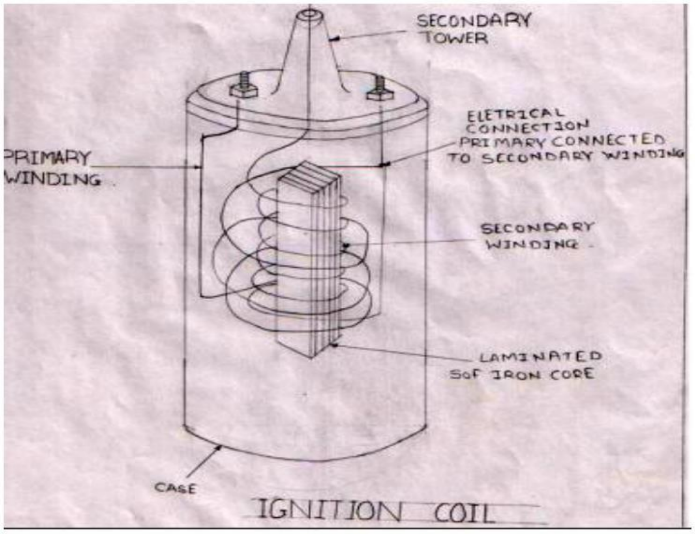
Important Instructions to examiners:

The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
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.
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.
In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
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	**State the purpose of the following electrical component** **Relay** **Fuse**	**04**
		Answer: **1) Relay:** **Purpose:** Purpose of relay is to control a load circuit with the use of small current carrying control circuit. It saves the size of wiring connected to the switches and reduces weight **2) Fuse:** **Purpose: -** A fuse is the most common circuit protection device. A fuse is placed in an electrical circuit so that, when current flow exceeds the rating of the fuse, it blows or blows out i.e. it is designed to turn off the circuit that it protects	**02 Marks Each**
	ii	**State any four types of batteries and its applications.**	**04**
		Answer: (Credit should be given to an appropriate answer.) Types of batteries 1. Lead Acid Battery 2. Alkaline batteries (Nickel – Cadmium Battery) 3. Nickel Metal Battery 4. Hybrid Battery 5. Sodium Sulphur Battery 6. Aluminium Air Battery 7. Zinc Air Battery 8. Lithium Ion Battery	**02 Mark for types** **&** **02 Marks for Application**

		Applications : 1. These can be found in remote controls, clocks, and radios. 2. The high run time makes alkaline batteries ideal for digital cameras, hand held games, MP3 players etc. 3. The basic use is in low power drain applications such as flash lights, remote controls, toys, and table clocks. 4. The major application of lead acid battery is in starting, lightning, and ignition systems (SLI) of automobiles. 5. Wet cell battery is used as backup power supply for high end servers, personal computers, telephone exchanges, and in off grid homes with inverters. 6. Portable emergency lights also use lead acid batteries. used in portable consumer instruments like calculators, iPods, digital diaries, wrist watches and stop watches, toys, and artificial pacemakers. 7. Silver Oxide batteries are used in military and submarines. 8. Lithium cells can also be used as a replacement of alkaline batteries in many devices, such as cameras and clocks.	**(any 04)**
	iii	**List out any four components of starting system and state its function.**	**04**
		Answer: **List of Components of starting system** **1) Battery** **2) Ignition switch,** **3) Neutral safety switch** **4) Solenoid** **5) Starter motor** **6) Starter drive** **Functions of Components of starting system** **1. Battery:** A battery supplies the current to starter motor, needed for engine cranking. **2. Ignition switch**: It controls the current supplied to the solenoid and to the starter motor for cranking. In starter mode, the switch provides current to solenoid and the starter motor gets supply. **3. Neutral safety switch:** The neutral safety switch prevents the engine from being started unless the shift selector of the transmission is in NEUTRAL or PARK. It disables the starting circuit when the transmission is in gear. **4. Solenoid:** Solenoid controls a larger cranking current with use of small current carrying circuit that uses a movable core. The core is mechanically linked to the electrical contacts through some form of mechanical linkage. **5. Starter motor:** Upon receiving current, motor initially provides adequately high torque needed for engine cranking. **6. Starter drive:** It ensures the starter motor engagement while cranking, and immediate disengagement upon engine starting.	**02 Mark for list** **2 Marks for function (any four)**
	iv	**Describe construction of ignition coil with neat sketch**	**04**

		Answer:(Credits should be given to appropriate answer) **construction of ignition coil:** An ignition coil consists of a laminated iron core surrounded by two coils of copper wire. Unlike a power transformer, an ignition coil has an open magnetic circuit — the iron core does not form a closed loop around the windings. The energy that is stored in the magnetic field of the core is the energy that is transferred to the spark plug. The primary winding has relatively few turns of heavy wire. The secondary winding consists of thousands of turns of smaller wire, insulated from the high voltage by enamel on the wires and layers of oiled paper insulation. The coil is usually inserted into a metal can or plastic case with insulated terminals for the high voltage and low voltage connections.  **Fig. Ignition Coil**	**02 Marks for construction** **&** **02 Marks for Figure.**
1	**(b)**	**Attempt any ONE of the following:**	**06**
	I	**Describe construction and working of engine oil pressure gauge.(Electromagnetic type)**	**06**
		Answer: **Construction and working of electromagnetic engine oil pressure gauge:** Oil pressure gauge shown in the diagram is electrically operated. It displays the actual oil pressure of the engine. The indicator light only warns the driver of low oil pressure. Oil pressure sending unit is screwed into the oil gallery. As oil passes through an oil pressure sender, it moves a diaphragm, which is connected to a variable resistor. This resistor changes the amount of current passing through the circuit. The gauge then reacts to the current and moves a needle over a scale to indicate the oil pressure. As oil pressure changes, the resistance in the oil pressure gauge circuit and the reading on the gauge change accordingly.	**04 Marks for construction & working** **02 Marks for fig.**

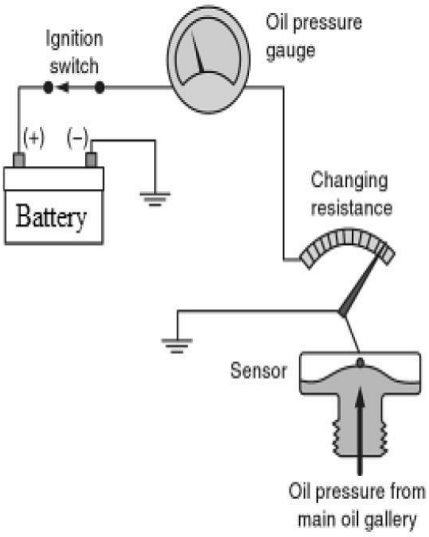
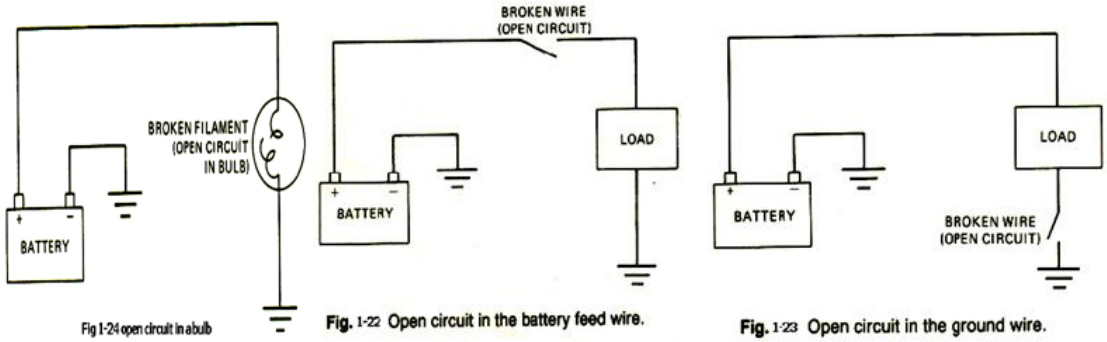


