



WINTER – 2022 EXAMINATION  
Model Answer

**Subject Name:** Automobile Engineering.

**Subject Code:**

22656

**Important Instructions to examiners:**

- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills).
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
- 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
- 6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.
- 8) As per the policy decision of Maharashtra State Government, teaching in English/Marathi and Bilingual (English + Marathi) medium is introduced at first year of AICTE diploma Programme from academic year 2021-2022. Hence if the students in first year (first and second semesters) write answers in Marathi or bilingual language (English +Marathi), the Examiner shall consider the same and assess the answer based on matching of concepts with model answer.

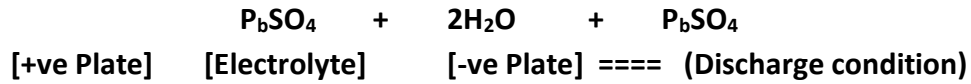
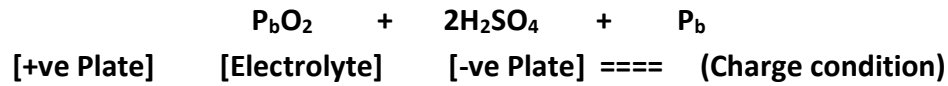
Q. No.	Sub Q. N.	Answer	Marking Scheme																														
1		<b>Attempt any FIVE of the following: (2 x 5 )</b>	10																														
	a	<p><b>Compare front engine front wheel drive (FEFWD) with front engine rear wheel drive (FERWD) (Any Four Points).</b></p> <p><b>Comparisons between FEFWD Vs FERWD:</b></p> <table border="1"> <thead> <tr> <th>S.N.</th> <th>Front Engine Front Wheel Drive</th> <th>Front Engine Rear Wheel Drive</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Engine is mounted in front of the front axle, and the drive is also given to the front axle for driving the front wheels.</td> <td>Engine is mounted at the front and the power is transmitted from the engine to the differential, rear axle via the propeller shaft.</td> </tr> <tr> <td>2</td> <td>More weight distribution at forward.</td> <td>Balanced (Even) weight distribution</td> </tr> <tr> <td>3</td> <td>No need for a Propeller shaft for power flow.</td> <td>Need of Propeller shaft for power flow.</td> </tr> <tr> <td>4</td> <td>No speed limitations due to the absence of a propeller shaft.</td> <td>Speed limitations due to whirling of the propeller shaft.</td> </tr> <tr> <td>5</td> <td>Increased interior space.</td> <td>Decreased interior space.</td> </tr> <tr> <td>6</td> <td>Lower center of gravity.</td> <td>Higher center of gravity.</td> </tr> <tr> <td>7</td> <td>Ground clearance is less.</td> <td>Ground clearance is more.</td> </tr> <tr> <td>8</td> <td>Improved fuel efficiency due to less weight.</td> <td>Less fuel efficient compared to Front Engine Front Wheel Drive.</td> </tr> <tr> <td>9</td> <td>Lower initial cost.</td> <td>Higher initial cost.</td> </tr> </tbody> </table>	S.N.	Front Engine Front Wheel Drive	Front Engine Rear Wheel Drive	1	Engine is mounted in front of the front axle, and the drive is also given to the front axle for driving the front wheels.	Engine is mounted at the front and the power is transmitted from the engine to the differential, rear axle via the propeller shaft.	2	More weight distribution at forward.	Balanced (Even) weight distribution	3	No need for a Propeller shaft for power flow.	Need of Propeller shaft for power flow.	4	No speed limitations due to the absence of a propeller shaft.	Speed limitations due to whirling of the propeller shaft.	5	Increased interior space.	Decreased interior space.	6	Lower center of gravity.	Higher center of gravity.	7	Ground clearance is less.	Ground clearance is more.	8	Improved fuel efficiency due to less weight.	Less fuel efficient compared to Front Engine Front Wheel Drive.	9	Lower initial cost.	Higher initial cost.	02 <b>Any four Points, 1/2 M for each)</b>
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	10	Applications: TATA Indica, Maruti 800, Maruti Omni, Matador	Applications: Ambassador, Fiat, Truck & Buses	
b Ans.	<p><b>State working principle of a centrifugal clutch.</b></p> <p><b>Working Principle of Centrifugal Clutch:</b> The centrifugal clutch operates on a <u>principle of centrifugal force</u>, instead of spring force for keeping it in the engaged position. The force acting away from the center; is known as a Centrifugal force. Centrifugal clutch does not require a clutch pedal for operation. The clutch is operated automatically depending on the engine speed. The vehicle can be stopped in gear without stalling the engine. Similarly, the vehicle can be started in any gear by pressing the accelerator pedal. This makes the driving operation very easy.</p>		<b>2 M for appropriate principle statement</b>	
C Ans	<p><b>Define under steering and over steering.</b></p> <p>During turns, <i>centrifugal force</i> acts on the wheels. Two cases can arise; <b>(i) Under steering (ii) Oversteering</b>. These two conditions are equally valid even when the vehicle is going straight and is subjected to <i>side force</i> due to <i>road camber</i> or some <i>crosswind</i>.</p> <p><b>Under Steering:</b> The vehicle will try to move away from its normal direction of motion &amp; therefore to keep it on the right path, the driver shall have to steer a little more than is theoretically needed. This condition is known as <u>Understeer</u>.</p> <p><b>Over Steering:</b> The vehicle will try to move in its normal direction of motion &amp; therefore to keep it on the right path, the driver shall have to steer a little less than is theoretically needed. This condition is known as <u>Oversteer</u>.</p>		<p style="text-align: right;"><b>01</b></p> <p style="text-align: right;"><b>01</b></p>	
d Ans	<p><b>List components of a vehicle counted in sprung and un-sprung weight.</b></p> <p><b>Components of vehicle counted in Sprung weight:</b> It is the weight supported by the spring. (Anything carried by the weight of springs.), which includes; <u><b>the weight of the frame, body, engine, and entire transmission system.</b></u></p> <p><b>Components of vehicle counted in Unsprung weight:</b> It is the weight of other parts of the vehicle which is not supported by springs, including; <u><b>the weight of the rear axle assembly, steering knuckle, front axle, wheels, tires, and brakes.</b></u></p>		<p style="text-align: right;"><b>01</b></p> <p style="text-align: right;"><b>01</b></p>	
e Ans	<p><b>Write the principle of working of Lead acid battery.</b></p> <p><b>Principle of Working of Lead Acid Battery:</b> It operates on the <u>principle of Electrolysis</u>. Electrolysis is the conduction of electricity between two electrodes immersed in a solution containing ions (electrolytes), which causes chemical changes at the electrodes. When two dissimilar metal plates for example one copper and one zinc, were immersed in an acid solution and joined by a</p>		<b>02</b>	



