Q.1) a) Describe the basic construction of lead acid battery. Explain the four basic battery capacity ratings systems.

Ans: Figure shows the makeup of a lead-acid battery container houses the separate cells. Most containers are hard rubber, plastic, or some other material that is resistant to the electrolyte and mechanical shock and will withstand extreme temperatures. The container (battery case) is vented through vent plugs to allow the gases that form within the cells to escape. The plates in the battery are the cathodes and anodes that were discussed earlier. In figure the negative plate group is the cathode of the individual cells and the positive plate group is the anode. As shown in the figure, the plates are interlaced with a terminal attached to each plate group. The terminals of the individual cells are connected together by link connectors as shown in figure. The cells are connected in series in the battery and the positive terminal of one end cell becomes the positive terminal of the battery. The negative terminal of the opposite end cell becomes the negative terminal of the battery.

Separators

Separators between the positive and negative plates prevent short-circuit through physical contact, mostly through dendrites ('treeing'), but also through shedding of the active material. Separators obstruct the flow of ions between the plates and increase the internal resistance of the cell. Wood, rubber, glass fiber mat, cellulose, and PVC or polyethylene plastic have been used to make separators. Wood was the original choice, but deteriorated in the acid electrolyte. Rubber separators were stable in the battery acid.

The terminals of a lead-acid battery are usually identified from one another by their size and markings. The positive terminal marked (+) is sometimes colored red and is physically larger than the negative terminal, marked (-).

Battery Capacity Ratings

Batteries are rated in amp hours (Ah), Cold Cranking Amps (CCA), Cold Cranking Power (CCP), and Marine Cranking Amps (MCA), reserve capacity or peak capacity. What does all this mean?

The amp-hour rate (or 20 hour rate) is measured at a current that drains the battery capacity in 20 hours to a voltage point of 10.5 volts. This test is conducted at 80°F.

Battery capacity and voltage are reduced as the temperature declines. To start a car on a freezing winter morning, a powerful battery is needed. CCA or CCP is the maximum discharge current in amps that a new, fully charged 12 volt battery

at 0°F can deliver for 30 seconds and maintain a voltage of 7.2 volts. MCA uses the same method except the temperature is 32°F. The higher the CCA or MCA rating the easier it will be to start your engine in cold weather.

Batteries are also rated in reserve capacity or peak capacity. Reserve capacity is a test in which a of 25 amps is placed on a battery at 80°F, and the time is measured until the battery discharge load voltage reaches an end point of 10.5 volts. The higher the reserve capacity the greater the amp-hours a battery hold.

b) What is the need of 42 volt technology? Explain transition period & list the advantages & disadvantages of 42 volt technology over 12 volt technologies.

Ans: 42 Volt Systems are rapidly emerging as the technical solution for improved emissions, fuel consumption and higher electrical power requirements. These higher power requirements can not be cost effectively or technically supplied by a 12V system.

Assuming a 6 to 8kW power requirement, it now becomes practical to combine the starter and alternator into a single starter-generator unit. This combination with the peak overload torque provides the capability for mini-hybrid (not to be confused with the full hybrids) start / stop operation at zero or little extra cost. Small engine performance, critical to 42 Volt adoption, is thus enhanced along with emissions and fuel consumption.

42 Volts will reduce the cost of some existing systems including: coil on plug, many solenoid operated devices, motor drive circuits, large power connectors, etc. But it will also lead to cost increases on certain types of devices such as relays, mechanical power switches, coil winding, motor components, etc.

42 Volts and its resulting higher power will be the enabler for a range of new technologies and the change agent for many others. Typical applications will include electric power steering, water pumps and door closures, advanced braking and suspension systems, hermetically sealed air conditioning, and further displacement of viscous fan drives.

Q.2) a) Explain in the difference between Independent (direct) & simultaneous (waste spark) ignition system.

