WINTER– 2017 EXAMINATION

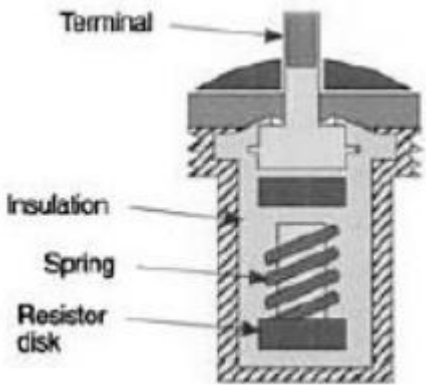
Subject Name:AEE **Model Answer** Subject Code: 17617

Important Instructions to examiners:

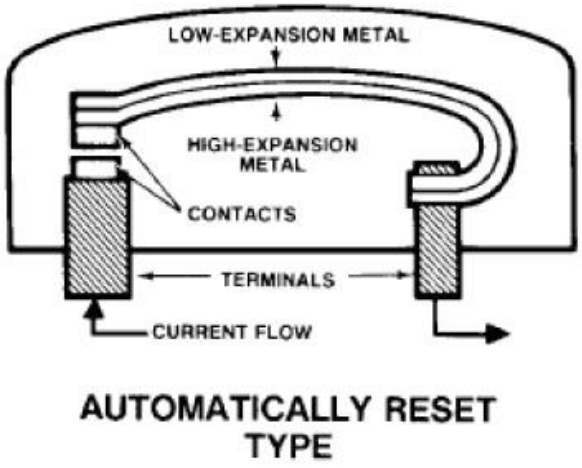
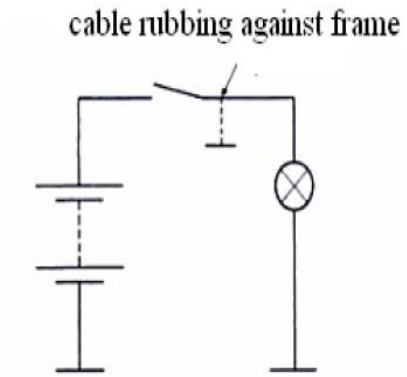
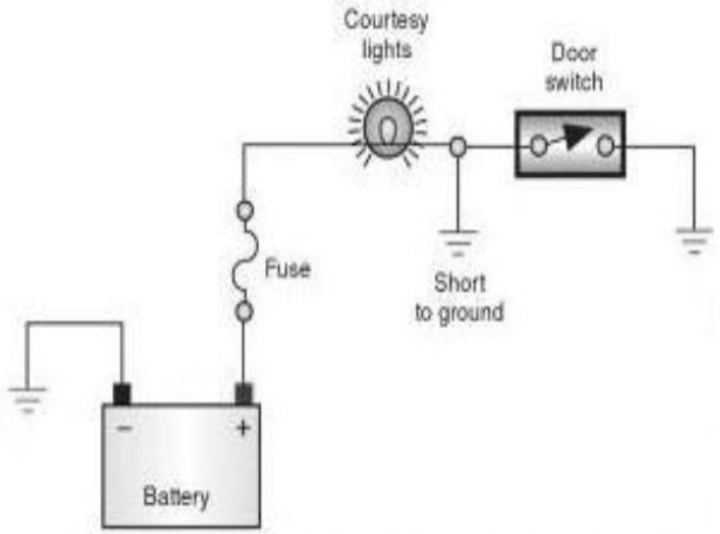
1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given moreImportance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in thefigure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constantvalues 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.

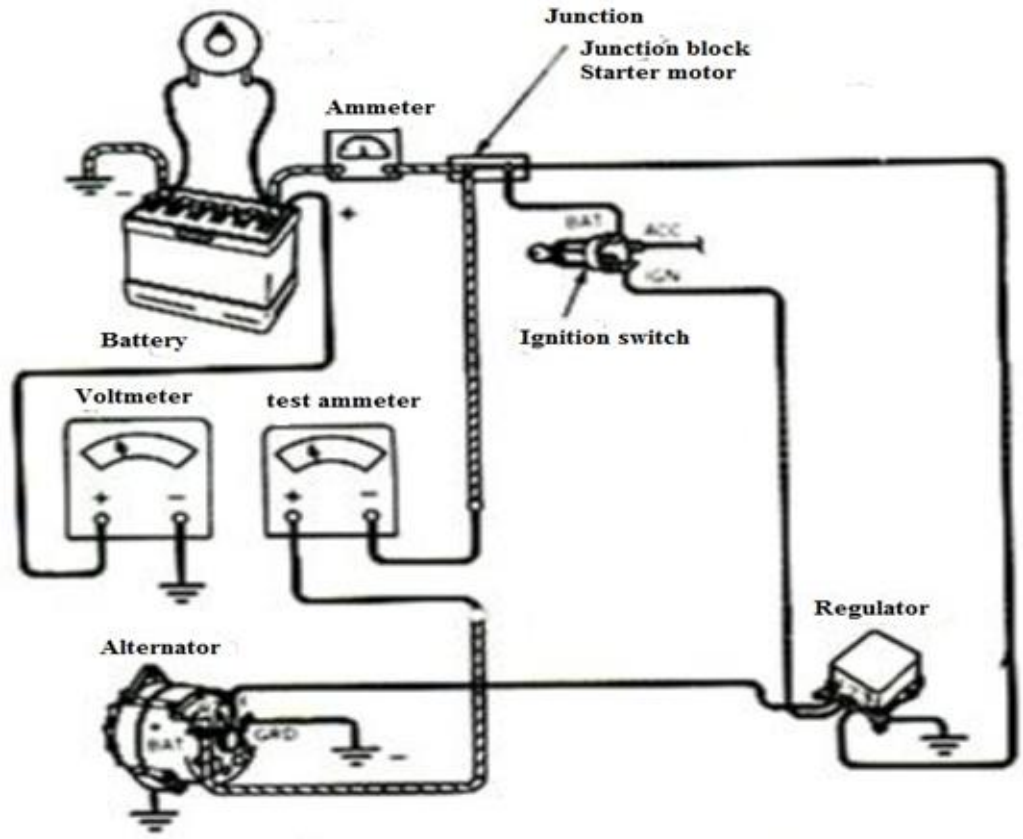
Q. No.	Sub Q. N.	Answer	Marking Scheme
1	A)	**Attempt any THREE of the following:**	12
	i	**Enlist the function of following electric components.** **1) Relay** **2) Switch** **3) Solenoid** **4) buzzers**	4
		Answer: *(each components:- 1 marks)* **1) Relay:** 1) Function of relay is to control a load circuit with the use of small current carryingcontrol circuit. 2) It saves the size of wiring connected to the switch/es and reduces weight. **2) Switch:** 1. Function of switch is to control circuits 2. To open and close the circuits 3. In starter mode, the switch provides current to solenoid and the starter motor gets supply **3) Solenoid :** 1) Purpose of a solenoid is to control a larger current carrying circuit with use of small current carrying circuit. 2) It converts electrical energy into mechanical movement of core. **4) Buzzer :** A buzzer, or sound generator, is sometimes used to warn the driver of possible safety hazards by emitting an audio signal (such as when the seat belt is not buckled)	4

	ii	**Explain the concept of hybrid battery.**	**4**
		Answer:- A hybrid battery is a battery used to power the propulsion of battery electric vehicles (BEVs). Vehicle batteries are usually a secondary (rechargeable) battery. Traction batteries are used in forklifts, electric Golf carts, riding floor scrubbers, electric motorcycles, full-size electric cars, trucks, vans, and other electric vehicles. Hybrid batteries differ from starting, lighting, and ignition (SLI) batteries because they are designed to give power over sustained periods of time. Deep-cycle batteries are used instead of SLI batteries for these applications. Traction batteries must be designed with a high ampere-hour capacity. Batteries for electric vehicles are characterized by their relatively high power-to-weight ratio, energy-to-weight ratio and energy density; smaller, lighter batteries reduce the weight of the vehicle and improve its performance. Compared to liquid fuels, most current battery technologies have much lower specific energy, and this often impacts the maximal all-electric range of the vehicles. However, metal-air batteries have high specific energy because the cathode is provided by the surrounding oxygen in the air. Rechargeable batteries used in electric vehicles include lead–acid ("flooded", deep-cycle, and VRLA), NiCd, nickel–metal hydride, lithium-ion, Li-ion polymer, and, less commonly, zinc–air and molten-salt batteries. The amount of electricity (i.e. electric charge) stored in batteries is measured in ampere hours or in coulombs, with the total energy often measured in watt hours. The battery makes up a substantial cost of BEVs, which unlike for fossil-fueled cars, profoundly manifests itself as a price of range. In the case of the MiEV 2012 model, the price tag and advertised range is close to proportional between two versions with a different battery	**4**
	iii	**Enlist types and function of starter drive.**	**4**
		Answer:*(Types : 2 marks , functions:- 2 marks)* **Types of Starter Drives**: *(any four)* 1) Bendix drive 2) Folo-thru drive 3) Barrel type drive 4) Gear reduction drive 5) Overrunning clutch 6) Dyer drive 7) Friction clutch drive **Function of starter drives** *:(Any two)* • To transmit the turning force to the engine when the starting motor runs and to disconnect the starting motor from the engine immediately after the engine has started and to provide a gear reduction ratio between the starting motor and the engine. • When the engine starts and is running under its own power, the ring gear attempts to drive the pinion gear faster than the starter motor. Thus to protects the starter motor from getting driven by the started engine, vehicle need starter drive. It is necessary to avoid damage of starter motor while engine is running, hence drives are used. • It ensures the starter motor engagement while cranking, and immediate disengagement upon engine starting. This prevents the engine from driving and damaging the starter.	**02** **02**