wire a small current flowed through the circuit. This basic principle is used in Lead acid batteries with active materials used as lead peroxide ( $PbO_2$ ) on a positive plate and spongy lead ( $Pb$ ) on a negative plate along with a combination of distilled water and sulphuric acid ( $H_2SO_4$ ) as an electrolyte.



**(2 Marks for an appropriate explanation of the principle of electrolysis/Chemical reaction of lead acid battery)**

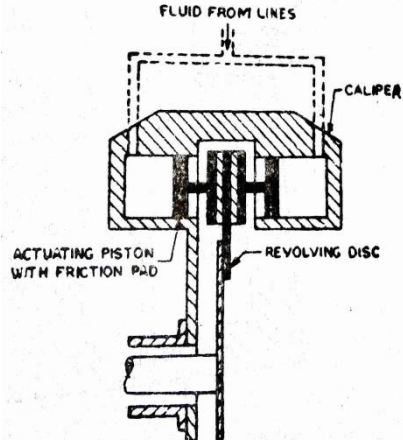
f Ans	<p><b>Define HGV and MGV.</b></p> <p><b>Heavy Goods Vehicle (HGV):</b></p> <p>HGV means any goods carriage with the gross vehicle weight of which or a tractor or a road roller the unladen weight of either of which, exceeds 12,000 kg.</p> <p><b>Medium Goods Vehicle (MGV):</b></p> <p>MGV means any goods carriage other than a light motor vehicle or a heavy goods vehicle.</p>	<p><b>01</b></p> <p><b>01</b></p>
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g Ans	<p><b>State need of universal joint and slip joint used in the propeller shaft.</b></p> <p><b>Need of Universal Joint and Slip Joint in propeller shaft:</b></p> <p><b>Need for Universal Joint:</b></p> <p>A universal joint is a particular type of connection between two shafts, whose axes are inclined to each other. It is used where two shafts are connected at an angle to transmit the torque. The purpose of the universal joint in an automobile is to absorb the angular changes brought about by changes in relative positions of the differential in relation to the transmission and in this way to smoothly transmit power from the transmission to the differential. U joints take care of the variation in the inclination of the propeller shaft during the up-and-down movement of the vehicle.</p> <p><b>Need of Slip (Sliding) Joint:</b></p> <p>Depending upon the type of drive, one slip joint may be there in the shaft. This serves to adjust the length of the propeller shaft when demanded by the rear axle movements. Slip joint used to accommodate the change in length due to road irregularities.</p>	<p><b>01</b></p> <p><b>01</b></p>
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2		<b>Attempt any THREE of the following: (3 x 4)</b>	<b>12</b>																																	
a	<b>Ans</b>	<p><b>List different frames used in automobile construction. Write functions of the frame.</b></p> <p><b>Types of Frames used in Automobiles:</b></p> <p><b>(A) According to Construction:</b></p> <p>(i) Conventional frame (ii) Integral Frame (Unitized Body/Frameless construction/Monocoque construction) (iii) Sub/Half Integral frame</p> <p><b>(B) According to Engine Position:</b></p> <p>(i) Full Forward Chassis Frame (ii) Semi Forward Chassis Frame (iii) Bus Chassis Frame</p> <p><b>Functions of Frame:</b></p> <p>[1] To support the chassis components and the body. [2] To withstand static and dynamic loads. [3] To carry the weight of the vehicle and its passengers. [4] To withstand the centrifugal force while cornering. [5] To propel the vehicle directs its motion. [6] To maintain the space and relationship between the other parts.</p> <p><b>(Any two appropriate types of Chassis Frame: 1 M each, Any two appropriate functions of Chassis frame: 1 M each)</b></p>	<b>02</b>         <b>02</b>																																	
b	<b>Ans</b>	<p><b>List various parts of the synchromesh gear box with the role of each component.</b></p> <table border="1"><thead><tr><th>S. No.</th><th>Name of Component</th><th>Role/Function of Component</th></tr></thead><tbody><tr><td>1</td><td>Clutch (Engine Shaft)</td><td>Connected to the flywheel as the input shaft.</td></tr><tr><td>2</td><td>Gears on Main (Splined) Shaft</td><td>Gears on the main shafts are free and always in mesh with corresponding gears on the countershaft.</td></tr><tr><td>3</td><td>Free Members</td><td>Free members are free to slide on splines on the main shaft.</td></tr><tr><td>4</td><td>Ring Shaped Member</td><td>Ring-shaped members having internal teeth fit onto the external teeth members.</td></tr><tr><td>5</td><td>Dog Teeth on Gear B &amp; Gear D</td><td>Dog teeth fit onto the teeth of ring-shaped members.</td></tr><tr><td>6</td><td>Forks</td><td>Used to select appropriate gear as per requirement.