Figure: Electromagnetically operated engine oil pressure gauge

	ii	**Describe any four factors which affect the life of battery.**	**06**
		Answer: (Credit should be given to an appropriate answer.) **Factors Affecting Battery Life:** • Electrolyte level. As the battery vents hydrogen and oxygen, electrolyte level drops. As the level of battery acid drops, the tops of the plates are exposed, hardening the plates. • Overcharging. Overcharging the battery, either by the charging system or by a battery charger, causes excessive internal heat and can boil the battery acid. This can damage the active materials on the plates and destroy the battery. • Undercharging. If the charging system does not adequately recharge the battery, the plates can become permanently sulfated. Undercharging also leaves the electrolyte weaker as more water is present in the acid. This can allow the battery to freeze in cold weather.	**06 Marks**

		• Corrosion. Vented hydrogen and oxygen condense back on the battery, causing corrosion. This corrosion can create excessive resistance at the battery connections, which creates a voltage drop. This can affect the available battery voltage and cause the battery to fail to fully recharge. Corrosion can also cause a circuit to form across the top of the battery between the posts. This circuit allows the battery to self-discharge. • Temperature. High temperatures, either from overcharging or high ambient and underhood temperatures, shorten battery life. Cold temperatures reduce battery efficiency and available output. • Vibration. When the vehicle is assembled, a battery holddown device is attached to secure the battery. This prevents excessive vibration and damage to the plates. A loose battery can become cracked, tip over, or bounce around enough to short the terminals against other parts of the vehicle.	
2		**Attempt any FOUR of the following:**	**16**
	A	**State the function of the following** **1. Temp. gauge** **2. Fuel gauge** **3. Engine oil pressure gauge** **4. Speedometer gauge**	**04**
		Answer: **Functions of following**: **1. Temperature gauge:** This gauge indicates engine coolant temperature. It should normally indicate between C (Cold) and H (hot). **2. Fuel gauge:-** Fuel gauge is used to indicate the **fuel** level in the fuel tank. **3. Engine Oil Pressure Gauge:** Engine oil **pressure** gauge is used to indicate the **oil pressure** level in the engine. **4. Speedometer gauge:** A **speedometer** or a speed meter is a gauge that measures and displays the instantaneous speed of a vehicle.	04 (01 mark for each)

	b	**State any four types of tests used to find out circuit defects**	**04**
		Answer: **Types of circuit defects:** Open circuit Short Circuit Short to ground Resistance in connection (Voltage Drop) **1. Open circuit** An open circuit is a break in an electric circuit that prevents the flow of electric current. circuit may be a broken wire, a faulty set of switch contacts, a faulty component, a blow defective ground. The open, or broken, part of the circuit may be in the supply, or feed, the battery (Fig), in the ground wire (Fig), or in the load itself (Fig). With any of these co load will not operate.  Fig 1-24 open circuit in a bulb **Fig.** 1-22 Open circuit in the battery feed wire. **Fig.** 1-23 Open circuit in the ground wire. **2. Short circuit** When the feed or switch wire insulation is damaged and the conductor touches the metal frame, some or all of the current will take this 'easy' path to earth. This alternative path offers the current a short path back to the battery, so the term SHORT CIRCUIT is used to describe this condition. The extent of the short-to-earth, i.e. the resistance of the alternative path, governs the potential difference that is left to act on the lamp in figure. As the resistance in the short circuit path is reduced, the potential difference across the lamp is also reduced so the effect of the voltage reduction will be a proportional decrease in the lamp brightness. A dead short describes a very low resistance path to the earth. When this occurs, the very high current flow that results will soon make the cable glow red-hot. This melts the plastic covering of the cable and often starts a fire. Some circuit – protection device such as a fuse is needed if this danger is to be avoided.	**01 marks Each**

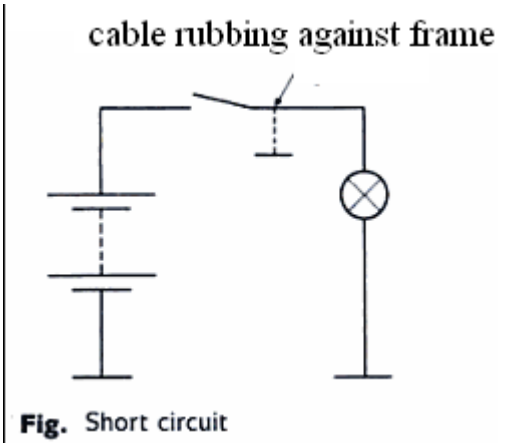


Fig. Short circuit

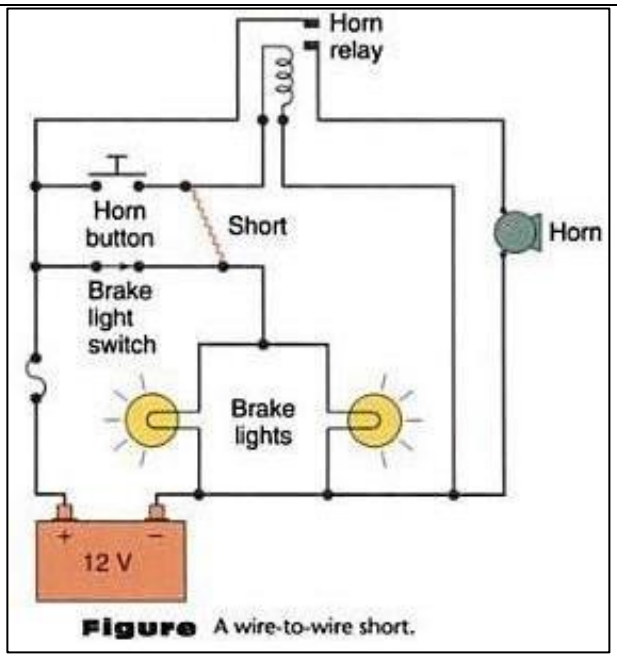
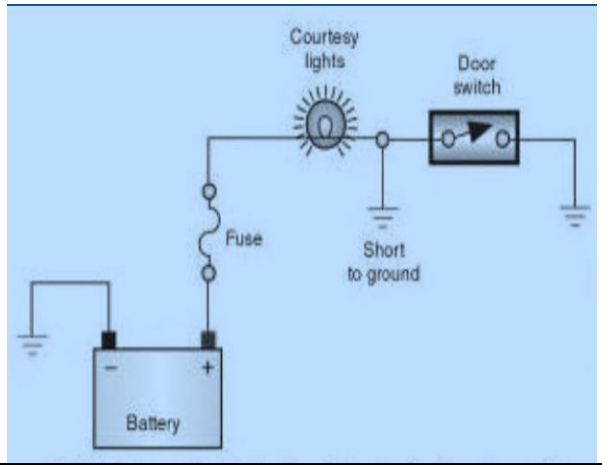


Figure A wire-to-wire short.