	iv	**Explain the need of ignition system.**	**4**
		Answer:The needs of ignition system are as follows:*(any four- 1mark each)* 1. It should provide sufficiently strong spark between the electrodes of the plugs at correct timing. 2. It should function efficiently over the entire range of engine speed. 3. It should be light, effective and reliable in service. 4. It should be compact and easy to maintain. 5. Sufficiently large voltage across the spark plug electrodes to affect the spark discharge even in lean mixtures. 6. Supply energy required to ignite the combustible mixture across air gap. 7. It should be capable to advance or retard ignition timing as per engine load and speed. 8. Effective to trigger the primary circuit at appropriate time with respect to crankshaft position.	**4**
	B)	**Attempt any <u>ONE</u> of the following.**	**6**
	i	**Draw a neat labelled sketch of temperature gauge and explain its construction and working.**	**6**
		Answer:*(construction &working – 4 marks & sketch – 2 marks) Credit should be given to equivalentsketch.* **Coolant Temperature gauge**: This gauge indicates engine coolant temperature. It should normally indicate between C(Cold) and H (hot). The sending unit is typically a variable resistor such as a thermistor. It regulates the current flow through the temperature gauge winding. With low coolant temperature, sender resistance is high and current low is low. The needle points to C. As coolant temperature increases, sender resistance decreases and current flow increases. The needle moves toward H. The temperature gauge on a digital panel is of the bar type with a set number of segments.The number of illuminated bars varies according to the current from the gauge sender. With low coolant temperature, sender resistance is high and few segments are turned on. Ascoolant temperature increases, sender resistance decreases and the number of illuminated segments increases.  	**04** **02**

	ii	**Enlist different method of battery charging .enlist any six precautions to be taken during charging.**	**6**
		Answer:*(four method:- 2 marks and eight precautions:- 4 marks)* **Method of battery charging** 1. Constant current charging 2. Constant voltage charging 3. Trickle charging 4. Random charging 5. Taper current 6. IUI charging	**02**
		Precautions during charging of battery: (any eight) 1. Always follow manufacturer's instructions. 2. Before placing a battery on charge, ensure that the terminals are clean 3. Verify that the electrolyte level is proper in all the cells. If not, add enough distilled water to cover the plates. 4. Remember to wear eye protection and gloves. 5. If battery has vent plugs, the same are removed along with exhaust tube. 6. Connect the charger to the battery, observing proper polarity- the positive charger lead to the positive battery post and the negative charger lead to the negative post. Make sure the connections are tight. 7. Turn the charger on and slowly increase the charging rate until the recommended ampere value is reached. 8. Charging should be done in a well-ventilated area, away from sparks and open flames. 9. During charging, the battery electrolyte temperature should be monitored. If the temperature reaches 54°C, then discontinue charging. Resume charging after allowing the battery to cool to 45°C. 10. The charger should be off before connecting or disconnecting the leads to the battery. When the battery is charged, turn the charger off and disconnect it. 11. Do not add additional electrolyte to the battery, during recharging. If electrolyte level is low, add only distilled water. 12. If there is any evidence of smoke or dense vapour or liquid coming out of the battery, shut off the charger. The battery should be rejected or the charging rate reduced or temporarily halted	**04**
2		**Attempt any <u>FOUR</u> of the following:**	**16**
	a	**Describe operation of automatic resetting type circuit breaker.**	**4**
		Answer:*(Sketch – 2 Marks & operation -2 Marks)* The automatic resetting type circuit breaker is designed to open when circuit current exceeds a given level. It uses a bimetallic strip that opens if current draw is excessive. **Automatic Resetting type of Circuit breakers**- Automatic resetting type of circuit breaker uses a thermally sensitive element (bimetal strip) that snaps open the contact points when overheated by excessive amperage. But after a short cooling-down period, the circuit breaker resets itself. The bimetal strip has two metals of different coefficient of expansion. There is nothing to replace. Circuit breakers range from 5 to 50 amperes	**02**

			**02**
	b	**Enlist various circuit defects and explain short to ground.**	**4**
		Answer:*(List: 2 Marks, Description & Sketch: 2)* **Types of circuit defects**. i. Open Circuit ii. Short Circuit iii. Short to ground iv. Resistance in connection (Voltage Drop) **Short to ground:**A grounded circuit exists when defective insulation allows a conductor such as a wire to touch the vehicle frame.  **Fig.** Short circuit OR  *FIGURE* A ground in this location will cause the lamp to remain on.	**02** **02**

	c	**Explain current output test for alternator.**	**4**
		Answer: Current output test: Current output test will determine the maximum output of the AC generator /Alternator **The following test is carried out on a Auto Electric Test Bench or equivalent:** 1. The alternator taken for the test is of 14V 16/35 A. 2. Place the alternator on a secure vice on the test bench. 3. Connect the test pulley on the alternator. 4. Connect the belt of the motor to the test pulley. 5. Start the motor, the alternator will run at 6000 rpm. 6. Turn `ON` the load switch one by one 5A, 20A, 30A, 40A. 7. The alternator will show the maximum current output i.e. >/ 33 Amps at 13.5 V. **OR** Connect a carbon pile across the battery to load the alternator output circuit. Connect a voltmeter between the battery + terminal and ground, Connect an ammeter + lead to the alternator BAT terminal and the - lead to the battery + terminal or to a junction for the alternator output as shown in fig. Turn on the ignition and read the rate of discharge on the ammeter. This is field current and ignition current draw. Then, start and run the engine at specified test speed and adjust the carbon pile for a steady 15 volts of system voltage or for the highest possible current. Read the ammeter and add this reading to the previous one. **Result:** Compare the total current to alternator maximum output specifications. Most manufacturers allow ± 10-percent or ± 10-ampere tolerance on the rated maximum current.  **Figure.Basic output current test connections**	**4**

OR

Bypass the voltage regulator to apply full current to the alternator field. Some carmakers Recommend this method instead of the previous test. If any system fails the first current output test above, you don't know if the cause is in the alternator or the regulator. Bypassing the regulator lets you check unregulated current output and isolate the problem to the alternator or the regulator. Use the same test equipment connections as used for the first current output test. If the regulator is mounted remotely from the alternator, you must bypass it with a jumper wire. If the regulator is a solid-state unit, mounted on or inside the alternator, manufacturers provide different ways to bypass it. With the regulator bypassed and full current to the field, run the engine at the specified speed and adjust the carbon pile for maximum current at a specified voltage (about 15 volts).

Result: Compare the ammeter reading to specifications. If current is out of limits, the alternator is bad. If current is within limits, the regulator may be bad.