</td></tr><tr><td>7</td><td>Spring Loaded Balls</td><td>Tend to prevent the sliding of ring-shaped members on free members.</td></tr><tr><td>8</td><td>Frictional Surfaces</td><td>Frictional surfaces are slightly attached and meshed with the respective conical faces of gears after synchronizing the speed as per gear requirement.</td></tr><tr><td>9</td><td>Gears on Counter Shaft</td><td>Always fixed on the countershaft and meshed with the gears on the main shaft.</td></tr><tr><td>10</td><td>Reverse Gear on Reverse Shaft</td><td>To make reverse position arrangement.</td></tr></tbody></table>	S. No.	Name of Component	Role/Function of Component	1	Clutch (Engine Shaft)	Connected to the flywheel as the input shaft.	2	Gears on Main (Splined) Shaft	Gears on the main shafts are free and always in mesh with corresponding gears on the countershaft.	3	Free Members	Free members are free to slide on splines on the main shaft.	4	Ring Shaped Member	Ring-shaped members having internal teeth fit onto the external teeth members.	5	Dog Teeth on Gear B & Gear D	Dog teeth fit onto the teeth of ring-shaped members.	6	Forks	Used to select appropriate gear as per requirement.	7	Spring Loaded Balls	Tend to prevent the sliding of ring-shaped members on free members.	8	Frictional Surfaces	Frictional surfaces are slightly attached and meshed with the respective conical faces of gears after synchronizing the speed as per gear requirement.	9	Gears on Counter Shaft	Always fixed on the countershaft and meshed with the gears on the main shaft.	10	Reverse Gear on Reverse Shaft	To make reverse position arrangement.	<b>Appropriate name of any four components along with function/role, 1 M for each</b>
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C	<p><b>Describe the working of the Disc brake. Draw a neat sketch.</b></p> <p><b>Working of Disc Brake:</b></p> <p>Motor vehicles are now fitted with disc brakes instead of conventional drum brakes. Disc brakes use friction to create braking power. Disc brakes create braking power by forcing flat friction pads against the sides of the rotating disc. Disc brake mainly consists of, (i) Rotor (ii) Caliper, and (iii) Brake pads. In between each piston &amp; disc, a friction pad is held in position by springs. When the brakes are applied, hydraulically actuated pistons move the friction pads into contact with the discs, applying equal and opposite forces on the latter. On releasing the brakes, the rubber sealing rings act as return springs and retract the pistons and the friction pads away from the disc.</p>  <p style="text-align: center;"><b>Figure: Disc Brake</b></p>	<p><b>02 M for appropriate working of disc brake, 02 M for neat labeled sketch</b></p>
d  Ans	<p><b>Explain the working of gas-filled shock absorbers in brief. Draw a simple sketch for the same</b></p> <p><b>Gas-Filled Shock Absorber:</b></p> <p>The gas-filled shock absorber is a hydraulic shock absorber that is <i>charged with gas</i>. The principal gas used in <i>nitrogen</i> is kept under either; <i>Low pressure (10-15 Kg/cm<sup>2</sup>)</i> or <i>High pressure (20-30 Kg/cm<sup>2</sup>)</i>.</p> <p><b>Working of Gas-Filled Shock Absorber during Bounding (Compression):</b></p> <p>The piston rod moves downward, causing the pressure of the fluid to be higher in the lower chamber than in the upper chamber. Therefore, the fluid in the lower chamber is forced into the upper chamber through the piston valve. At this time, the damping force is generated by the flow resistance of the valve. The high-pressure gas exerts great pressure on the fluid in the lower chamber, forcing it to flow quickly &amp; smoothly into the upper chamber. This ensures a stable damping force.</p> <p><b>Working of Gas Filled Shock Absorber during Rebounding (Expansion):</b></p> <p>The piston rod moves upward causing the fluid pressure in the upper chamber to be higher than that in the lower chamber. Therefore, the fluid in the upper chamber is forced into the lower chamber through the piston valve and the resistance exerted by the valve acts as a damping force. Since the rod moves upward, a portion of it moves</p>	<p><b>02 M for the appropriate working of Gas Filled Shock Absorber, 02 M for suitably labeled sketch</b></p>