3. Short to ground: A grounded circuit exists when defective insulation allows a conductor such as a wire to touch the vehicle frame



	c)	**State the function of four elements of charging system.**	04
		Answer: *(Credit should be given to an appropriate answer.)* **1. Battery** The function of the battery is as a storage of electrical energy. The battery will store all the electrical energy generated by the alternator and then this stored electricity is used when necessary. **2. Fuse and Fusible links** The function of this fuse is to protect the entire electrical system of the car from excessive currents. 3. A **fusible link** is connected between the **fuse** terminals. This means that when an electrical current passing through the **fuse** goes beyond what the device is able to handle, the **fusible link** will melt and the circuit opens thus preventing electrical component damage.	01 Mark each (any 04)

4. CHG Lights

CHG lamp or commonly also called "charging warning light" is an indicator light to indicate the failure of charging system. It warns when the car's generator/alternator is not charging the battery .

5. Ignition key

Ignition **key** used in a motor vehicle to turn the switch that connects the battery to the **ignition** system and other electrical devices.

6. Regulator

The function of the regulator is to regulate the voltage generated by the alternator. The regulator will be used to keep the voltage generated by the alternator not exceeding 14 volts even if the engine run in high RPM.

7. Alternator

The function of the alternator is to convert a partial engine's rotating energy into electricity.

8. Charging Wires

The function of charging wires are to connect every component of the charging system.

	d)	**Describe working of power window with the help of block diagram.**	04
		Answer:	
		Working of Power window circuit:	**02 marks for Working**
		Major components of a typical Power windows system are – master control switch, individual window control switches, lock switch and the window drive motors as shown in figure. A permanent magnet motor operates each power window. Each motor raises or lowers the glass when voltage is applied to it. The direction that the motor moves the glass is determined by the supply voltage. The motors are permanent magnet reversible DC motors. The master control switch provides overall system control. A lock switch is safety device to prevent children from opening the windows without the driver's knowledge. Circuit breakers are generally used on power windows to open the circuit if an overload occurs. Without a circuit breaker to open, the motor may be damaged trying to move the window against the ice. As ice is removed, the breaker will cool, close and allow future window operation.	**&** **02 marks for Block diagram**

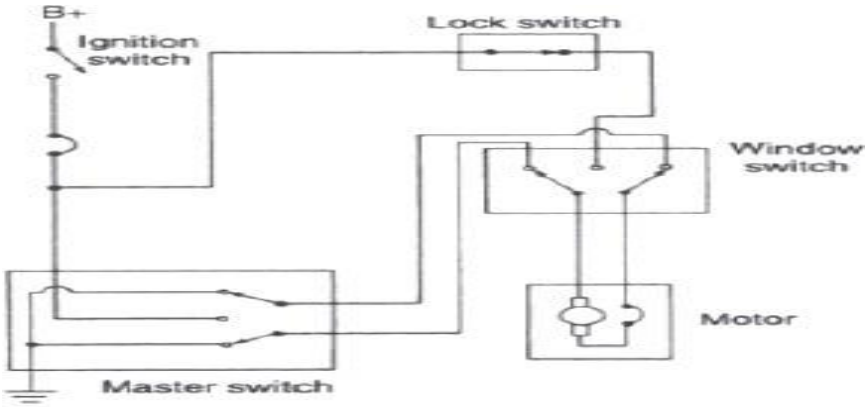
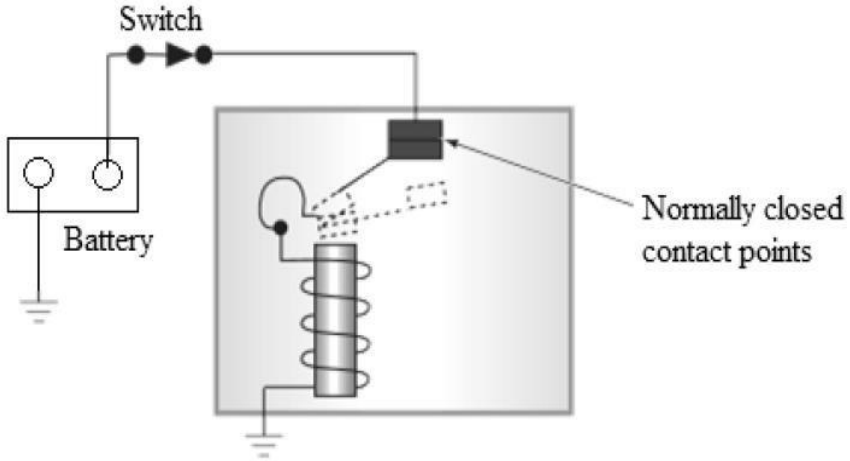
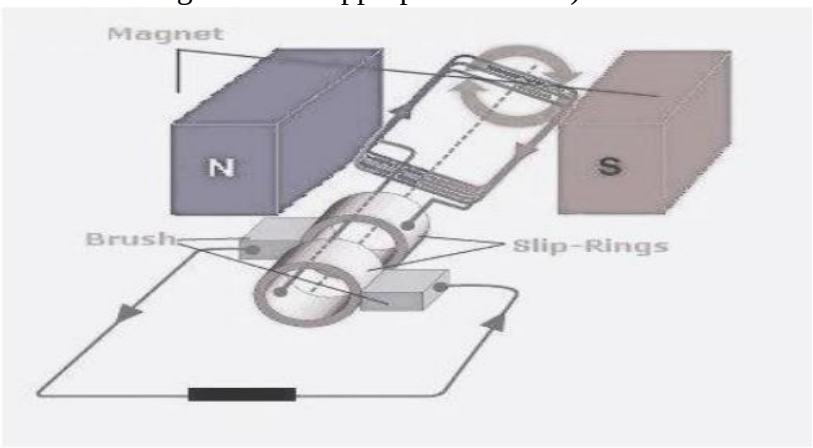


Figure A simplified power window circuit.

	e)	**Describe the working of Buzzers with neat sketch**	04
		Working: **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). A buzzer is similar in construction to a relay except for the internal wiring. The coil is supplied current through the normally closed contact points. When voltage is applied to the buzzer, current flows through the contact points to the coil. When the coil is energized, the contact arm is attracted to the magnetic field. As soon as the contact arm is pulled down, the current flow to the coil is opened, and the magnetic field is dissipated. The contact arm then closes again, and the circuit to the coil is closed. This opening and closing action occurs very rapidly. It is this movement that generates the vibrating signal and the buzzing sound. **Electrical Buzzer:**  Fig: A buzzer opens and closes contact points rapidly, creating a noise	**02 marks for Working** **&** **02 marks for sketch**
	f)	**Describe working principle of alternator with necessary sketches.**	04
		Answer: (Credit should be given to an appropriate sketch)  **Working 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	**2 marks for principle** **&** **2 marks for**

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.

Diagram

3 **Attempt any FOUR of the following:** 16

a State any two purpose of 1) Keyless entry system 2) Automatic head light dimming **04**

Answer:

(i) Keyless entry system

Purpose:

1. The keyless entry system allows the driver to unlock the doors or trunk lid from outside the vehicle without using a key.
2. It can be operated within a range of 25 to 50 feet and from any direction. The operating is done by a button press, then driver door is unlocked, theft security is disarmed.