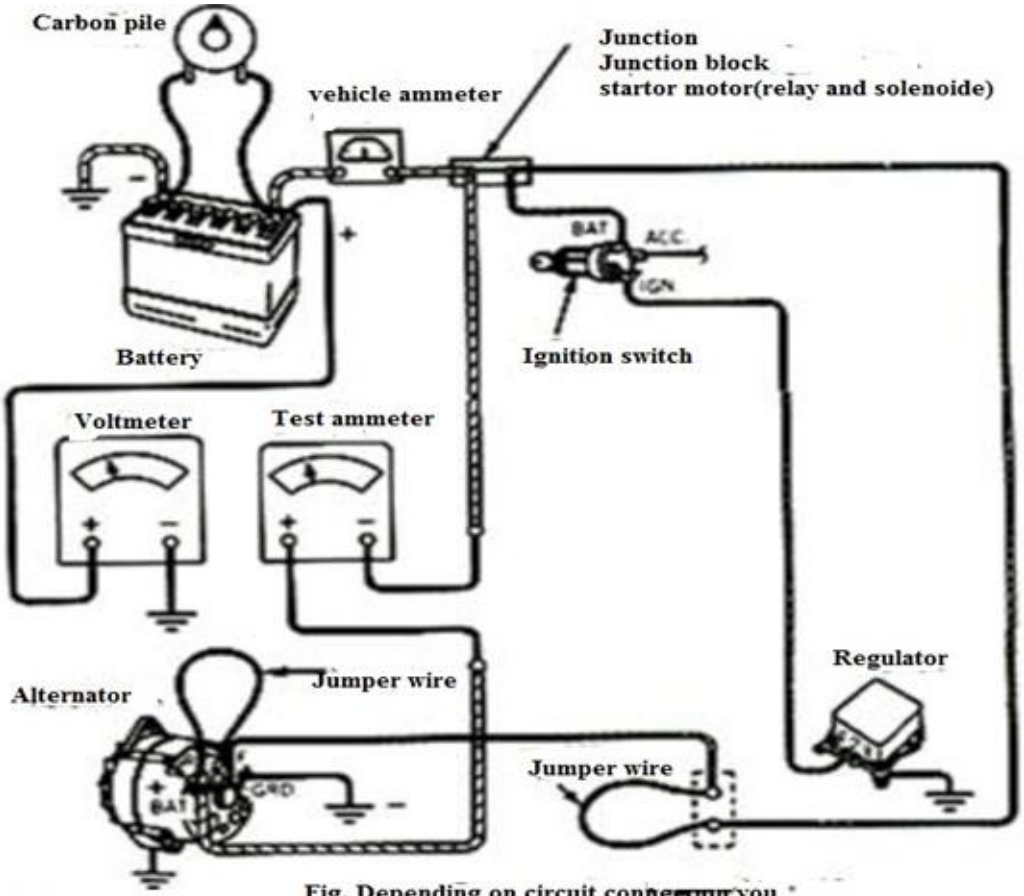


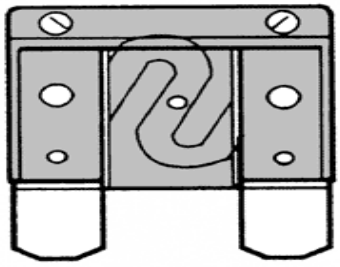
Fig. Depending on circuit connection you can bypass the regulator connector at the alternator

	d	**Describe cartridge fuse and maxi fuse with neat sketch.**	**4**
		Answer:*(Description :-2 marks, sketch:-2 marks)* **Cartridge fuse:** Cartridge fuses have a cylindrical body terminated with metal end caps. Some cartridge fuses are manufactured with end caps of different sizes to prevent accidental insertion of the wrong fuse rating in a holder, giving them a bottle shape.	**2**

Cartridge fuse

MAXI Fuses

Maxi-Fuse is a fast-acting blade fuse, standard for vehicle circuit protection. Designed to provide predictable time delay and low heat dissipation. Color-coded for easy identification of fuse ratings**.** **2**



Maxifuse

	e	**Explain construction and working of speedometer gauge.**	**4**
		Answer:*(construction & working: 2marks, sketch: 2marks)* **Mechanical Speedometer:** The speedometer is driven from the transmission output shaft by a set of gears. The driven gear fastens to a flexible shaft or speedometer cable. It runs from the transmission output shaft to the back of the speedometer head. Inside the speedometer, the cable turns a shaft with a small magnet on it. The rotating magnetic field produces a varying pull on the metal ring surrounding the magnet. A pointer is attached to the metal ring. As the magnetic field spins, it causes the ring to overcome a light spring and swing with the magnetic field. This moves the pointer which then indicates car speed. The faster the vehicle speed, the faster the magnet spins, and the farther the pointer moves.	**2**

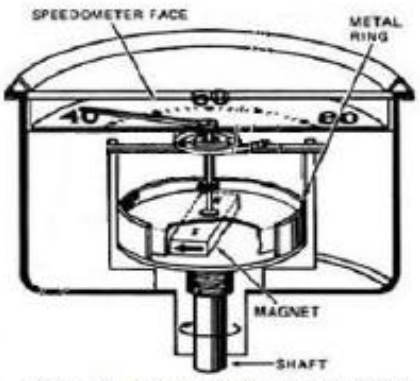
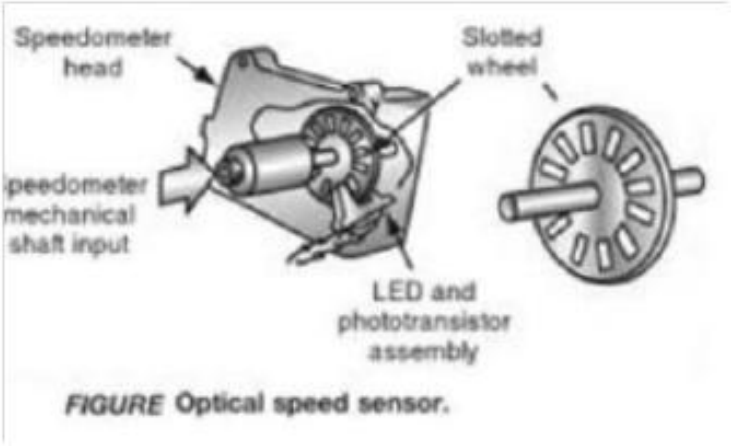
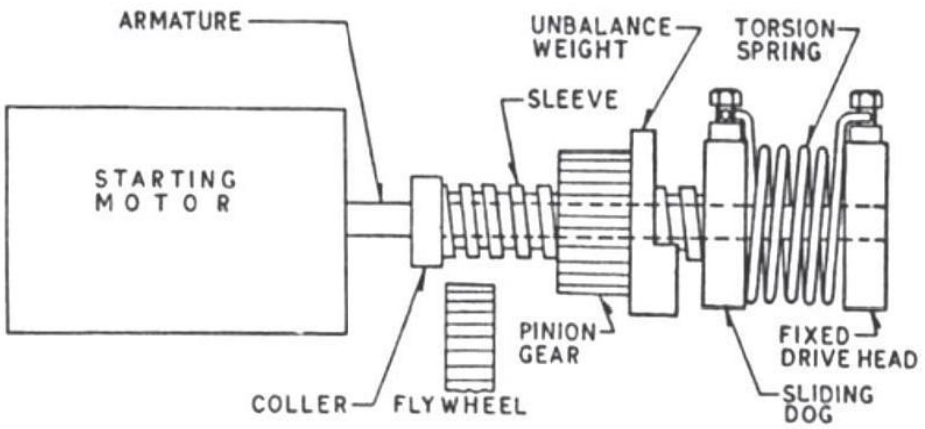
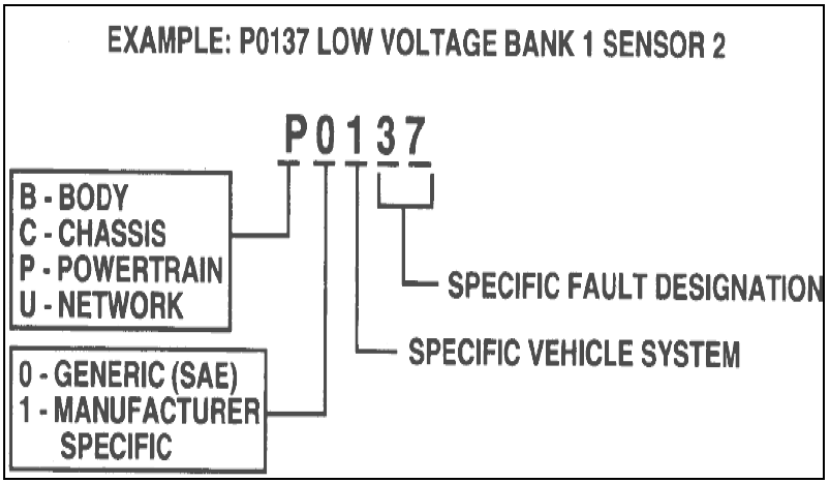
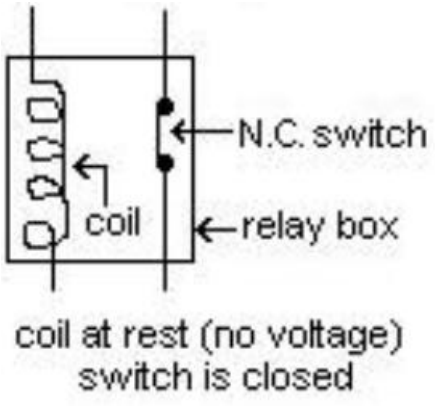
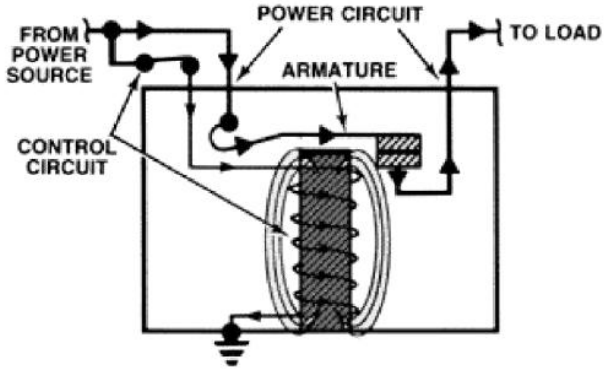
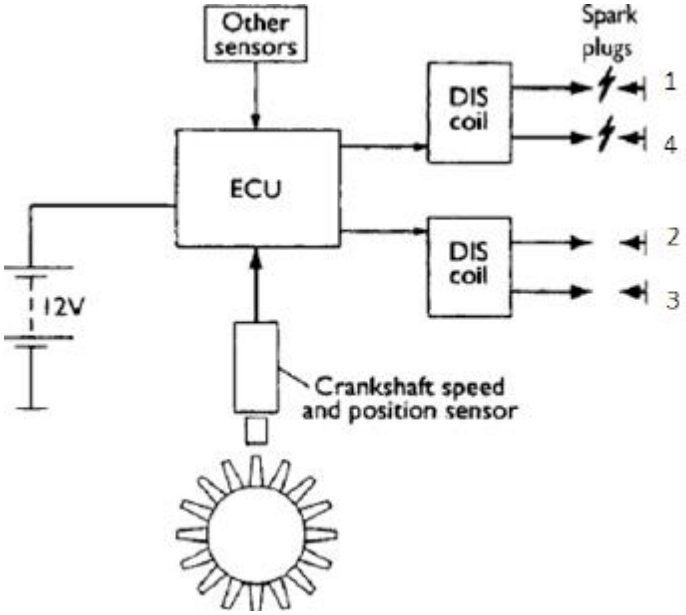


