	

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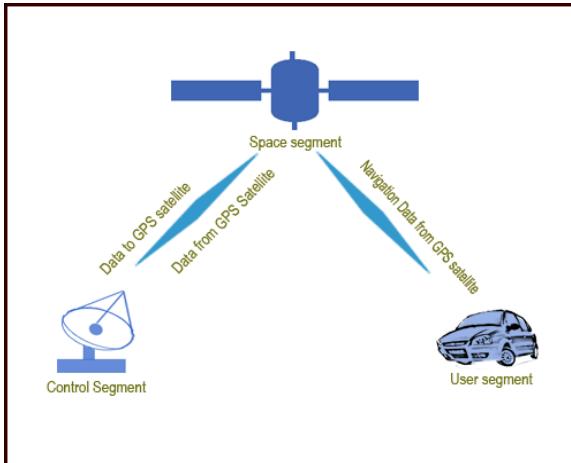
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**17619****1. Space Segment:**

GPS satellites fly in circular orbits at an altitude of 20,200 km 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° tilt relative to Earth's equator in order to cover the polar regions. Each satellite makes two complete orbits each sidereal day. Sidereal - 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.
- 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.**Fig. Global Positioning System****f)****State the uses of lux meter and frequency meter****04**

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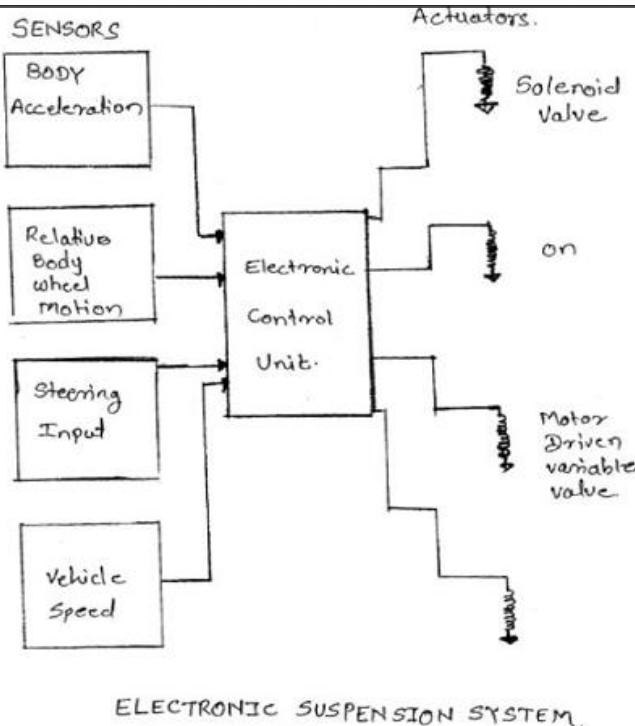
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	<b>Ans</b>	Following are the uses of : <b>1. Lux meter:</b> a) It is used for measuring the intensity of light of the system. a) It is used in photography and video filming, b) Check intensity of headlights in the automatic ON/OFF headlight system. <b>2. Frequency meter: - (Any Two – 1 Mark each)</b> a) To check sensors such as throttle position, b) crankshaft position, cam-shaft position etc. c) To check radio frequency in cars, d) Electronic suspension system (to check vibrations of dampers)																	
6		Attempt any FOUR of the following:																	
	<b>a)</b>	<b>Distinguish between digital visual display and analog visual display</b>	<b>04</b>																
	<b>Ans</b>	(Any 4 points- 1 mark each) <table border="1"><thead><tr><th>Digital visual display</th><th>Analog visual display</th></tr></thead><tbody><tr><td>A digital signal is a physical signal that is a representation of a sequence of discrete values.</td><td>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.</td></tr><tr><td>The reading is precise.</td><td>The reading is not precise.</td></tr><tr><td>Recording of the reading is easy</td><td>Recording of the reading is not easy.</td></tr><tr><td>No convex/errors are present.</td><td>Convex errors may be present</td></tr><tr><td>Extension of the reading is possible</td><td>Extension of the reading is not possible.</td></tr><tr><td>Complex in design.</td><td>Simple in design</td></tr><tr><td>High cost</td><td>Low cost</td></tr></tbody></table>	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	
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	<b>b)</b>	<b>Describe the use of Bluetooth and GSM communication in automobile</b>	<b>04</b>																
	<b>Ans</b>	<b>Bluetooth:</b> Bluetooth is designed to support personal area network (PAN) to replace wired cable between nearby devices. Bluetooth is 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 mobile phones and allows a mobile 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. <b>GSM network-</b> GSM is a mobile communication modem; it 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																	

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	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	
c)	Describe the working of an air flow sensor	04
Ans	<p><b>Working of Air flow Sensor:</b></p> <p>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.</p>	
d)	<p><b>Explain working of electronic suspension system in vehicle</b></p> <p><b>(Note: Description with equivalent sketch- 04 marks)</b></p> <p><b>Electronic control of suspension:</b> 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 does this by computing weighted average of spectrum of the acceleration the relative body or wheel motion can be used to estimate tire force.</p>	04

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e)	<b>Explain onboard diagnosis of CRDI system.</b>	<b>04</b>
Ans	<p><b>Answer:</b> <i>(Note: Credit should be given to equivalent procedure – 4 mark)</i></p> <p><b>On board diagnosis procedure for CRDI system:</b> The On Board Diagnosis procedure can be carried out with the help of a diagnostic tool. There are a variety of tools used for diagnosis of a vehicle. We shall list out the procedure carried out with the help of a BOSCH KTS 180 SCANNER or equivalent tool. <b>The following procedural steps are carried out:</b></p> <ol style="list-style-type: none"><li>1. Connect the tool with the output of the ECM with the help of a data link connector.</li><li>2. Select the vehicle to diagnose from the menu list of the tool.</li><li>3. After that the tool is going to ask the operator to select the group i.e. Engine control, ABS, HVAC, or Central electronics system etc.</li><li>4. Suppose engine control group is selected the tool is now going to identify the code of the ECM used in the vehicle.</li><li>5. After identifying the ECM code the tool is going to ask for conducting the diagnosis of sensors and actuators.</li><li>6. While checking the sensors if there is any DTC present the tool is going to display the code on the screen.</li><li>7. Actuator tests can also be performed by the tool to check if the actuators are operating properly.</li></ol>	04