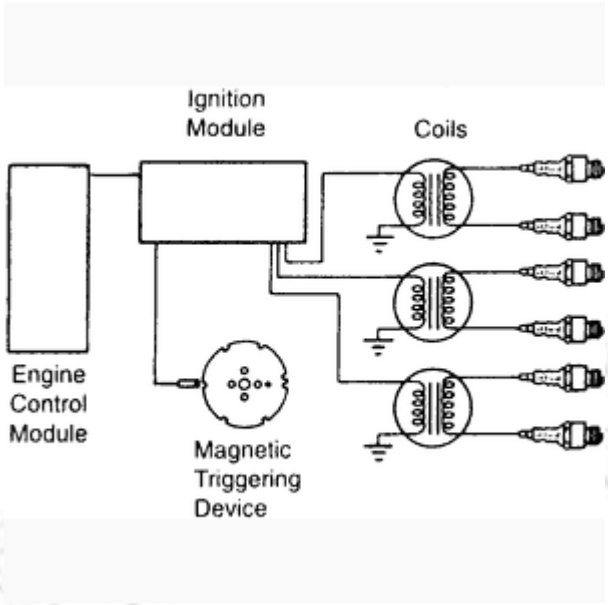
Ans: The ignition Direct Ignition is ignition with advance controlling. It is development for the two or four-cycle automobile and motorcycle engines. Controlling of advance it possible in range 0 to 90° in 180 to 20.500RPM. The ignition allow controlling one or exactly independent two switching of inductors.

All the functions and optional working ignition regimes can be set by a personal computer. For this reason there is a program Ignition Control that also enables Online visual control of real values of turns, pre-ignition (set-up time). To connect the personal computer through ignition the standard extension cable of USB link should be used.

Distributorless ignition systems
The third type of ignition system is the distributorless ignition. The spark plugs are fired directly from the coils. The spark timing is controlled by an Ignition Control Unit (ICU) and the Engine Control Unit (ECU). The distributorless ignition system may have one coil per cylinder, or one coil for each pair of cylinders.

Some popular systems use one ignition coil per two cylinders. This type of system is often known as the waste spark distribution method. In this system, each cylinder is paired with the cylinder opposite it in the firing order (usually 1-4, 2-3 on 4-cylinder engines or 1-4, 2-5, 3-6 on V6 engines). The ends of each coil secondary leads are attached to spark plugs for the paired opposites. These two plugs are on companion cylinders, cylinders that are at Top Dead Center (TDC) at the same time. But, they are paired opposites, because they are always at opposing ends of the 4 stroke engine cycle. When one is at TDC of the compression stroke, the other is at TDC of the exhaust stroke. The one that is on compression is said to be the event cylinder and one on the exhaust stroke, the waste cylinder. When the coil discharges, both plugs fire at the same time to complete the series circuit.

Since the polarity of the primary and the secondary windings are fixed, one plug always fires in a forward direction and the other in reverse. This is different than a conventional system firing all plugs the same direction each time. Because of the demand for additional energy; the coil design, saturation time and primary current flow are also different. This redesign of the system allows higher energy to be available from the distributorless coils, greater than 40 kilovolts at all rpm ranges. The Direct Ignition System (DIS) uses either a magnetic crankshaft sensor, camshaft position sensor, or both, to determine crankshaft position and engine speed. This signal is sent to the ignition control module or engine control module which then energizes the appropriate coil.



b) Explain the working principle & construction of the alternator. Explain rectification.

Ans: An alternator is an electromechanical device that converts mechanical energy to electrical energy in the form of alternating current. Most alternators use a rotating magnetic field but linear alternators are occasionally used. In principle, any AC electrical generator can be called an alternator, but usually the word refers to small rotating machines driven by automotive and other internal combustion engines. Alternators in power stations driven by steam turbines are called turbo-alternators.

Working principle-

Alternators generate electricity by the same principle as DC generators, namely, when the magnetic field around a conductor changes, a current is induced in the conductor. Typically, a rotating magnet called the rotor turns within a stationary set of conductors wound in coils on an iron core, called the stator. The field cuts across the conductors, generating an induced EMF, as the mechanical input causes the rotor to turn.

The rotating magnetic field induces an AC voltage in the stator windings. Often there are three sets of stator windings, physically offset so that the rotating magnetic field produces three phase currents, displaced by one-third of a period with respect to each other.

The rotor magnetic field may be produced by induction (in a "brushless" alternator), by permanent magnets (in very small machines), or by a rotor winding energized with direct current through slip rings and brushes. The rotor magnetic field may even be provided by stationary field winding, with moving poles in the rotor. Automotive alternators invariably use a rotor winding, which allows control of the alternator generated voltage by varying the current in the rotor field winding. Permanent magnet machines avoid the loss due to magnetizing current in the rotor, but are restricted in size, owing to the cost of the magnet material. Since

the permanent magnet field is constant, the terminal voltage varies directly with the speed of the generator. Brushless AC generators are usually larger machines than those used in automotive applications.