Fig: A speedometer Assembly **2**

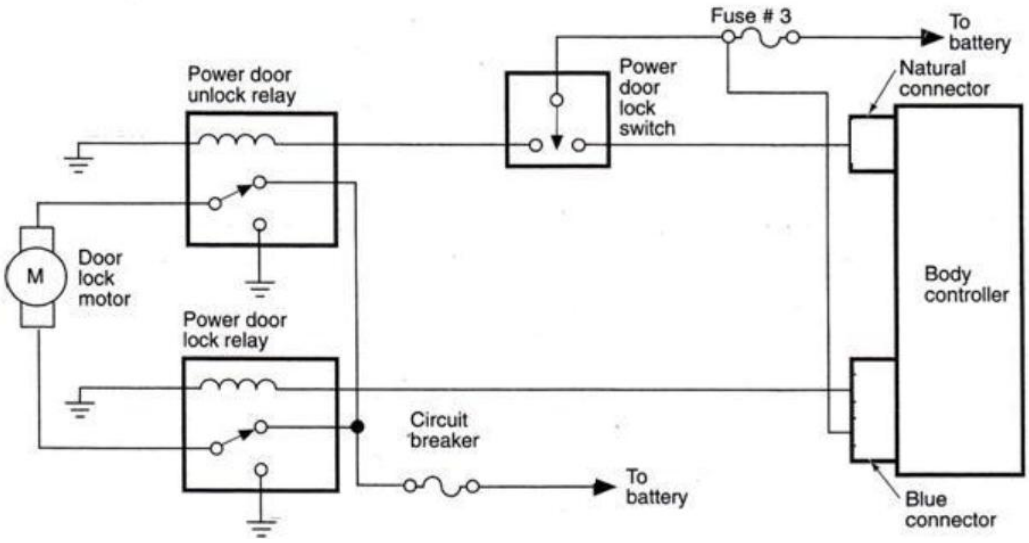
		OR **Electrical / Electronic Speedometer:** The electronic Speedometer receives voltage signal from the vehicle speed sensor (VSS). This sensor can be a PM generator, Hall effect sensor or Optical sensor. Such speedometer operates using conventional speedometer cable. The cable rotates a slotted wheel between a light-emitting diode (LED) and a phototransistor. As the slots in the wheel break the light, the transistor conducts an electronic pulse signal to the speedometer. An integrated circuit rectifies the analog input signal from the optical sensor and counts the pulses per second. The value is calculated into kilometers per hour and displayed in the digital readout. The display is updated every ½ second.  ***FIGURE*** **Optical speed sensor.**	
	f	**Explain working of bendix drive.**	**4**
		Answer:*(working – 2 marks, sketch-2 marks)* **Working: Bendix Drive** 1. When the motor starts, the armature shaft rotates causing the sleeve to rotate andbecause the pinion cannot rotate due to unbalance weight, it moves axially towards the motor till it is engaged with flywheel. 2. Further movement of the pinion is prevented by the collar attached on the sleeve and because of this pinion has to start rotating. 3. As it is also mesh with engine flywheel, the flywheel is rotated and the engine starts. 4. When the engine starts, it is flywheel that rotates the pinion and because of its bigger size, the flywheel rotates the pinion much faster than the armature (which by now, has slowed down due to releasing of the self- starter switch) with the result that the pinion backed out of mesh with the flywheel.	**2**

		 **Fig. Bendix Drive**	**2**
3		**Attempt any FOUR of the following:**	**16**
	a	**How can fiber optics material be useful in advance lighting system?**	**4**
		Answer:*(Explanation :- 3 marks, Applications:- 1 marks)* 1. The invention of fiber optics has provided a means of illuminating several objects witha single light source. 2. Plastic fiber optic strands made from a special plastic (polymethylmethacrylate plastic) are used to transmit light from the source to the object to be illuminated. 3. This plastic helps to keep the light rays parallel even in the presence of extreme bendsin the plastic. 4. The strands of plastic are sheathed by a polymer that insulates the light rays as theytravel within the strands. 5. The light rays travel through the strands by means of internal reflections. **Some of the application of fiber optics include:** • Fender-mounted turn signal lights • lighting ash trays • illuminating instrument panels • dash lighting over switches • Ignition key "halo" light. • Door Keys • Panel Illumination • Dash illumination	**3** **1**
	b	**Describe DTC structure as detected by SAEJ 2012.**	**4**
		Answer:*(Description-2 marks,sketch-2marks)* SAE J-2012 (Diagnostic Trouble Codes) defines a set of diagnostic trouble codes (DTCs) where industry uniformity has been achieved. DTCs (five digits) consist of an alpha character followed by four characters. The first digit of the code indicates if the DTC is generic or manufacturer specific. A "0" indicates the code is generic while a "1" indicates it is manufacturer specific. The second digit indicates the vehicle the vehicle system that generated the fault code.	**2**

			**2**
	c	**Explain basic purpose of relay. Draw neat sketch normally closed relay.**	**4**
		Answer:*(Purpose - 2 marks and sketch 2 marks)* **i) Relays:** 7. Purpose of relay is to control a load circuit with the use of small current carrying control circuit. 8. It saves the size of wiring connected to the switch/es and reduces weight. **Sketch of NC Relay: (Credit should be given to equivalent sketch)**  **OR**  **Engergised state of Relay**	**2** **2**
	d	**Explain computer control ignition system with block diagram.**	**4**
		Answer:*(Explanation - 2 marks, Equivalent diagram- 2 Marks)* **Operation of Computer controlled OR Distributor less coil ignition system:** **The distributor less ignition system consists of three main components:** i. An ECU ii. Crankshaft speed and crankshaft position sensor. iii. Ignition coils • The system is generally used for four cylinder or six cylinder engines. The basic principle is that of the „Lost Spark". • The distribution of the spark is achieved by using two double ended coils, which are	**2**

		fired alternately by using ECU. • The timing is determined by using information from a crank shaft speed and crankshaft position sensors as well as some other sensors such as engine load, coolant temperature and detonation sensor etc. • The coil pack (2 ignition coils for four cylinder engine) gets triggered twice in each cycle of operation by using ECU, so that flow of current through one of the two primary windings is stopped. • When the flow of current is stopped, the magnetic field in the primary winding collapses suddenly and a high voltage is produced in the secondary winding. • When one of the coils is fired, a spark is delivered to two companion cylinders, either 1and 4 or 2 and 3 for four cylinder engine, at the end of compression and exhaust respectively. • The spark delivered to the cylinder on the compression stroke will ignite the mixture. • The spark produced in the other cylinder will have no effect, as this cylinder will be completing its exhaust stroke.  	**2**
	e	**List various sensor used in ignition system.**	**4**
		Answer: 1. Detonation Sensor: 2. Cylinder Identification sensor / camshaft position sensor: 3. Crankshaft position sensor: 4. Manifold absolute sensor 5. Throttle position sensor 6. Hall effect sensor 7. Engine speed sensor 8. Knock sensor 9.	**4**