out of the cylinder, so the volume of fluid displaced by it decreases. To compensate for this, the free piston is pushed upward by a distance equivalent to this volume.

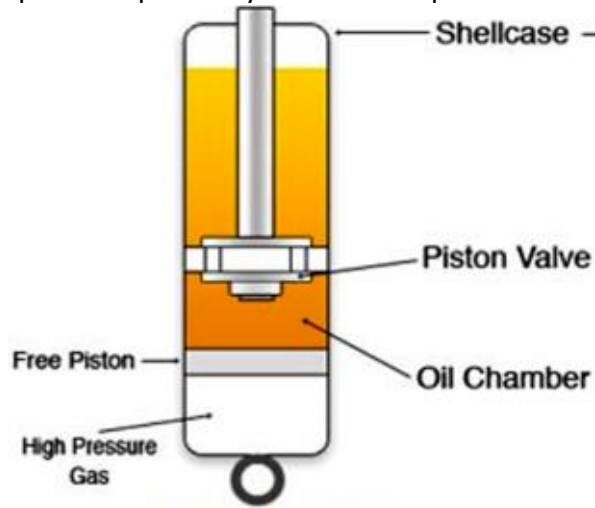


Figure: Monotube Type Gas Filled Shock Absorber

3

Attempt any **THREE** of the following (3 x 4)