2 marks Each

ii)Automatic head light dimming

Purpose:

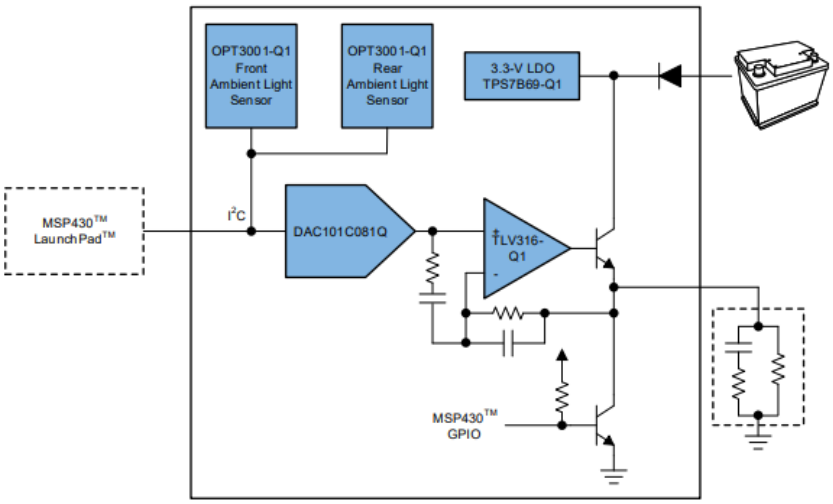
1. Automatic Headlight Dimming automatically switches the headlights from high beams to low beams When light from oncoming vehicles strikes the photocell-amplifier.
2. Automatic Headlight Dimming automatically switches the headlights from high beams to low beams when Light from the taillights of a vehicle being passed strikes the photocell-amplifier

b) **List any four sensor used in modern car with their locations.** 04

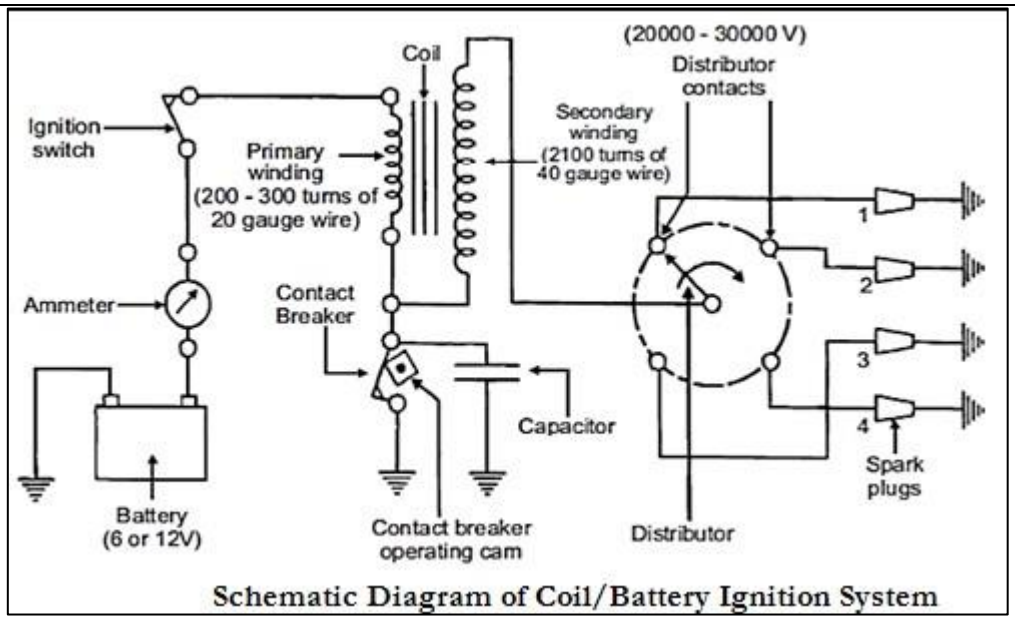
Answer:

Sr. No.	Sensors used in Automobiles	Location
1	Mass airflow sensor	Inlet Manifold
2	Engine Speed Sensor	Crank shaft
3	Oxygen Sensor	Exhaust manifold
4	Spark Knock Sensor	on the engine block, cylinder head or intake manifold
5	Coolant Sensor	Water cooling system
6	Manifold Absolute Pressure (MAP) Sensor	Intake manifold. Under or near the throttle body
7	Fuel Temperature Sensor	Fuel Tank / Hood
8		
9	Camshaft Position Sensor	Cam Shaft
10	Throttle Position Sensor	on the butterfly spindle/shaft
11	Vehicle Speed Sensor	in the transmission housing on the passenger side output flange

01 marks Each

	c)	**Describe constructional details of electrochromic mirror with suitable block diagram.**	04
		Answer:- *(Credit should be given to an appropriate sketch.)* **constructional details of Electro chromic mirror:-** An electrochromic mirror controls optical properties such as optical transmission, absorption, reflectance and/or emittance in a continual but reversible manner on application of voltage. Electrochromic mirror work on reflectance mode. In this mode, one of the transparent conducting electrodes (TCE) is replaced with a reflective surface like aluminum, gold or silver, which controls the reflective light intensity; this mode is useful in rear-view mirrors of cars and EC display devices. Electrochromic reflecting surfaces are employed as self-darkening mirrors that regulate reflections of flashing light from following vehicles at night so that a driver can see them without discomfort.  **Block diagram of electrochromic mirror**	**02 Marks for construction & 02 Marks for fig.**
	d)	**Describe conventional ignition system with neat sketch.**	04
		Answer: **Conventional battery ignition system.**	**02 Marks for Explanation & 02 Marks for**

fig



Schematic Diagram of Coil/Battery Ignition System

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.

OR

Magneto Ignition System:

In this case magneto will produce and supply the required current to the primary winding. In this case as shown, we can have rotating magneto with fixed coil or rotating coil with fixed magneto for producing and supplying current to primary, remaining arrangement is same as that of a battery ignition system.