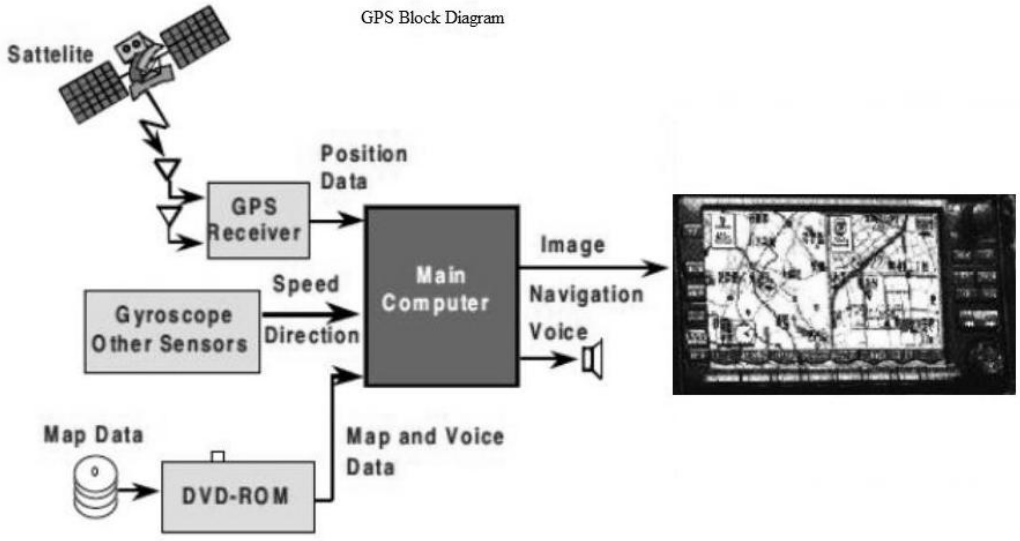
4	**A)**	**Attempt any <u>THREE</u> of the following:**	**12**
	i	**Explain antitheft system used in modern automobile.**	**4**
		Answer: Anti-theft system:*(Any Four)* An anti-theft system is any device or method used to prevent or deter the unauthorized appropriation of items considered valuable. Anti-theft systems have been around since individuals began stealing other people's property and have evolved accordingly to thwart increasingly complex methods of theft. From the invention of the first lock and key to the introduction of RFID tags and biometric identification, antitheft systems have evolved to match the introduction of new inventions to society and the resulting theft of them by others. Three basic types of antitheft devices are available: locking devices, disabling devices, and alarm systems. Many of the devices are available as optional equipment from the manufacturers; others are aftermarket installed. **a) Locks and keys:** Locks are designed to deny entry to the engine, passenger, and trunk compartments of the car as well as to prevent a thief from driving the car away. Most locks deny entry by moving a mechanical block between the vehicle's body and the door. Latches and keys simply move those blocks. **b) Passkey Systems:** The passkey is a specially designed key, or transponder, that is selected and programmed just for thevehicle for which it was intended. Although another key may fit into the ignition switch or door lock, thesystem does not allow the engine to start without the correct electrical signal from the key. **c) Keyless Entry Systems:** A keyless entry system allows the driver to unlock the doors or trunk lid from outside of the vehiclewithout using a key. It has two main components: an electronic control module and a coded-buttonkeypad on the driver's door or a key fob **d) Alarm systems:** The two methods for activating alarm systems are passive and active. Passive systems switch onautomatically when the ignition key is removed or the doors are locked. They are often more effectivethan active systems. Active systems are activated manually with a key fob transmitter, keypad, key, ortoggle switch.	**4**
	ii	**Explain automatic door lock system**	**4**
		Answer:*(Explain: 4 marks & credit should be given to sketch)* **Automatic door lock system:-** Motors used in power door locks are of permanent magnet type and are operated through a relay by conventional switches. These motors are controlled by a double pole double throw switch that is externally grounded. A clockwise rotation of the motor output shaft extends the shaft to unlock the door. When polarity is reversed, the output shaft rotates anticlockwise retracting the shaft to lock the doors. The purpose of automatic door lock system is to prevent entry to engine, passenger and trunk compartments of the car as well as to prevent a thief from driving the car away. The automatic door lock system is an additional safety and convenience system. The system may use the body computer to control the door lock relays, or a separate controller. The controller (or body computer) takes the place of the door lock switches for automatic operation.	**04**

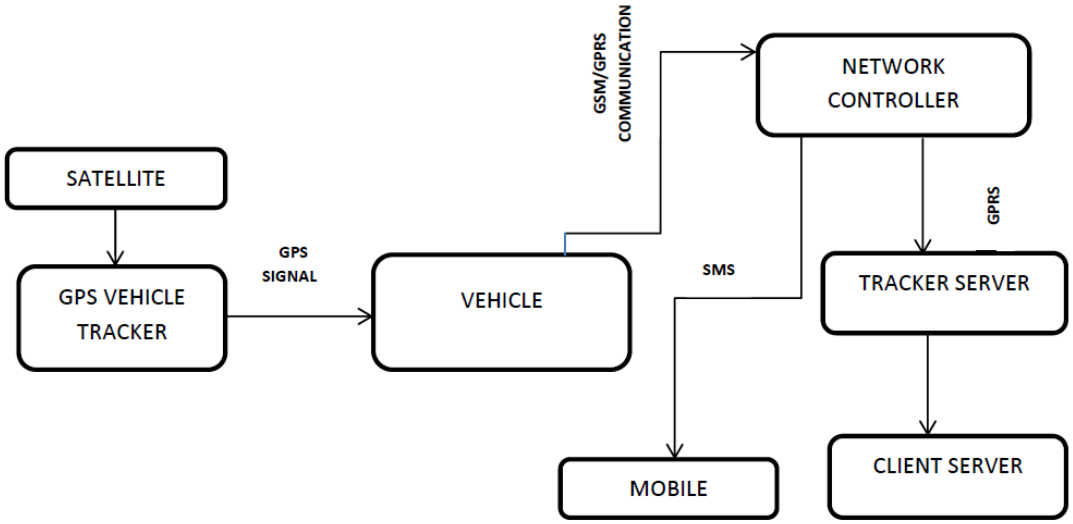


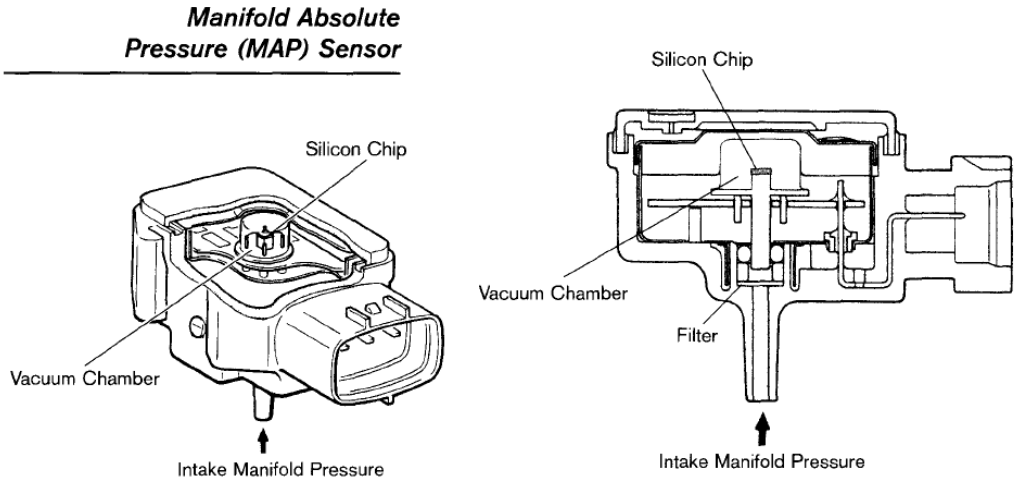
	iii	**Enlist testing method for electronic fuel injector? Explain sound test.**	**4**
		Answer: (Methods: 2 marks Explane:2marks) **Testing methods of electronic fuel injector:** 1. Sound test 2. Spray test 3. Voltage drop test 4. Fuel Flow test 5. Ohmmeter test. **Sound Test:** The use of auto fuel injectors is a sophisticated way to provide the right fuel and air mix to anengine for a vehicle. The small cylindrical fuel injectors play a specific role in a larger fuel intake system, along with other elements like the fuel pump and the fuel tank. Over time, fuel Injectors may need to be maintained or checked for proper functioning. 1. The electronic fuel injection system relies on electronic signals that control how these items operate. 2. Along with checking a fuel injector electronically, you can listen for certain kinds of sounds that will tell you when a fuel injector might not be working correctly. 3. A clunking sound or similar warning sound may show that the fuel injector is not Functioning the way it should. 4. If the injector electrical leads are difficult to access, an injector power balance test is hard to perform. As an alternative, start the engine and use a technician stethoscope to listen for correct injector operation. 5. A good injector makes a rhythmic clicking sound as the solenoid is energized and de Energized several times each second. 6. If clunk- clunk instead of steady click-click is heard, chances are the problem injector has been found. 7. Cleaning or replacement is in order. 8. If an injector does not produce any clicking noise, the injector, connecting wires or	**2** **2**