The main parts of alternators are stator, rotor. According to the construction of rotor alternators are classified into two types.

1. Salient pole alternator
2. Cylindrical pole alternator(Non salient pole alternator)

Construction of stator:

1. A stator for a dynamoelectric machine, comprising:

a stator core having a generally cylindrical shape, the stator core having a plurality of circumferentially spaced slots, a stator winding including a plurality of conductors, each conductor having a plurality of straight segments interconnecting a plurality of end loop segments

the plurality of conductors organized into at least a first filar and a second filar, the plurality of conductors organized into multiple phases defined by a circumferential pitch, each phase having a conductor in the first filar and a conductor in the second filar; the plurality of conductors organized into layers

Rectification-

A rectifier is an electrical device that converts alternating current (AC) to direct current (DC), a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals. Rectifiers may be made of solid state diodes, vacuum tube diodes, mercury arc valves, and other components.

A device which performs the opposite function (converting DC to AC) is known as an inverter.

When only one diode is used to rectify AC (by blocking the negative or positive portion of the waveform), the difference between the term *diode* and the term *rectifier* is merely one of usage, i.e., the term *rectifier* describes a *diode* that is being used to convert AC to DC. Almost all rectifiers comprise a number of diodes in a specific arrangement for more efficiently converting AC to DC than is possible with only one diode. Before the development of silicon semiconductor rectifiers, vacuum tube diodes and copper(I) oxide or selenium rectifier stacks were used.

Q.3) a) What is the purpose or function of a knock sensor? Explain in detail how the ECM(Engine computer) uses the knock sensor to control timing.

Ans: Knock Sensor

A knock sensor can be characterized as a tiny electronic microphone; it is put in place to listen for pre-ignition knocks and then regulate the timing by retarding it at two degree intervals. There are two types of pre-ignition; the first is when you get premature combustion in the cylinder before the piston reaches top dead center. This can be caused by dirty gas, low octane fuel, timing issues with the engine, and also by the wrong spark plugs. The second is engine run on, when the vehicle is turned off the engine still "rattles" as if it is on. The cause for this type of pre-ignition is a spark plug that is too hot or an improper plug for application. The knock sensor cannot help with this type of pre-ignition.

Working-

It detects the slightest noise in the engine and picks up on the "knock" of pre-ignition and sends the information to the ECM (Electronic Control Module). This 'ping' or 'knock' is caused when the mixture of air and gas does not burn smoothly or when it burns too soon. When the timing is off, this can also cause the knocking of the engine. The knock sensor is put in place to regulate these issues. This sensor is usually mounted on the block by a threaded edge that is screwed directly into the block of the engine and is connected to the ECM by wires. When the knocking or pinging is detected, the sensor sends a signal to the ECM, and this in turn retards the engine spark timing at two degree intervals until it has corrected the issue. The sensor's microphone is so sensitive it picks up the knocking when the human ear cannot detect it. It will hear the slightest ping even when the engine is at its top speed. Most vehicles are equipped with a knock sensor, although there are a few that aren't. All production turbo charged high performance vehicles come equipped with this knock sensor, because these engines are prone to pre-ignition issues.

b) Explain in detail the operation of the Zirconium Oxygen sensor. Explain in detail how the PCM (ECM) uses the O2 sensor information.

Ans: An oxygen sensor, or lambda sensor, is an electronic device that measures the proportion of oxygen (O_2) in the gas or liquid being analyzed. The original sensing element is made with a thimble-shaped zirconium ceramic coated on both the exhaust and reference sides with a thin layer of platinum and comes in both heated and unheated forms. The planar-style sensor entered the market in 1998 (also pioneered by Robert Bosch GmbH) and significantly reduced the mass of the ceramic sensing element as well as incorporating the heater within the ceramic structure. This resulted in a sensor that both started operating sooner and responded faster. The most common application is to measure the exhaust gas concentration of oxygen for internal combustion engines in automobiles and other vehicles. Divers also use a similar device to measure the partial pressure of oxygen in their breathing gas.

Scientists use oxygen sensors to measure respiration or production of oxygen and use a different approach. Oxygen sensors are used in oxygen analyzers which find a lot of use in medical applications such as anesthesia monitors, respirators and oxygen concentrators.