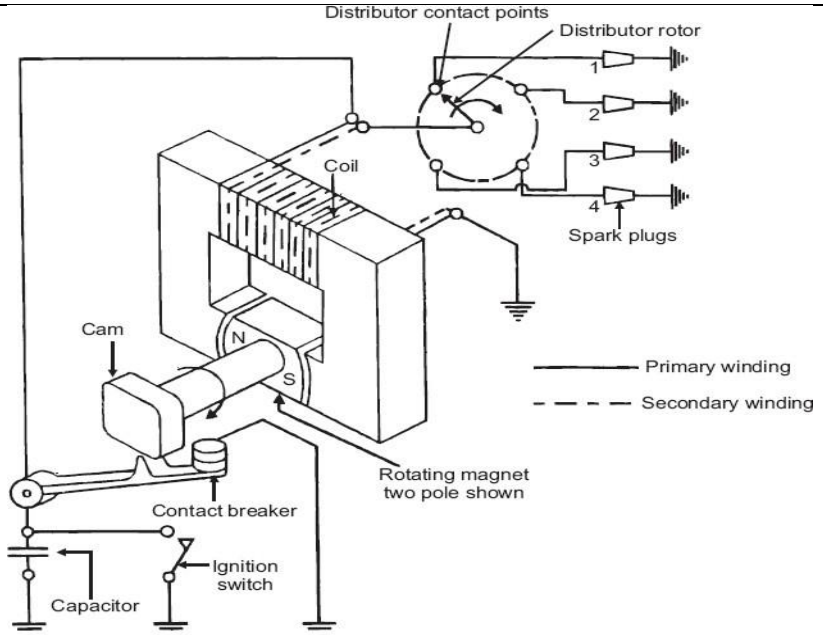
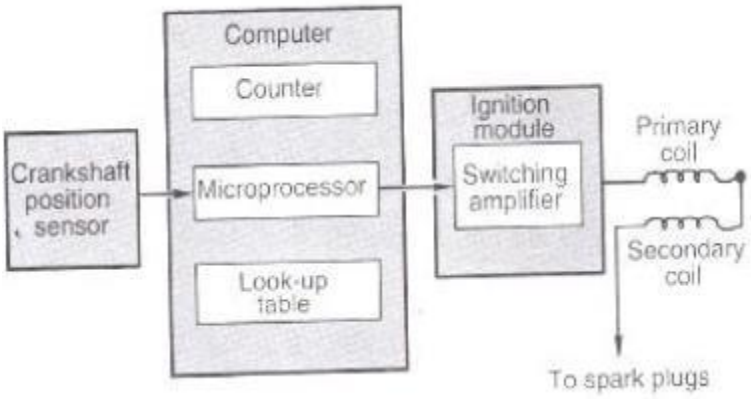


Figure 4.3 : Schematic Diagram of Magneto Ignition System

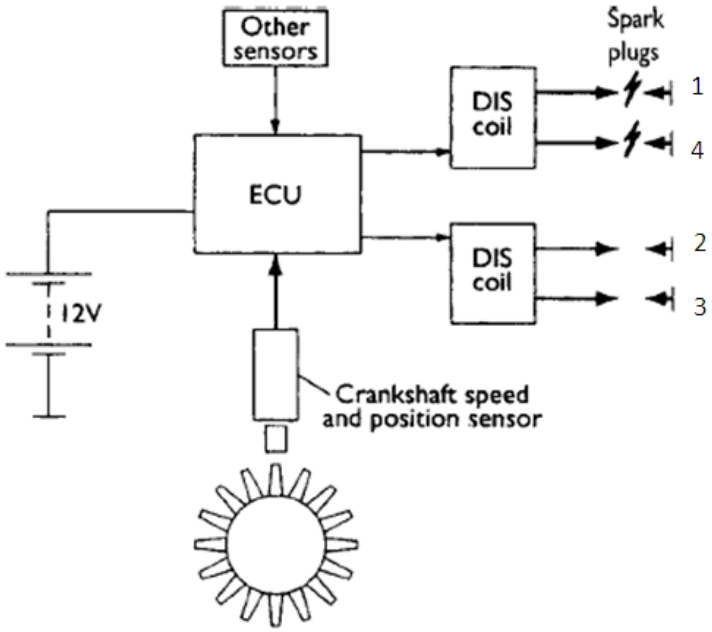
	e	**Describe working of computer controlled ignition system with block diagram.**	04
		Answer: **Working of Computer Controlled ignition system:** Computer controlled ignition systems (figure) control the primary circuits and distribute the firing voltages in the same manner as other types of electronic ignition system. The main difference between the system is to eliminate any mechanical or vacuum advance devices from the distributor in the computer controlled system. switching signal, distribute secondary voltage to the spark plugs. Timing advance is controlled by a microprocessor or computer in fact some of this system have even removed the primary switching function from the distributor by using crank shaft position sensor. In this case the function of distributor is to distribute secondary voltage to the sparks plugs.. Spark timing on this system is controlled by the computer that continuously varies ignition timing to obtain optimum air /fuel combustion. The computer monitors the engine operating parameters with sensors. Based on this input computer signal and ignitions modules to collapse the primary circuits allowing the secondary circuits to fire the spark plug (figure) Timing control is selected by the computers program during engine starting computer control is bypassed and mechanical setting of distributor controls spark timing. Ones the engine started and running spark timing is control by the computer. This scheme of strategy allows the engine to start regardless of weather the electronic control system is functioning properly or not. The goal of the computerized spark timing is to produce maximum engine power top fuel efficiency and minimum emissions level during all types of operating conditions. The computer does this by continuously adjusting ignition timing. The computer determines the best spark timing based on certain engine operating conditions such as crank shaft position, engine speed, throttle position engine coolant temperature and initial an operating manifold or barometric pressure.	**02 Marks for Working** **&** **02 Marks for fig**

Once the computer receives input from these and other sensors, it compress existing operating conditions to information permanently store or programmed into its memory. The computer matches the existing conditions to set of condition store in its memory determine proper timing setting and sends the signal to the ignition module to fire the plugs

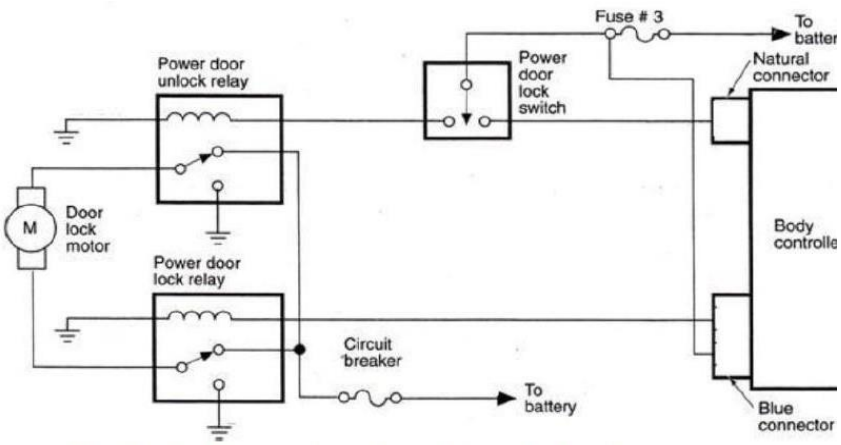
The computer continuously monitors existing conditions adjusting timing to match what its memory tells. It is ideal setting for those conditions. It can do this very quickly making thousands of decisions in a signal second.



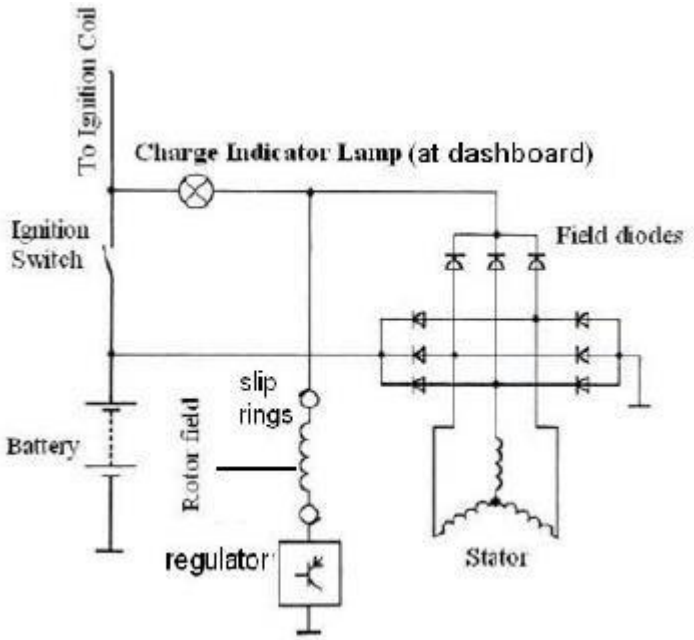
OR



4	**(a)**	**Attempt any THREE of the following:**	**12**
	i)	**Describe working of park assistance system.**	**04**
		Answer: **Operation of park assists system:** Parking sensors make reversing into tricky/ tight spaces easier and help prevent minor damage to a vehicle. The park assist system sensors make it easier by warning when you're getting too close to something, preventing small knocks and scratches.	