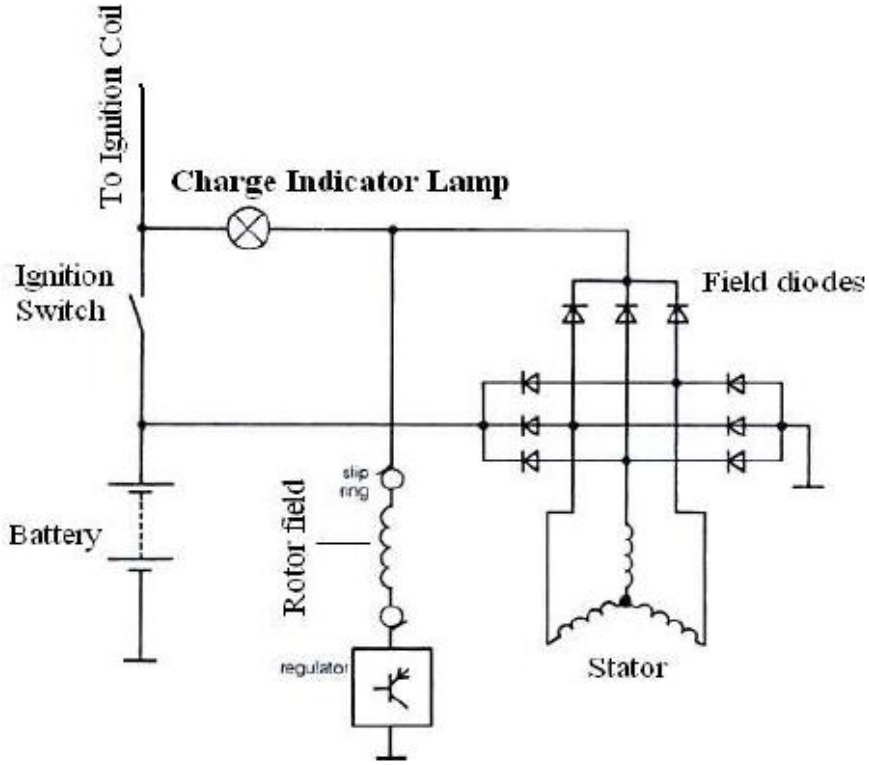
		PCM may be defective. 9. When the injector clicking noise is erratic, the injector plunger may be sticking. 10. If there is no injector clicking noise, proceed with the injector resistance test and lightto locate the cause of problem. 11. If a stethoscope is not handy, use a thin steel rod, wooden dowel, or fingers to feel for a Steady on/off pulsing of the injector solenoid.	
	iv	**Describe testing of oxygen sensor.**	**4**
		Answer:- Test Procedure Using A Scan Tool A good oxygen sensor should be able to sense the oxygen content and change voltage outputs rapidly. How fast an oxygen sensor switches from high (above 450 m V) to low (below 350 m V) is defined by use of oxygen sensor cross counts. One cross count is the change of an oxygen sensor voltage from high to low (from low to high voltage is not counted) in 1 second (or 1.25 seconds, depending on scan tool and computer speed). Typical oxygen sensor cross counts include: NOTE: Oxygen sensor cross counts can be determined using a scan tool or other suitable tester that reads computer data information or frequency. Carburetted engine at 2,000 engine rpm: more than 3 cross counts are normal. Fuel-injected engine at 2,000 engine rpm: more than 10 cross counts are normal In cases, the higher the number of cross counts, the better. If the cross counts are low (or zero), the oxygen sensor may be contaminated or the fuel delivery system is delivering a constant rich or lean air/fuel mixture. **OR** **Test procedure without a scan tool** The oxygen sensor can be checked for proper operation using a digital high-impedance voltmeter. Step 1. With the engine off, unplug the oxygen sensor at the terminal. Step 2. Install a jumper wire (or wires if an electrically heated oxygen sensor). NOTE: The jumper wire permits access to the electrical connection between the sensor and the Computer and still maintains the correct operation of the system. A breakout box can also be used instead of using a jumper wire. Step 3. Start the engine and allow it to reach closed-loop operation. Step 4. In closed loop, the oxygen sensor voltage should be constantly changing as the fuel mixture is being controlled**.** **Results:** If the oxygen sensor fails to respond and its voltage remains about 450 m V, the Sensor may be defective and require replacement. Before replacing the oxygen sensor, check the manufacturer's recommended procedures. If the oxygen sensor reads high all the time (above 550 m V), the fuel system could be supplying too rich a fuel mixture or the oxygen sensor may be contaminated. If the oxygen sensor voltage remains low (below 350 m V), the fuel system could be supplying too lean a fuel mixture. Check for a vacuum leak or partially clogged fuel injector(s). Before replacing the oxygen sensor, check the manufacturer's recommended procedures**.**	**4**

	B)	**Attempt any <u>ONE</u> of the following:**	**6**
	i	**Explain construction and operation of alternator.**	**6**
		Answer: (Construction – 3 marks and operation -3 marks. Credit should be given to Schematic diagram) **Construction of Alternator:** Alternator consists of following components: I. Stator II. Rotor mounted on alternator shaft III. Drive end Frame or Housing IV. Rectifier end Frame or Housing V. Voltage regulator & rectifier VI. Slip rings & brushes VII. Pulley & cooling fan Alternator stator, rotor, rectifier and regulator are assembled using two end frames, made of aluminum for better heat dissipation. Power diodes are embedded in a heat sink and are mounted on an insulated plate. The cooling fan is connected to the drive shaft. The rotor houses field winding and provides the magnetic field across the two pieces. The stator is a laminated construction with the stator winding wound in three phases. Each phase is soldered to the pair of diodes. The slip ring and brush arrangement provides electrical connection across the regulator and field winding. **Operation of Alternator:** As alternator gets drive from the engine, rotor provides rotating magnetic field. The conductors in the stator are subjected to changing magnetic field. Due to change in magnetic field, associated with the stator windings AC is generated. This AC current is rectified using power diodes. The alternator receives current for excitation from battery. The alternator output is regulated by a voltage regulator and it is connected to battery using a diode trio.	**3** **3**
	ii	**State purpose of following component used in ignition system.** **1) Spark plug** **2) Distributor** **3) Condenser**	**6**
		Answer:*(2 marks for each components)* **1) Spark plug :-** • Purpose of spark plug is to provide an arc to ignite the air fuel mixture within the combustion chamber of a SI engine. • Spark at the plug electrodes must be regular and synchronously timed with respect to the cylinder piston position at all speeds and loads of an engine. • The spark should be sufficiently strong so as to start proper ignition of even lean charge. • Being the hottest component in the SI engine, it dissipates the heat effectively to the cylinder head. This avoids abnormal combustion. • The duration of spark should be sufficient enough so as to sustain the flame and avoid flame quenching in turbulent mixtures.	**2**