There are many different ways of measuring oxygen and these include technologies such as zirconium, electrochemical (also known as Galvanic), infrared, ultrasonic and very recently laser. Each method has its own advantages and disadvantages.

Automotive oxygen sensors, colloquially known as O_2 sensors, make modern electronic fuel injection and emission control possible. They help determine, in real time, if the air fuel ratio of a combustion engine is rich or lean. Since oxygen sensors are located in the exhaust stream, they do not directly measure the air or the fuel entering the engine. But when information from oxygen sensors is coupled with information from other sources, it can be used to indirectly determine the air-to-fuel ratio. Closed-loop feedback-controlled fuel injection varies the fuel injector output according to real-time sensor data rather than operating with a predetermined (open-loop) fuel map. In addition to enabling electronic fuel injection to work efficiently, this emissions control technique can reduce the amounts of both unburnt fuel and oxides of nitrogen from entering the atmosphere. Unburnt fuel is pollution in the form of air-borne hydrocarbons, while oxides of nitrogen (NO_x gases) are a result of combustion chamber temperatures exceeding 1,300 kelvins due to excess air in the fuel mixture and contribute to smog and acid rain. Volvo was the first automobile manufacturer to employ this technology in the late 1970s, along with the 3-way catalyst used in the catalytic converter.

The sensor does not actually measure oxygen concentration, but rather the amount of oxygen needed to completely oxidize any remaining combustibles in the exhaust gas. Rich mixture causes an oxygen demand. This demand causes a voltage to build up, due to transportation of oxygen ions through the sensor layer. Lean mixture causes low voltage, since there is an oxygen excess.

Modern spark-ignited combustion engines use oxygen sensors and catalytic converters in order to reduce exhaust emissions. Information on oxygen concentration is sent to the engine management computer or ECU, which adjusts the amount of fuel injected into the engine to compensate for excess air or excess fuel. The ECU attempts to maintain, on average, a certain air-fuel ratio by interpreting the information it gains from the oxygen sensor. The primary goal is a compromise between power, fuel economy, and emissions, and in most cases is achieved by an air-fuel-ratio close to stoichiometric. For spark-ignition engines

(such as those that burn gasoline, as opposed to diesel), the three types of emissions modern systems are concerned with are: hydrocarbons (which are released when the fuel is not burnt completely, such as when misfiring or running rich), carbon monoxide (which is the result of running slightly rich) and NO_x (which dominate when the mixture is lean). Failure of these sensors, either

through normal aging, the use of leaded fuels, or fuel contaminated with silicones or silicates, for example, can lead to damage of an automobile's catalytic converter and expensive repairs.

Q4) a) List the two starting system circuits. Explain in detail how a "Conventional starter" differs from that of a "Gear Reduction starter"

Ans: Both Otto cycle and Diesel cycle internal-combustion engines require the pistons to be moving before the ignition phase of the cycle. This means that the engine must be set in motion by an external force before it can power itself.

The modern starter motor is either a permanent-magnet or a series-parallel wound direct current electric motor with a solenoid switch (similar to a relay) mounted on it. When current from the starting battery is applied to the solenoid, usually through a key-operated switch, it pushes out the drive pinion on the starter driveshaft and meshes the pinion with the ring gear on the flywheel of the engine. Before the advent of key-driven starters, most electric starters were actuated by foot-pressing a pedestal located on the floor, generally above the accelerator pedal.

The solenoid also closes high-current contacts for the starter motor, which begins to turn. Once the engine starts, the key-operated switch is opened, a spring in the solenoid assembly pulls the pinion gear away from the ring gear, and the starter motor stops.

Gear-reduction starters

Chrysler Corporation contributed materially to the modern development of the starter motor. In 1962, Chrysler introduced a starter incorporating a geartrain between the motor and the driveshaft. Rolls Royce had introduced a conceptually similar starter in 1946, but Chrysler's was the first volume-production unit. The motor shaft has integrally-cut gear teeth forming a drive gear which mesh with a larger adjacent driven gear to provide a gear reduction ratio of 3.75:1. This permits the use of a higher-speed, lower-current, lighter and more compact motor assembly while increasing cranking torque. Variants of this starter design were used on most vehicles produced by Chrysler Corporation from 1962 through 1987. The Chrysler starter made a unique, readily identifiable sound when cranking the engine.