		The system has up to six ultrasonic sensors located in the rear - and sometimes the front - bumpers. Each of the sensors receives battery voltage and ground from the park assist module. Each sensor has a dedicated serial bus communication circuit to the module. The sensors monitor a range of up to 150 centimeters behind and, depending on the model, in front of the vehicle. The system comes into action when reverse gear is engaged, or at very low speed. It uses the principle of the echo sounder to detect obstacles and their distance from your car. The park assist system is a parking aid that alerts the driver to obstacles located in the path immediately behind the vehicle / in the path of vehicle. Ultrasonic sensors evaluate attributes of a target by interpreting the echoes from sound waves. When an object is detected, the system uses an LED display and warning chimes to provide the driver with visual and audible warning of the object's presence. It starts to sound an intermittent warning tone which gets faster the nearer you are. The warning signal becomes continuous when the vehicle gets so close that will result in a collision.	**04 Marks for Explanation**
	ii	**Describe automatic door lock system.**	**04**
		Answer: **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.  **Fig: circuit diagram for automatic door lock system**	04

	iii	**Describe construction and working of engine coolant temperature sensor.**	**04**
		Answer: **Construction:** The engine coolant temperature sensor is temperature-variable resistor, which usually has a negative temperature coefficient. It is a two-wire thermistor immersed in coolant and measures its temperature. **Working of Engine Coolant Temperature Sensor(ECT):** In order to convert the ECT resistance variation to voltage variation, which is further processed by the ECU, the ECT sensor is connected in a circuit typically supplied with a reference voltage of +5V. In cold engine and an ambient temperature of 20 ºC the sensor resistance is between 2000Ω and 3000Ω. After the engine start, coolant temperature begins to rise. ECT gradually heats and its resistance reduces proportionately. At 90 ºC its resistance is in the range of 200Ω to 300Ω. Thereby, a coolant temperature dependent variable voltage signal is send to the onboard computer.	**02 Marks for construction** **&** **02 marks For Working**
	iv	**Describe sound test and ohmmeter test for electronic fuel injection system.**	**04**
		Answer: **Procedure for sound test for testing electronic fuel injector:** The use of auto fuel injectors is a sophisticated way to provide the right fuel and air mix to an engine 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. The electronic fuel injection system relies on electronic signals that control how these items operate 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. A clunking sound or similar warning sound may show that the fuel injector is not functioning the way it should. 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. A good injector makes a rhythmic clicking sound as the solenoid is energized and de energized several times each second. If clunk- clunk instead of steady click-click is heard, chances are the problem injector has been found. Cleaning or replacement is in order. If an injector does not produce any clicking noise, the injector, connecting wires or PCM may be defective. When the injector clicking noise is erratic, the injector plunger may be sticking. If there is no injector clicking noise, proceed with the injector resistance test and light to locate the cause of problem. 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. **ii) Ohmmeter test:** **Following are the steps of Ohm meter test for electronic fuel injector:** An ohmmeter is connected across the injector terminals to check the injector windings	**02 Marks for sound test &** **02 Marks for ohmmeter test**

		after the injector wires are disconnected. If the ohmmeter reading is infinite, the injector winding is open. An ohmmeter reading below the specified value indicates that the injector winding is shorted. A satisfied injector winding should have resistance between 0.3 to 0.4 ohms. Replace the injector if the results do not have the resistance as specified by manufacturer.	
4	**(b)**	**Attempt any ONE of the following:**	**06**
	I	**Describe the operation of charge indicator light circuit with simple wiring diagram in charging system.**	**06**
		Answer: **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.  	**03 Marks For Operation** **&** **03 Marks for fig**
	ii	**"Computer controlled ignition system is better as compared to conventional ignition system." Justify your answer.**	**06**
		Answer: **Computer controlled ignition system is better as compared to conventional ignition system** :	

Sr. No.	Computer controlled ignition system	conventional ignition system
1	Moving parts are absent-so no maintenance.	Regular maintenance is required due moving parts.
2	Contact breaker points are absent-so no arcing.	Arcing and pitting are the major problems in contact breaker points.
3	Spark plug life increases by 50% and they can be used for about 60000 km without any problem.	Spark plug life is short.
4	Better combustion in combustion chamber, about 90-95% of air fuel mixture is burnt compared with 70-75% with conventional ignition system.	Less combustion efficiency as compared to computer controlled ignition system.
5	More power output.	Comparatively Less power output
6	More fuel efficiency.	Due to maintenance problems, carbon deposits on spark plugs, fuel efficiency is less.

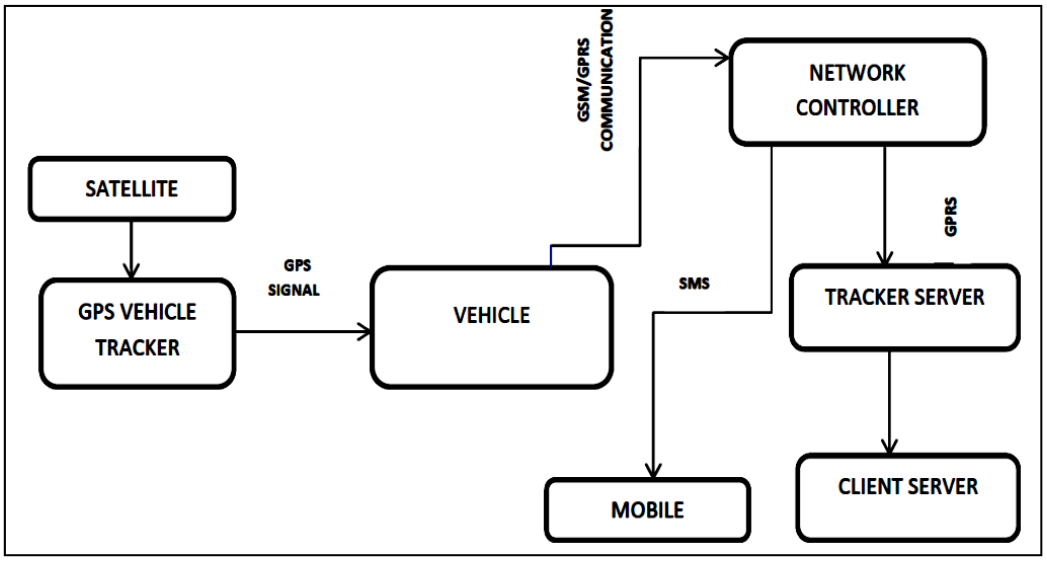
06 Marks

5 **Attempt any FOUR of the following:** **16**

A **Describe the working of GPS system with its block diagram .** **04**

Answer:

GPS(Global Positioning System) is a satellite-based navigation system. It provides time and location-based information to a GPS receiver, located anywhere on or near the earth surface. GPS works in all weather conditions, provided there is an unobstructed line of sight communication with 4 or more GPS satellites. GPS is managed by the US Air Force. A GPS operates independently of the user's internet connection or telephone signal. However, their presence increases the effectiveness of GPS positioning. GPS was initially developed by the US government for military purpose, but currently, anyone with a GPS receiver can receive radio signals from GPS satellites.