12

a

Explain the following terms related with car Aerodynamics. (i) Drag (ii) Lift

**(i) Drag:** It is the largest and most important aerodynamic force encountered by a vehicle at normal highway speeds. The major factors included in aerodynamic drag are- Induced drag, profile drag, and Friction drag. It depends on the shape of the body. Air drag is given by the equation,

$$D_A = \frac{1}{2} \rho V^2 C_D A$$

Where,  $\rho$  = Density of air

$V$  = Speed of Vehicle

$C_D$  = Coefficient of Drag

$A$  = Frontal Area of the vehicle.

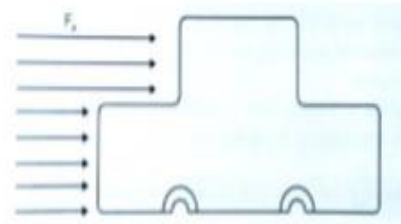


Figure Aerodynamic Drag

**(ii) Lift:** The pressure difference from the top to bottom of the vehicle causes the lift force. The lift force is measured at the centerline of the vehicle at the center of the wheelbase. The aerodynamic lift and pitching moment are undesirable effects. The lift force is given by the equation,

$$L_A = \frac{1}{2} \rho V^2 C_L A$$

Where,  $\rho$  = Density of air

$V$  = Total wind velocity

$C_L$  = Lift Coefficient

$A$  = Frontal Area of the vehicle.

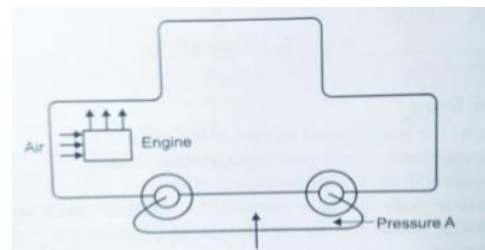
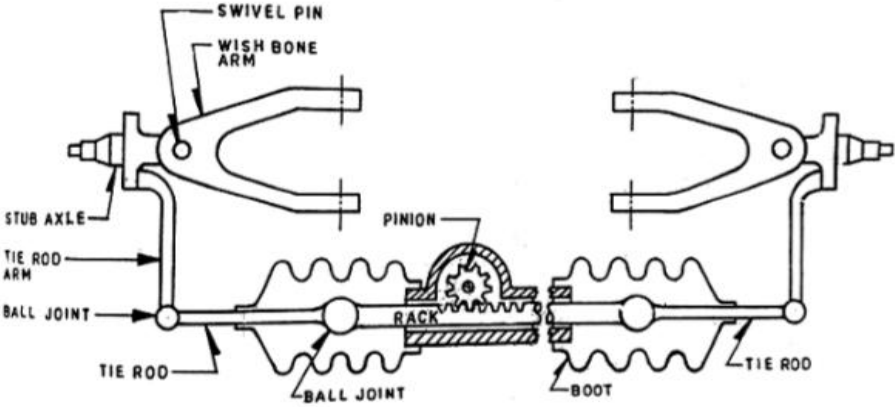


Figure aerodynamic lift

Appropriate significance of Drag and Lift, 02 M, 02 M for suitable sketch of Drag & Lift