Those starters not employing offset gear trains like the Chrysler unit generally employ planetary epicyclic gear trains instead. Direct-drive starters are almost entirely obsolete owing to their larger size, heavier weight and higher current requirements.

b) Explain how the colors of the wire insulation are use & give an example. Explain how wire is sized, different sizing system & provide examples.

Ans: In order to quickly identify &also to simplify the wiring system, the cables are colored. The Seven color code system is general one as follows-

i) Brown cables- Brown cables are used for the battery circuits. It is used from the cranking motor switch to the ammeter to the radio receiver to the electrical clock to the inspection socket & to the battery auxiliary fuse.
ii) Yellow cables- These are used for the generator circuit. The cable is used from the generator terminal to the corresponding control box terminal & to the ignition warning light.
iii) White cables- These cables are used for the ignition circuit & also for other circuits Which do not require fuses.
iv) Green cables- These cables are used for all the auxiliary circuits e.g. Circuits are the brake stop lamps, the fuel gauge, the wind screen wiper, and the direction indicators.
v) Blue cables- These cables are used for the head lamp circuits.
vi) Red cables- These cables are used for the side lamp, tail lamp, fog lamp, panel light & other lamps.
vii) Black cables- These cables are used for the earth circuits.

In order to install any electrical wire installation, the proper wire size for the application is needed. But how do you know what size wire to use? Wire is sized by the American Wire Gauge (AWG) system. Your installation of conductors will depend on a few factors. The gauge of the wire, wire capacity, and what the wire will feed should all be considered.

You'll notice that the smaller the wire gauge, the larger the ampacity that the wire can handle. Wire ampacity is the safe amount of current that a wire can handle without getting hot or causing a fire. The following examples of devices in your home, the ampacity that they are rated for, and the wire gauge, will help you determine the right size wire for the appropriate application.

Wire Gauges and Uses

Wire Use	Rated Ampacity	Wire Gauge

Low-voltage Lighting and Lamp Cords	10 Amps	18 Gauge
Extension Cords	13 Amps	16 Gauge
Light Fixtures, Lamps, Lighting Runs	15 Amps	14 Gauge
Receptacles, 110-volt Air Conditioners, Sump Pumps, Kitchen Appliances	20 Amps	12 Gauge
Electric Clothes Dryers, 220-volt Window Air Conditioners, Built-in Ovens, Electric Water Heaters	30 Amps	10 Gauge
Cook Tops	45 Amps	8 Gauge
Electric Furnaces, Large Electric Heaters	60 Amps	6 Gauge
Electric Furnaces, Large Electric Water Heaters, Sub Panels	80 Amps	4 Gauge
Service Panels, Sub Panels	100 Amps	2 Gauge
Service Entrance	150 Amps	1/0 Gauge
Service Entrance	200 Amps	2/0 Gauge

Q.5) a) What is Telematics? Enlist the different applications of Telimatics technology.

Telematics:

Ans: A technology that uses two-way wireless communications between a vehicle and a processing center to transmit voice and data information from the vehicle and the driver. Also used to describe the industry that uses this technology to deliver services to consumers (consumer Telematics) and to commercial fleet owners and managers (commercial Telematics).

As combined, the term "Telematics" describes the process of long-distance transmission of computer-based information. The convergence of telecommunications and information processing, the term later evolved to refer to automation in automobiles, such as the invention of the emergency warning system for vehicles. GPS navigation, integrated hands-free cell phones, wireless safety communications and automatic driving assistance systems all are covered under the Telematics umbrella. "The potential for collection, aggregation, and storage of pertinent data that can be digested locally, or post-processed remotely."

Vehicle tracking

Vehicle tracking is a way of monitoring the location, movements, status and behavior of a vehicle or fleet of vehicles. This is achieved through a combination of a GPS(GNSS) receiver and an electronic device (usually comprising a GSM GPRS modem or SMS sender) installed in each vehicle, communicating with the user (dispatching, emergency or coordinating unit) and PC- or web-based software.

Trailer tracking

Trailer tracking is the technology of tracking the movements and position of an articulated vehicle's trailer unit, through the use of a location unit fitted to the trailer and a method of returning the position data via mobile communication network or geostationary satellite communications, for use through either PC- or web-based software.

Satellite navigation

Satellite navigation in the context of vehicle Telematics is the technology of using a GPS and electronic mapping tool to enable the driver of a vehicle to locate a position, then route plan and navigate a journey.