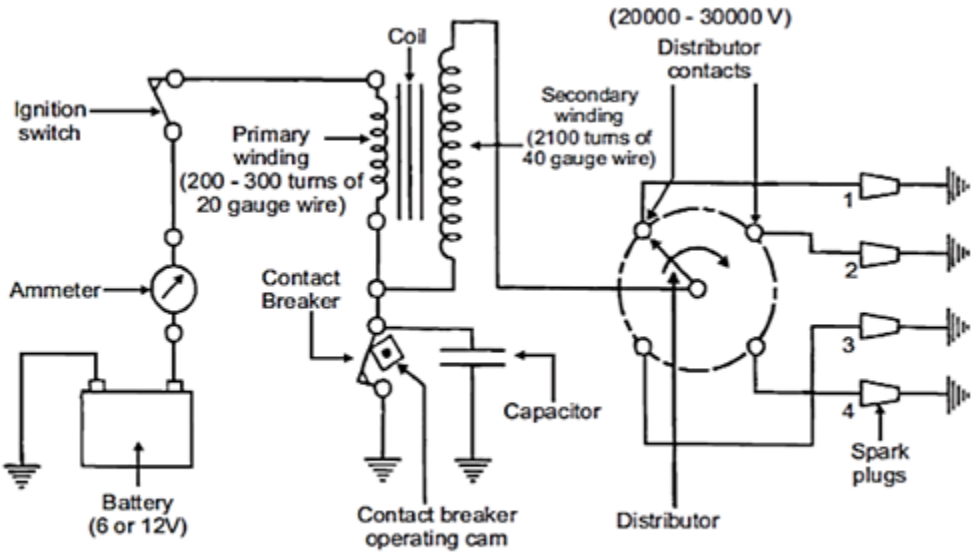
		2) Distributor :- • To interrupt the flow of current through the primary winding so that a high voltage is produced in the secondary winding. • To distribute the high voltage surge to different plugs at the right moment. • To provide advance/retard an ignition timing. • To provide drive to oil pump and mechanical fuel feed pump 3) **Condenser:-** The condenser is used to prevent the arc action in case of ignition system with distributor contact points. Also improve the life of contact breaker points.	**2** **2**
5		**Attempt any four of the following**	**16**
	a	**Describe GPS system with neat sketch.**	**4**
	Ans:	**Answer:** *(Block diagram -2 marks and working -2 marks; Credit should be given to equivalent diagram, if drawn)* Global Positioning System (GPS) technology fulfills goals of accurate location, navigation, and asset tracking. It makes automotive commute safer and easier. **Working:** A **GPS** receiver must be locked on to the *signal of 4 or more satellites* to calculate a 3-D position of user (latitude, longitude and altitude) and track movement. The GPS satellites transmit signals to a GPS receiver. These receivers passively receive satellite signals; they do not transmit and require an unobstructed view of the sky, so they can only be used effectively outdoors. GPS operations depend on a very accurate time reference, which is provided by atomic clocks on board the satellites. Each GPS satellite transmits data that indicates its location and the current time. All GPS satellites synchronize operations so that these repeating signals are transmitted at the same instant. The signals, moving at the speed of light, arrive at a GPS receiver at slightly different times because some satellites are further away than others. The distance to the GPS satellites can be determined by estimating the amount of time it takes for their signals to reach the receiver. When the receiver estimates the distance to at least four GPS satellites, it can calculate its position in three dimensions.  GPS Block Diagram	**2** **2**

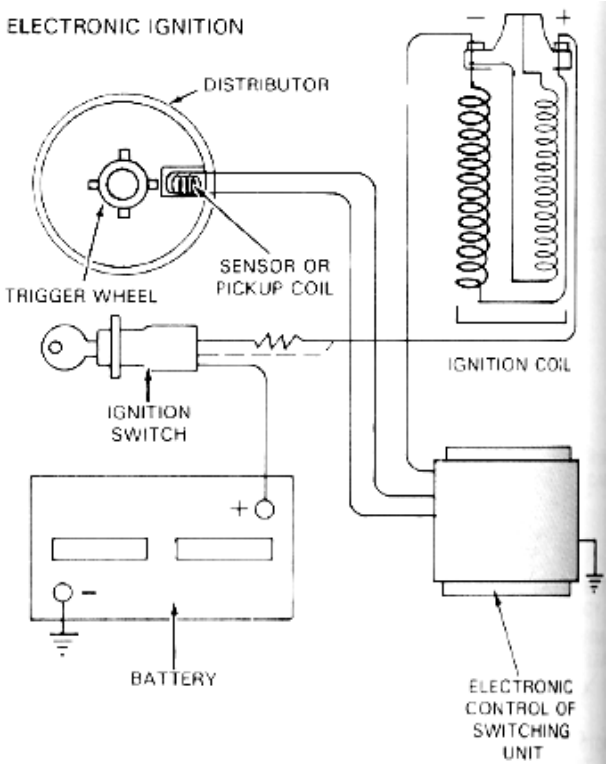
		OR  	
	b	**Describe operation of automatic ON/OFF head light with time delay.**	**4**
		Answer: Automatic On/Off head light with timedelay:- The automatic on/off with time delay feature has two functions:- • To turn on the headlights automatically when the ambient light decreases to a predetermined level. • To allow the headlights to remain on for a certain amount of time after the vehicle has been turned off. This system is used in combination with the automatic dimming system. **The common components of the automatic on/off with time delay include:-** 1. Photocell and amplifier. 2. Power relay. 3. Timer control. In this system the photocell is located inside the vehicles dash to sense the outside light. As the ambient light level decreases, the internal resistance of the photocell increases. When the resistance value reaches a predetermined value, the photocell and amplifier trigger the sensoramplifier module. The sensor-amplifier module energizes the relay, turning on the headlights and exterior parking lights. Some systems provide a time delay feature that allows driver to set a timer circuit to control how long the headlights remain on after they leave the vehicle. The timer control is a potentiometer that is the part of the head light switch. The timer control unit controls the automatic operation of the system and the length of time the headlights stay on after the ignition switch is turned off. The timer control signals the sensor-amplifier module to energize the relay for the requested amount of time.	**4**
	c	**State precautions to be taken while jump starting.**	**4**
		Precautions: ***(1 Mark for each)*** i) DO NOT lean directly over the battery while making jumper connections. ii) Make sure the two vehicles are not touching each other. iii) For each vehicle engage the parking brake and put the transmission in neutral or park. iv) Turn off the ignition switch and all accessories on both vehicles.	**4**

	d	**Explain operation of manifold absolute pressure sensor.**	**4**
		Answer: (*Description – 4 marks. Credit should be given to equivalent Sketch)* **Working of MAP sensor:** In the MAP sensor there is a silicon chip mounted inside a reference chamber. One side of the chip is the reference pressure. This reference pressure is a calibrated pressure; On the other side is the pressure to be measured. The silicon chip changes its resistance with the change in pressure. This change in resistance alters the voltage signal which tells the ECU there was a change in pressure. There are two types that are commonly used. One of these gives a variable voltage output to represent. In variable voltage MAP sensor, it receives a 5 V supply from the ECU. Variations in manifold pressure (vacuum) cause the small silicon diaphragm to deflect. This deflection alters the resistance of the resistors in the sensor's bridge circuit and the resulting electrical output from the bridge circuit is proportional to manifold pressure.  	**4**
	e	**Describe operation of charge indicator light with neat wiring diagram.**	**4**
		Answer : *(Diagram - 2 marks, working- 2 marks ,credit given to equivalent diagram)* **Operation of Charge Indicator Light Circuit:** 1. When the engine is to be started, the ignition is switched on. 2. This connects the Charge Indicator Lamp to the battery and makes a circuit through rotor field and regulator to earth. 3. At this stage the charge indicator lamp is illuminated and the field is excited to the extent controlled by the wattage of the lamp; a typical lamp size is 12V, 2W. 4. As alternator speed is raised, the potential difference on the output side of the field diodes is increased. 5. This gradually reduces the voltage applied to the lamp so the light slowly fades and goes out when the output voltage of the alternator equals the battery voltage; i.e. when the alternator "cuts –in" and starts to charge. 6. When this happens the field diodes will be providing the entire field current.	**2**