b  Ans	<p><b>Explain Rack and Pinion type steering gearbox with a neat sketch.</b></p> <p><b>Rack and Pinion Type Steering Gear Box:</b> In this type of steering gearbox, a pinion is mounted at the end of the steering shaft. The pinion engages with the rack which is provided with a ball joint at each end in order to allow for the rise and fall of the wheel. The rotary motion of the steering wheel is transmitted to the pinion. The circular motion of the pinion is converted into the linear rack movement, which is further transmitted to tie rods to the stub axle through the ball joint. This type of steering gearbox provides sufficiently low gear reduction for cars and it is quite suitable even for heavier motor vehicles if assisted with power. It occupies very less space and less a number of linkages.</p>  <p>Figure: Rack and Pinion steering gear</p>	2 M for explanation, 2 Marks for neat labelled sketch.
C  Ans	<p><b>State function and need of independent suspension system.</b></p> <p><b>Function of Independent Suspension System:</b></p> <ol style="list-style-type: none"><li>1. It has light moving parts that help the wheel to follow the road irregularities.</li><li>2. The Unsprung weight is low.</li><li>3. It absorbs road shocks or impacts due to bumping in the road by oscillation.</li><li>4. Tires also provide a spring effect, but to a smaller extent.</li><li>5. It set the parameters like camber, caster, and kingpin inclination for better steering Quality.</li><li>6. Axle should not tilt and the wheel remains vertical.</li><li>7. It reduces the shocks to passengers and gives a comfortable ride, also reducing additional stresses in the automobile frame body.</li><li>8. It requires a more rigid subframe or chassis frame.</li></ol> <p><b>Need for Independent Suspension System:</b></p> <ol style="list-style-type: none"><li>1. In order to provide a comfortable ride to the passenger and avoid additional stresses in the vehicle frame.</li><li>2. The vehicle should neither bounce nor roll or sway the passengers when cornering nor pitch when accelerating, braking or suddenly lifting or dropping of the front wheel with respect to the rear wheel.</li><li>3. Although some of the road irregularities and inequalities are absorbed by large tires.</li><li>4. It may provide a softer suspension because the low spring rate (stiffness) enables</li></ol>	Any 4 appropriate points in Function, ½ M each, Any 4 appropriate points in Need, ½ of each

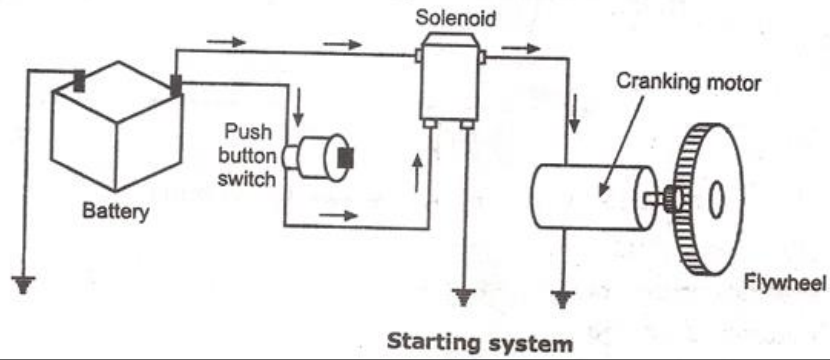


large wheel movement.  
5. In this the engine and chassis frame can be placed relatively lower which means the engine position can be moved forward so more space for the passenger.  
6. The unsprung weight is low.

d  
  
Ans

**Explain the working of starting system of a vehicle with a neat sketch.**

**Working of Vehicle Starting System:**  
The starting or cranking system consists of starting motor, battery, control switch, and interconnecting wiring. The starting system is the heart of the electrical system in automobiles. The key is inserted into the ignition switch and turned to the start position a small number of current passes through the neutral safety switch to the starter relay or starter solenoid. The Starter solenoid allows high current to flow through the battery cable to the starter motor. The starter motor cranks the engine so that the piston moving downward, can create suction that draws the air-fuel mixture into the cylinder.



**2 M for Working, 2 M for suitable sketch/block diagram**

4

**Attempt any THREE of the following: (3 x 4)**

12

a  
  
Ans

**Explain the necessity and importance of Cable Color Codes in automobiles.**

**Necessity and Importance of Automobile Cable Color Codes:**  
In order to quickly identify and also to simplify the wiring system, the cables are colored. For quick identification, insulations of various wires in a circuit are assigned different colors. The seven-color code system is the general one and involves brown, yellow, red, white, green, blue, and black colors. In motor vehicle wiring systems there are a number of wires for different systems such as a headlamp, fog, side indicator, horn, etc. As the wires are more for each circuit, we have limited space for making a suitable arrangement of wiring. Thus, the following seven color code systems mentioned below, used in an automobile:

**Color codes**

Sr. No	Colour	Colour code	Function
01	Brown	BR	Battery circuit
02	yellow	Y	Generator circuit
03	White	W	Ignition circuit
04	Green	G	Auxiliary circuit
05	Blue	BL	Head lamp circuit
06	Red	R	side lamp and tail lamp

**07. Black B For grounding.**

**2 M for appropriate statements of need and importance, 2 M for examples of color coding**





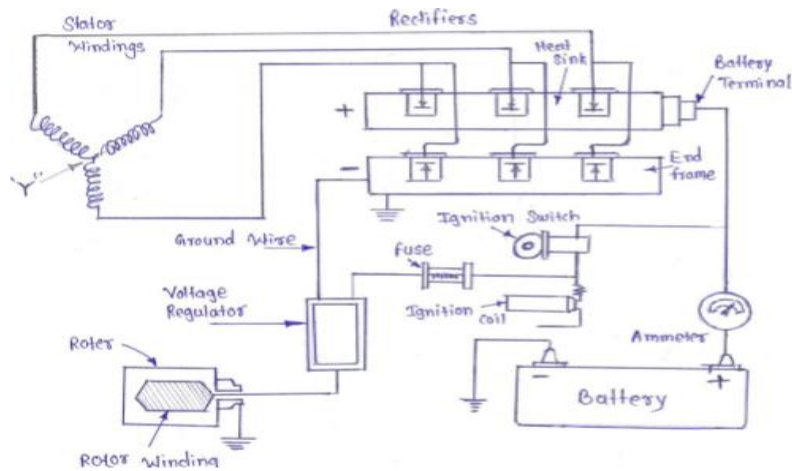
**Explain the charging system of a vehicle with a neat sketch.**

**Automobile Charging System:**

(a) The battery is the storage of direct current. The battery has to supply the current to the starter at the time of starting as well as to the various accessories of the automobile. Due to prolonged use, the charge of the battery is decreased. Therefore to keep the battery always in charged condition there is a need for a charging system.

(b) The charging system consists of an alternator provided with a rectifier to convert AC to DC and a voltage regulator to limit the generator voltage to a correct value. The alternator consists of a stator, Rotor which is driven by a fan belt.

(c) When the Ignition switch is turned on, the rotor receives the current from the battery through the voltage regulator. This current energizes the rotor field magnet, which induces a current in the stator windings as the rotor is turned by the pulley. The induced alternating current is changed to a direct current by the rectifier.



**2 M for the appropriate significance of charging system, 2 M for neat sketch/block diagram**





















**Write salient features of the motor vehicle Act 1989. Draw any 04 traffic signs and state their meaning.**

**Salient Features of M. V Act 1989:**

- This act covers the following point:  
Offenses and Penalties, Documentation, Control of traffic, Construction and maintenance of Vehicle.
- The policy must be against any liability incurred by the insured in respect of death or bodily injury to any person or damage to any property of a third party.
- The insurer can be made a party to the proceedings of the Motor Accident Claims Tribunal.
- Background: Currently, as per the Central Motor Vehicle Rules, 1989, a transport vehicle driver must need to have passed Class VIII.
- It will also help meet the shortage of nearly 22 lakh drivers in the country's transport and logistics sector, which is hindering economic growth.
- This act emphasized that anyone applying for a driving license will have to mandatory pass a stringent skill test
- Since driving schools are subject to regulatory control by states, therefore, training imparted should be of high quality and must cover all aspects of driving a particular type of motor vehicle

**2 M for Salient Features of M V Act, Any 4 Traffic signs in the category of Mandatory, Cautionary, and Informatory, ½ M each**



 STOP	 GIVE WAY	 STRAIGHT PROHIBITOR NO ENTRY	 PEDESTRIAN PROHIBITED	 HORN PROHIBITED
 NO PARKING	 NO STOPPING OR STANDING	 SPEED LIMITED	 RIGHT HAND CURVE	 LEFT HAND CURVE
 RIGHT HAIR PIN BEND	 LEFT HAIR PIN BEND	 NARROW ROAD AHEAD	 NARROW BRIDGE	 PEDESTRIAN CROSSING
 SCHOOL AHEAD	 ROUND ABOUT	 DANGEROUS DIP	 HUMP OR ROUGH	 BARRIER AHEAD