Wireless vehicle safety communications

Wireless vehicle safety communications Telematics aid in car safety and road safety. It is an electronic sub-system in a car or other vehicle for the purpose of

exchanging safety information, about such things as road hazards and the locations and speeds of vehicles, over short range radio links.

Emergency warning system for vehicles

Emergency warning system for vehicles Telematics particularly developed for international harmonization and standardization of vehicle-to-vehicle — infrastructure-to-vehicle — and vehicle-to-infrastructure real-time Dedicated Short Range Communication (DSRC) systems.

b) Explain the Air management system used in modern automotive. What is the role of a catalytic converter?

Ans: A charge air management system for an automotive engine includes a charge air-to-liquid coolant heat exchanger for receiving refrigerated liquid coolant from a reservoir. The liquid coolant is refrigerated by means of an engine driven refrigerant system including a compressor, a condenser, and an evaporator mounted within the reservoir.

A catalytic converter (colloquially, "cat" or "cat-con") is a device used to reduce the toxicity of emissions from an internal combustion engine. First widely introduced on series-production automobiles in the U.S. market for the 1975 model year to comply with tightening EPA regulations on auto exhaust, catalytic converters are still most commonly used in motor vehicle exhaust systems. Catalytic converters are also used on generator sets, forklifts, mining equipment, trucks, buses, trains, and other engine-equipped machines. A catalytic converter provides an environment for a chemical reaction wherein toxic combustion by-products are converted to less-toxic substances.

three-way catalytic converters have been used in vehicle emission control systems in North America and many other countries on road going vehicles. A three-way catalytic converter has three simultaneous tasks:

1. Reduction of nitrogen oxides to nitrogen and oxygen: $2NO_x \rightarrow xO_2 + N_2$
2. Oxidation of carbon monoxide to carbon dioxide: $2CO + O_2 \rightarrow 2CO_2$
3. Oxidation of unburnt hydrocarbons (HC) to carbon dioxide and water: $C_xH_{2x+2} + [(3x+1)/2]O_2 \rightarrow xCO_2 + (x+1)H_2O$

Q.6) a) What are the different types of lamps used in Automobile? Explain their working & construction with the neat sketch.

Ans: 1 Headlamps

1.1 Dipped beam (low beam, passing beam, meeting beam)

1.2 Main beam (high beam, driving beam, full beam)

2. Auxiliary lamps

2.1 Driving lamps
2.2 Rallye and off-road lamps
2.3 Front fog lamps
2.4 Cornering lamps
2.5 Spot lights

3 Conspicuity, signal and identification lights

Front
3.1 Front position lamps (parking lamps, standing lamps)
3.2 Daytime running lamps
3.3 Dim-Dip Lamps

Dipped beam (low beam, passing beam, meeting beam)

Dipped-beam (also called low, passing, or meeting beam) headlamps provide a light distribution to give adequate forward and lateral illumination without blinding other road users with excessive glare. This beam is specified for use whenever other vehicles are present ahead.

Main beam (high beam, driving beam, full beam)

Main-beam (also called high, driving, or full beam) headlamps provide an intense, centre-weighted distribution of light with no particular control of glare. Therefore, they are only suitable for use when alone on the road, as the glare they produce will dazzle other drivers.

Driving lamps

High beam headlamps augmented by auxiliary driving lamps

"Driving lamp" is a term deriving from the early days of nighttime driving, when it was relatively rare to encounter an opposing vehicle. Only on those occasions when opposing drivers passed each other would the dipped or "passing" beam be used. The full beam was therefore known as the driving beam, and this terminology is still found in international ECE Regulations, which do not distinguish between a vehicle's primary (mandatory) and auxiliary (optional) upper/driving beam lamps

Rallye and off-road lamps

Vehicles used in rallying, off-roading, or at very high speeds often have extra lamps to broaden and extend the field of illumination in front of the vehicle. On off-road vehicles in particular, these additional lamps are sometimes mounted along with forward-facing lights on a bar above the roof, which protects them from road hazards and raises the beams allowing for a greater projection of light forward.

Front fog lamps

A pair of yellow fog lamps

Front fog lamps provide a wide, bar-shaped beam of light with a sharp cutoff at the top, and are generally aimed and mounted low.[10][11][12] They may be either white or selective yellow. They are intended for use at low speed to increase the illumination directed towards the road surface and verges in conditions of poor visibility due to rain, fog, dust or snow. As such, they are often most effectively used in place of dipped-beam headlamps, reducing the glareback from fog or falling snow, although the legality varies by jurisdiction of using front fog lamps without low beam headlamps.