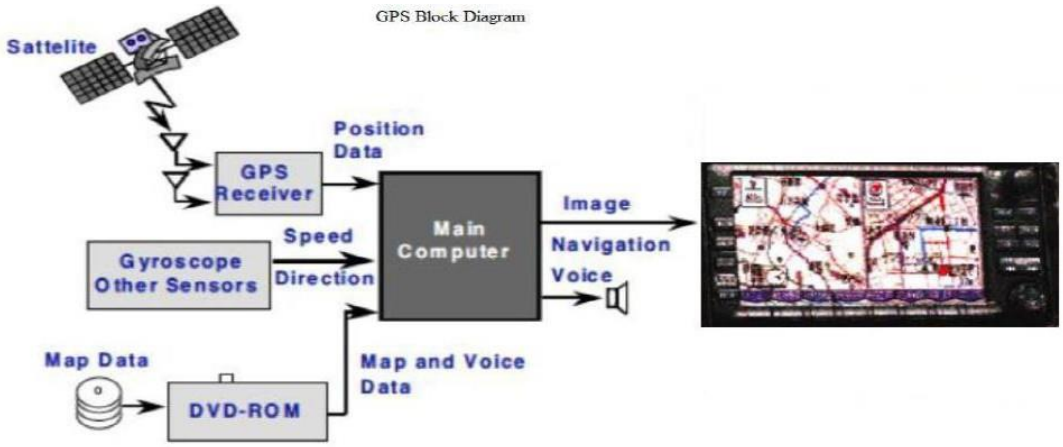


02 Marks for working

&

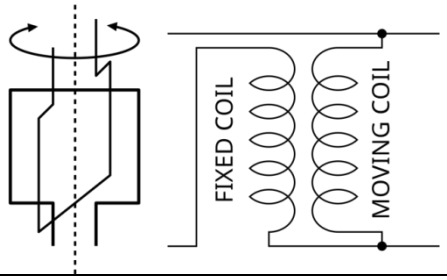
02 marks for block diagram

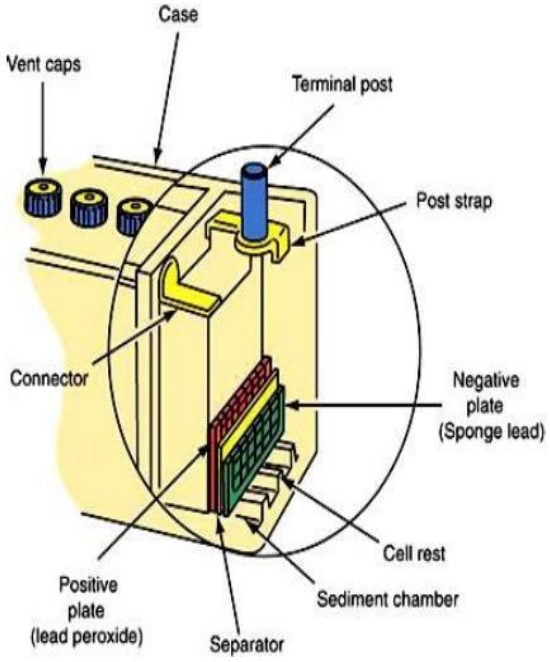
OR



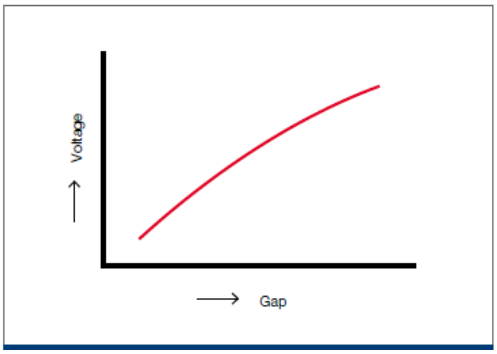
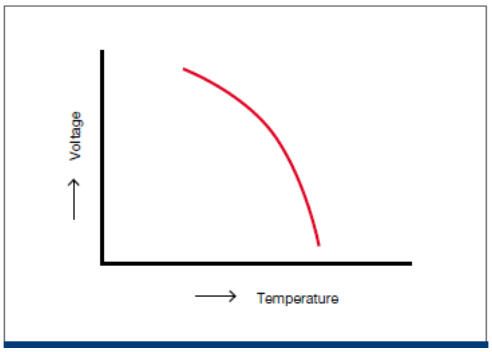
	B	**Describe anti-theft system used in vehicle.**	**04**
		Answer: **Anti-theft system:** An **anti-theft system** is any device or method used to prevent or deter the unauthorized appropriation of items considered valuable. Anti-theft systems have been around since individuals began stealing other people's property and have evolved accordingly to wart increasingly complex methods of theft. From the invention of the first lock and key to the introduction of RFID tags and biometric identification, anti-theft systems have evolved to match the introduction of new inventions to society and the resulting theft of them by others. **1. 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. **2. Passkey Systems** The passkey is a specially designed key, or transponder, that is selected and programmed just for the vehicle for which it was intended. Although another key may fit into the ignition switch or door lock, the system does not allow the engine to start without the correct electrical signal from the key. **3. Keyless Entry Systems** A keyless entry system allows the driver to unlock the doors or trunk lid from outside of the vehicle without using a key. It has two main components: an electronic control module and a coded-button keypad on the driver's door or a key fob **4. Alarm Systems:** The two methods for activating alarm systems are passive and active. Passive systems switch on automatically when the ignition key is removed or the doors are locked. They are often more effective than active systems. Active systems are activated manually with a key fob transmitter, keypad, key, or toggle switch.	**04 Marks**
	C	**“Overcharging and sulfation affects on the battery life.” Justify your answer.**	**04**
		Answer: (Credit should be given to an appropriate answer.)	