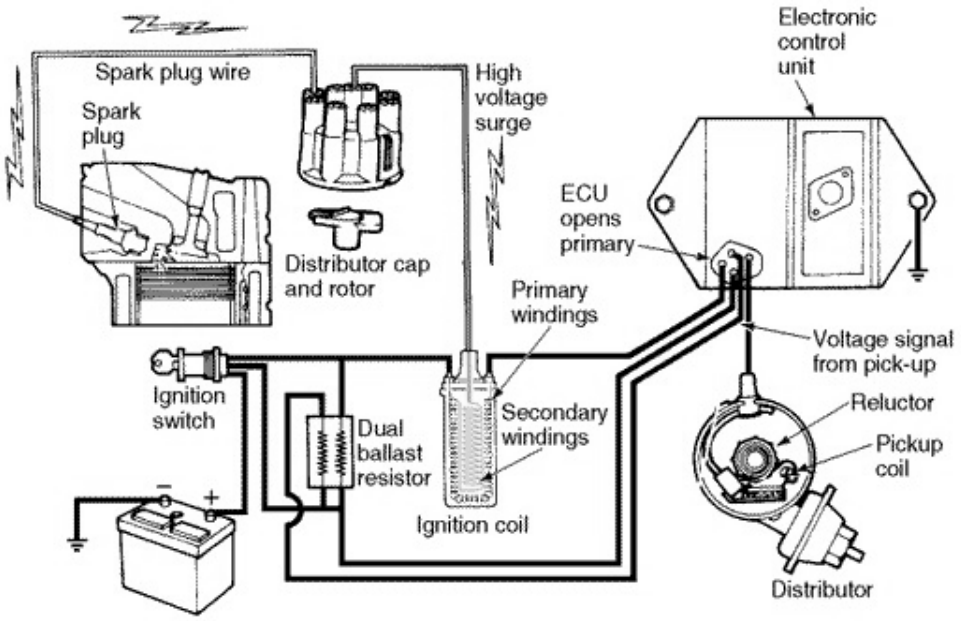
			**2**
	f	**Explain stator and rotor testing procedure.**	**4**
		Answer : **Stator Testing:** *(2 marks)* 1. Connect the test lamp or ohmmeter to the stator frame & one of the stator leads. 2. Record reading of ohmmeter / lamp illumination 3. Connect the test lamp or ohmmeter between each pair of stator leads 4. Record reading of the ohmmeter / lamp illumination. If the ohmmeter reads infinity between any two of the three stator windings, the stator is open and, therefore, defective. The ohmmeter should read infinity between any stator lead and the steel laminations. If the reading is less than infinity, the stator is grounded. Stator windings can be tested if shorted because the normal resistance is very low. **Rotor Testing:** *(2 marks)* Remove the rotor from end frame 1) Extract the retainer plate screws 2) Remove the retainer plate 3) Remove the end frame bearing 4) Remove the three attaching screws & separate the stator from end frame. 5) Attach one lead of a 110 volts test lamp or an ohmmeter to either slip ring & outer lead to the rotor- shaft or poles. 6) Note down reading of ohmmeter 7) Attach lamp or ohmmeter connections to each slip ring 8) Note down reading of ohmmeter or observe the lamp light 9) Connect 12 V battery and an ohmmeter in series with the slip rings of rotor 10) Record reading of ammeter 11) Connect an ohmmeter in series with slip ring of rotor 12) Record reading of ohmmeter	**2** **2**

6		**Attempt any four of the following:**	**16**
	a	**Describe battery rating and explain any one battery rating.**	**4**
		Answer:Battery ratings: It is a measure of the energy stored in the battery. It is expressed in terms of the period during which the battery will give the rated current before it reaches the specified final voltage. Types of Battery ratings: 1. Ampere-hours (A-h) 2. Cranking amperes (CA) 3. Cold cranking amperes (CCA) 4. Hot cranking amperes (HCA) 5. Reserve capacity minutes (RCM) **Types of Battery ratings: (any one)** **1.Ampere-hours (A-h)** is the product of the time that a battery can deliver a certain amount of current (in hours) times that current (in amperes), for a particular discharge period. This is one indication of the total amount of charge a battery is able to store and deliver at its rated voltage. This rating is rarely stated for automotive batteries, except in Europe where it is required by law. **2. Cranking amperes (CA)** also sometimes referred to as marine cranking amperes (MCA), is the amount of current a battery can provide at 32 °F (0 °C). The rating is defined as the number of amperes a lead-acid battery at that temperature can deliver for 30 seconds and maintain at least 1.2 volts per cell (7.2 volts for a 12 volt battery). **3. Cold cranking amperes (CCA)** is the amount of current a battery can provide at 0 °F (−18 °C). The rating is defined as the current a lead-acid battery at that temperature can deliver for 30 seconds and maintain at least 1.2 volts per cell (7.2 volts for a 12-volt battery). It is a more demanding test than those at higher temperatures. **4. Hot cranking amperes (HCA)** is the amount of current a battery can provide at 80 °F (26.7 °C). The rating is defined as the current a lead-acid battery at that temperature can deliver for 30 seconds and maintain at least 1.2 volts per cell (7.2 volts for a 12-volt battery). **5. Reserve capacity minutes (RCM)** also referred to as reserve capacity (RC), is a battery's ability to sustain a minimum stated electrical load; it is defined as the time (in minutes) that a lead-acid battery at 80 °F (27 °C) will continuously deliver 25 amperes before its voltage drops below 10.5 volts.	**2** **2(any one rating)**
	b	**Describe procedure of ground circuit test for starting system.**	**4**
		Answer:Ground circuit test for starting system. The starter ground circuit test checks the circuit between the starting motor and the negative terminal of the battery.Using a voltmeter, connect the leads to the negative terminal of the battery and to the end frame of the starting motor. Crank the engine and note the voltmeter reading. If it is higher than 0.5 volts, check the voltage drop across the negative battery cable. The engine may not be properly grounded. Clean, tighten, or replace the battery cable if needed. A battery cable problem can produce symptoms similar to a dead battery, badsolenoid, or weak starting motor. If the cables do NOT allow enough current to flow, the starter will turn slowly or not at all.	**4**

	c	**Explain factor affecting on battery life.**	**4**
		Answer:Factors Affecting Battery Life: *(Any Four)* All storage batteries have a limited service life, but many conditions can decrease service life. 1. Improper Electrolyte Level. 2. Corrosion of terminals and conductors or battery material. 3. Overcharging 4. Undercharge / Sulphation 5. Poor Mounting 6. Cycling 7.Temperature-high temperature during charging 8.Vibration	**4**
	d	**Explain construction and working of conventional battery ignition system.**	**4**
		Answer:*(2 marks construction, 2 marks working, credits should be given to diagram)* **Battery ignition system**  **Schematic Diagram of Coil/Battery Ignition System** **Construction:**Fig. shows line diagram of battery ignition system for a 4-cylinder petrol engine. It mainly consists of a 6 or 12 volt battery, ammeter, ignition switch, auto-transformer (step up transformer), contact breaker, capacitor, distributor rotor, distributor contact points, spark plugs, etc. The ignition system is divided into 2-circuits: (i) Primary Circuit : It consists of 6 or 12 V battery, ammeter, ignition switch, primary winding it has 200-300 turns of 20 SWG (Sharps Wire Gauge) gauge wire, contact breaker, capacitor. (ii) Secondary Circuit: It consists of secondary winding. Secondary winding consists of about 21000 turns of 40 (S WG) gauge wire. Bottom end of which is connected to bottom end of primary and top end of secondary winding is connected to centre of distributor rotor. Distributor rotors rotate and make contacts with contact points and are connected to spark plugs which are fitted in cylinder heads (engine earth).	**2** **2**

		Working: When the ignition switch is closed and engine is cranked, as soon as the contact breaker closes, a low voltage current will flow through the primary winding. It is also to be noted that the contact beaker cam opens and closes the circuit 4-times (for 4 cylinders) in one revolution. When the contact breaker opens the contact, the magnetic field begins to collapse. Because of this collapsing magnetic field, current will be induced in the secondary winding. And because of more turns (@ 21000 turns) of secondary, voltage goes unto 28000-30000 volts. This high voltage current is brought to Centre of the distributor rotor. Distributor rotor rotates and supplies this high voltage current to proper stark plug depending upon the engine firing order. When the high voltage current jumps the spark plug gap, it produces the spark and the charge is ignited-combustion starts-products of combustion expand and produce power. (a) The Function of the capacitor is to reduce arcing at the contact breaker (CB) points. Also when the CB opens the magnetic field in the primary winding begins to collapse. When the magnetic field is collapsing capacitor gets fully charged and then it starts discharging and helps in building up of voltage in secondary winding. (b) Contact breaker cam and distributor rotor are mounted on the same shaft. In 2-stroke cycle engines these are motored at the same engine speed. And in 4-stroke cycle engines they are motored at half the engine speed.	
	e	**Explain electronic spark timing with block diagram.**	**4**
		Answer:Electronic spark timing *(Description 2 marks, Sketch-2 marks)* Newer engines typically use electronic ignition systems (ignition controlled by a computer). The computer has a timing map which is a table with engine speed on one axis and engine load on another axis. Timing advance values are inserted in this table. The computer will send a signal to the ignition coil at the indicated time in the timing map in order to spark the spark plug.  	**2** **2**

OR


Spark plug wire
Spark plug
Distributor cap and rotor
High voltage surge
Electronic control unit
ECU opens primary
Primary windings
Voltage signal from pick-up
Reluctor
Pickup coil
Ignition switch
Dual ballast resistor
Secondary windings
Ignition coil
Distributor