Cornering lamps

A cornering lamp on a 1983 Automobile 98.

On some models, white cornering lamps provide extra lateral illumination in the direction of an intended turn or lane change. These are actuated in conjunction with the turn signals, though they burn steadily, and they may also be wired to illuminate when the vehicle is shifted into reverse gear,[15] as is done on many Saabs and Corvettes.

Spot lights

Police cars, emergency vehicles, and those competing in road rallies are sometimes equipped with an auxiliary lamp, sometimes called an alley light, in a swivel-mounted housing attached to one or both a-pillars, detectable by a handle protruding through the pillar into the vehicle. Until the mid-1940s, these spot lamps could be found as standard equipment on expensive cars

b) The exhaust emission can be control by engine design? Explain in details.

Ans: Exhaust emission can be control by some modification in engine & some equipment attached with engine. These are explain as follows-

Motor vehicles produce many different pollutants. The principal pollutants of concern—those that have been demonstrated to have significant effects on human, animal, plant, and environmental health and welfare—include:

Hydrocarbons, Carbon monoxide, Nitrogen oxide, CO2, Particulates, Sulphur oxide.

Tailpipe emissions control

Engine efficiency has been steadily improved with improved engine design, more precise ignition timing and electronic ignition, more precise fuel metering, and computerised engine management.

Advances in engine and vehicle technology continually reduce the toxicity of exhaust leaving the engine, but these alone have generally been proved insufficient to meet emissions goals. Therefore, technologies to detoxify the exhaust are an essential part of emissions control.

Air injection

One of the first exhaust emission control systems is secondary air injection. Originally, this system was used to inject air into the engine's exhaust ports, providing oxygen to burn unburned hydrocarbons in the engine exhaust. The air injection is now used to reduce startup emissions. An engine has to run richer at start, and the catalytic converter has not sufficiently warmed up at that time, thus the SAI burns off the rich hydrocarbons.

Exhaust gas recirculation

Many engines produced after the 1973 model year have an exhaust gas recirculation (EGR) valve between the exhaust and intake manifolds. The valve opens under certain conditions to admit exhaust into the intake tract. Exhaust is largely inert — it neither burns nor supports combustion — so it dilutes the air/fuel charge to reduce peak combustion chamber temperatures. This, in turn, reduces the formation of NO_x.

Catalytic converters

The catalytic converter is a device placed in the exhaust pipe, which converts hydrocarbons, carbon monoxide, and NO_x into less harmful gases by using a combination of platinum, palladium and rhodium as catalysts.

Q7) Write a short note on

a) GPS System

Ans: The Global Positioning System (GPS) is a space-based global navigation satellite system that provides reliable location and time information in all weather and at all times and anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the United States government and is freely accessible by anyone with a GPS receiver.

The GPS System was created and realized by the U.S. Department of Defense (DOD) and was originally based on and run with 24 satellites. It was established in 1973 to reduce the large number of navigation aids and to overcome the limitations of previous navigation systems.

The GPS consists of three parts: the space segment, the control segment, and the user segment.

GPS has become a widely used aid to navigation worldwide, and a useful tool for map-making, land surveying, commerce, scientific uses, tracking and surveillance, and hobbies such as geocaching and waymarking. The precise time reference provided by GPS is used in many applications including the scientific study of earthquakes and as a time synchronization source for cellular network protocols.

b) X-by wire-

Ans:X-by-Wire is the generic term used when clunky and inaccurate mechanical systems are replaced with precise electronic sensors and actuators. Many of the advancements to come as a result of the 42-volt bus can be lumped into the category of X-by-Wire. This X-by-Wire trend has been evident in the automotive industry for years. The trend can be seen in the implementation of fuel injectors to replace their bulky counterpart, the carburetor, and in the development of electronically controlled brakes know as ABS. X-by-Wire is not a new program to implement, but a term capturing the existing trend of development and pointing in the direction of future advancements.