		1. Overcharging: a. If a battery is subjected to prolonged period of charging to restore it to its full charge condition, excessive heat will be produced, which will cause the positive plates to expand & warp. The swelling of positive plates takes place because the free oxygen continues to enter the positive plates even after complete conversion of lead sulphate into active material. This free oxygen starts attacking the grid and gradually converts it into lead peroxide .Since lead peroxide, since lead peroxide needs more space than lead, the plates expands & push upwards, raising the cell covers. Overcharging also affect the negative plates of battery. The negative plates become hard & dense. **2. Sulphation:** a. During battery discharge, the active materials in negative & positive plates get converted into lead sulphate. If battery is recharged without allowing it to stand in this condition, the lead sulphate will get reconverted into active material without any difficulty. On the other hand, if the battery is allowed to stand in discharged condition for a longer period, the lead sulphate will become hard, which shall resist reconversion. d. During this process, the negative plates become grayish white whereas positive plates tend to become milky white.	02 02
	D	**"On board diagnostic is important aspect in vehicle maintenance ." Justify your answer.**	**04**
		Answer: (Credit should be given to an appropriate answer.) **OBD is important to find out faults in minimum time by performing following functions.** 1. To enable the computer systems to monitor the ability of systems and components to maintain low emission. 2. The standardized data link connector, that allows for these tools to communicate with the PCM. 3. Identifying faults in the computer-controlled systems and to notify the driver by means of a malfunction indicator light if the emission related fault causes an increase in emission up to 1.5 times the allowable standard. 4. In addition a diagnostic trouble code (DTC) was stored in the compute's memory. 5. For easier diagnosis of a problem by a technician by using added information stored in the PCM. 6. It brings standardization in components and systems used by various automobile manufacturers. e.g. Data link connectors, data circuits, diagnostic tests and diagnostic trouble codes and generic codes. 7. .It provides almost complete engine control and also monitors parts of the chassis, body and accessory devices, as well as the diagnostic control network of a vehicle.	**04 Marks**
	e)	**How performance of the charging system can be improved? Justify.**	**04**
		Answer: (Credit should be given to an appropriate answer.) The charging system performance can be improved by improving performance of charging system components described as below: 1. Check the battery's water level every 2 to 3 months, only if it's a non-maintenance-free wet-cell battery. 2. Clean the battery terminals with a wire brush every 6 to 8 months 3. Coat the battery with grease made for high temperatures. 4. Inspect cell voltage every time you get an oil change or have your car in for	

		maintenance. 5. Check the battery insulator, if your car has one. 6. Take your car in to your mechanic or shop for regular servicing and tune-ups. 7. Check alternator belt regularly, adjust its tension as per manual if required. 8. Bad diodes are a common cause of alternator failure. If only one or two diodes have failed, the alternator may still produce enough current to meet the vehicle's electrical needs, but it may not be enough to keep up with higher loads or keep the battery fully charged. This could cause the battery to run down over time. 9. Loose wire connections also affects the performance of charging system which can be improved by proper tightening.	**04**
	f	**Which component of charging system is "responsible to maintain the constant system voltage, irrespective to the engine speed". Justify your answer with suitable reasons.**	**04**
		Answer: (Credit should be given to an appropriate answer.) A **voltage regulator** is a system designed to automatically maintain a constant voltage level. A voltage regulator may use a simple feed-forward design or may include negative feedback. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages. Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line. A simple voltage/current regulator can be made from a resistor in series with a diode (or series of diodes). Due to the logarithmic shape of diode V-I curves, the voltage across the diode changes only slightly due to changes in current drawn or changes in the input. When precise voltage control and efficiency are not important, this design may be fine. Since the forward voltage of a diode is small, this kind of voltage regulator is only suitable for low voltage regulated output. When higher voltage output is needed, a zener diode or series of zener diodes may be employed. Zener diode regulators make use of the zener diode's fixed reverse voltage, which can be quite large.  	04
6		**Attempt any FOUR of the following:**	**16**
	A	**Describe construction details of lead acid battery.**	**04**
	Ans	**Answer:** **Construction of lead acid battery:** Batteries are made of five basic components: A resilient plastic container. Positive and negative internal plates made of lead. Plate separators made of porous synthetic material.	

		Electrolyte, a dilute solution of sulfuric acid and water, better known as battery acid. Lead terminals, the connection point between the battery and whatever it powers. A battery consists of number of cells, generally six for 12V battery. Each cell consists of positive and negative plates separated by a separator and connected in series with positive and negative terminals of battery respectively. The plates are immersed in a solution of sulfuric acid, which acts as electrolyte. Each plate consists of a grid upon which is attached the active material, lead dioxide on the negative plates, pure lead on the positive plates.  	**02 marks for Construction & 02 marks Diagram**
	B	**How condition of battery and its temperature affects on charging system .**	**04**
		Answer: (Credit should be given to an appropriate answer.) **A) The Condition of Battery is referred as overcharged battery or undercharged battery and the effects is as below** **1. Undercharged Battery** If you have a car's battery that is often undercharged, even with regular charging, then without a doubt there is some problem with the charging system. The charging system of the car may not be working as per the requirement of the car's battery. This can also be related to as the problem like alternator not charging the battery but the alternator is good. **2. Overcharge Battery** Just like the undercharged battery, there can be the condition called an overcharged battery. As the charging system is not working properly and is causing a lot of fluctuations, the overcharged battery can be one of the issues in the alternator and charging point.	**02 marks Each** **&** **02 marks Each**

		Temperature: Operating a **battery** at elevated **temperatures** improves performance but prolonged exposure will shorten **life**. Cold **temperature** increases the internal resistance and owers the **capacity**. A **battery** that provides 100 percent **capacity** at 27°C (80°F) will typically deliver only 50 percent at –18°C (0°F)**.**	
	c	**"Regular maintenance improves battery life." Justify your answer.**	**04**
		Answer: **Following points should be consider while maintenance of battery which improves battery life:** 1. Do not attempt to charge a dried-out battery. If needed, add distilled (or drinking) water to just above the battery plates. Do not overfill. 2. Refer to any written instructions provided by the battery and charger manufacturers. 3. Identify the positive and negative terminals of the battery and attach the correct charger leads. 4. If charging a battery connected to a vehicle, be sure that the vehicle's electrical system has protection against overvoltage or be sure that the charger will not have high-charging voltages that may damage the vehicle's electrical system 5. Make sure the battery terminals are clean and free from corrosion. 6. Check the battery's water level every 2 to 3 months, only if it's a non- maintenance-free wet-cell battery. 7. Clean the battery terminals with a wire brush every 6 to 8 months 8. Coat the battery with grease made for high temperatures. 9. Inspect cell voltage every time you get an oil change or have your car in for maintenance.	**04 Marks**
	d	**How following factors affects on the establishment of spark** **(i) The rate of increase the voltage at the gap.** **(ii) The temp of the electrode.**	**04**
		Answer: (Credit should be given to an appropriate answer.) **The rate of increase the voltage at the gap.** **The requirement of voltage to generate the spark at the gap is 10kV to 40kV.** **The battery voltage is not sufficient to produce the spark across the gap of spark plug, therefore the rate of voltage is increased by using Ignition coil.** **The temp of the electrode.** The ideal operating temperature of the plug electrode is between 673 and 1173 K. The voltage required to create the spark reduced as the electrode temperature rises. Because the electrode temperature increases in proportion to engine speed.	**02 marks for Each** **&** **02 marks Each**

		 voltage required to create a spark increases with a larger plug gap  Voltage required to create a spark reduces with an increased electrode temperature	
	e	**How electronic ignition system improves the performance of the engine? Justify.**	**04**
		Answer: (Credit should be given to an appropriate answer.) **Electronic ignition system improves the performance of the engine:** It provides sufficiently strong spark between the electrodes of the plugs at correct timing. It works efficiently over the entire range of engine speed. It is light, effective and reliable in service It is compact and easy to maintain. It is capable to advance or retard ignition timing as per engine load and speed. Effective to trigger the primary circuit at appropriate time. Moving parts are absent-so no maintenance. Contact breaker points are absent-so no arcing. Spark plug life increases by 50% and they can be used for about 60000 km without any problem. Better combustion in combustion chamber, about 90-95% of air fuel mixture is burnt compared with 70-75% with conventional ignition system. With above benefits of electronic ignition system improves power output and performance of the engine.	**04 Marks**