Many are hesitant to move to X-by-Wire for reliability and safety concerns. Conventional mechanical systems have stood the test of time and have proven to be reliable. More than a decade ago, the United States Air force went through a similar struggle in the change over from mechanical and hydraulic linkages to electrical connections in aircraft. The now indispensable fly-by-wire endured much scrutiny at its conception. An electrical failure could be catastrophic to any X-by-Wire system. In military applications, such a failure would be totally unacceptable. Military craft are required to function in some of the most extreme conditions in the world with unacceptable consequences of failure. Redundant electrical systems were developed and have been implemented in both military and commercial aircraft over the past decade. Fly-by-wire has allowed improvements to the military that would have otherwise been impossible. New standards being met by military aircraft could only be achieved using X-by-Wire. The latest air force development, the F-22 Raptor, is fully fly-by-wire, enabling it to perform maneuvers once thought impossible. X-bywire systems are now being incorporated into military land units as well. The new Grizzly Tank, the army's high-tech ground-assault vehicle, utilizes X-by-Wire [2]. The military has proven that X-by-Wire can be both reliable and highly effective.

c) ABS

Ans: An anti-lock braking system, or ABS is a safety system which prevents the wheels on a motor vehicle from locking up (or ceasing to rotate) while braking.

A rotating road wheel allows the driver to maintain steering control under heavy braking by preventing a skid and allowing the wheel to continue interacting tractively with the road surface as directed by driver steering inputs. ABS offers improved vehicle control and decreases stopping distances on dry and especially

slippery surfaces. However, on loose surfaces like gravel and snow-on-pavement, it can slightly increase braking distance while still improving vehicle control.[1]

Since initial widespread use in production cars, anti-lock braking systems have evolved considerably

A typical ABS is composed of a central electronic control unit (ECU), four wheel speed sensors — one for each wheel — and two or more hydraulic valves within the brake hydraulics. The ECU constantly monitors the rotational speed of each wheel, and when it detects a wheel rotating significantly slower than the others — a condition indicative of impending wheel lock — it actuates the valves to reduce hydraulic pressure to the brake at the affected wheel, thus reducing the braking force on that wheel. The wheel then turns faster; when the ECU detects it is turning significantly faster than the others, brake hydraulic pressure to the wheel is increased so the braking force is reapplied and the wheel slows. This process is repeated continuously, and can be detected by the driver via brake pedal pulsation. A typical anti-lock system can apply and release braking pressure up to 20 times a second

TCS-

A traction control system (TCS), also known as Anti-Slip Regulation (ASR), is typically (but not necessarily) an electro-hydraulic system on production vehicles designed to prevent loss of traction of the driven road wheels, and therefore maintain the control of the vehicle when excessive throttle is applied by the driver and the condition of the road surface (due to varying factors) is unable to cope with the torque applied. Although similar to electronic stability control (ESC) systems, traction control systems do not have the same goal.

The intervention can consist of one or more of the following:

- Retard or suppress the spark to one or more cylinders
- Reduce fuel supply to one or more cylinders
- Brake one or more wheels
- Close the throttle, if the vehicle is fitted with drive by wire throttle
- In turbo-charged vehicles, the boost control solenoid can be actuated to reduce boost and therefore engine power.

Typically, the traction control system shares the electro-hydraulic brake actuator (but does not use the conventional master cylinder and servo), and the wheel speed sensors with the anti-lock braking system.

d) Dies-Otto & HCCL-

Ans: The Mercedes-Benz DiesOtto is an experimental automobile engine that "is said to incorporate the benefits of a diesel engine, but runs on regular old unleaded."[1]

Its name is a portmanteau of *Diesel* and *Otto*, referring to the Diesel engine, first introduced by German engineer Rudolf Diesel, and the Otto cycle, as a reference to Nicolaus Otto

The concept engine has an in-line, four-cylinder configuration and displaces 1.8 litre. Its peak power is no less than 175 kW (235 hp), making its specific output 97 kW/L (130 hp/L), and its peak torque is 400 N·m, making its specific torque 220 N·m/L. Mercedes-Benz do not specify the RPM at which these specified maxima are reached.[2]

The DiesOtto features the following:

- HCCI (Homogeneous Charge Compression Ignition);
- variable valve timing;
- twin variable geometry turbo charging;
- variable compression ratio;
- Direct fuel injection.

It also uses a starter-alternator to reduce fuel consumption. The starter-alternator replaces the engine's flywheel, and allows the engine to be started instantaneously so that it can simply stop when not needed, such as at traffic lights, and smoothly re-start when needed.