**Note:** Equivalent credit shall be given to any other suitable Features and signs produced by students.

d  
Ans

**Enlist any four gauges and sensors with their functions.**

**Gauges with their Functions:**

- [1] **Fuel Gauge:** To indicate the level of fuel in the fuel tank.
- [2] **Water temperature Gauge:** To indicate the temperature of engine cooling water.
- [3] **Oil Pressure Gauge:** To indicate the oil pressure in the engine.
- [4] **Speedometer:** Use to measure the speed of the automobile vehicle.
- [5] **Tachometer:** Use to Measure the RPM of the Engine.

**Sensors with their Functions:**

- [1] **Mass airflow Sensor:** Use to calculate the air density in the engine.
- [2] **Engine Speed Sensor:** Use to monitor the crankshaft rotation speed.
- [3] **Oxygen Sensor:** Use to monitor the content of exhaust gases.
- [4] **Coolant Sensor:** Use to check temp. of coolant.
- [5] **Voltage Sensor:** Use to manage the car idling speed.

**Note:** Equivalent credit shall be given to any other appropriate Gauges & Sensors enlisted.

**Any 4 gauges with their function, ½ M each, Any 4 Sensors with their function, ½ M each**

e  
Ans

**Draw the organization structure of the motor vehicle (RTO) department. Write the role of RTO.**

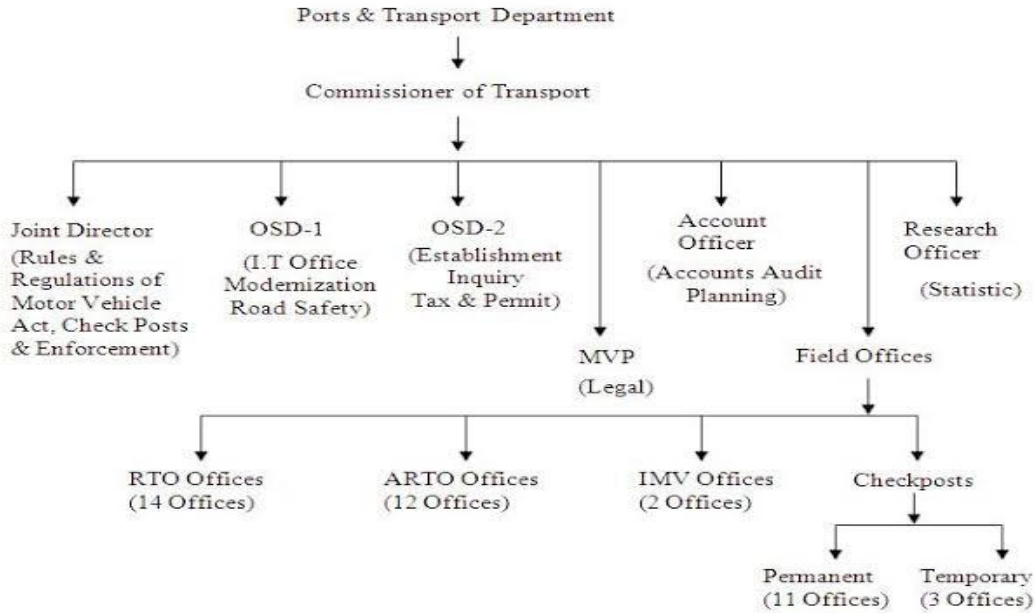
**Role of RTO:**

1. To maintain a database of registered vehicles.
2. Mechanical inspection of accidental vehicles.
3. To grant a certificate of fitness to transport vehicles.
4. To issue International driving permits.
5. To routinely inspect vehicles.
6. Checking emissions and issuing pollution certificates for vehicles.
7. To conduct the driving test, issue Learner's, Permanent driver's licenses and



- renew the same.
8. To maintain a proper check on the validity of insurance on motor vehicles.
  9. To issue badges to the drivers of public services vehicles like Auto rickshaws and Taxis.

**2 M for suitable sketch of Organization structure, 2 M for appropriate role of RTO**



5 Attempt any TWO of the following: (2 x 6)

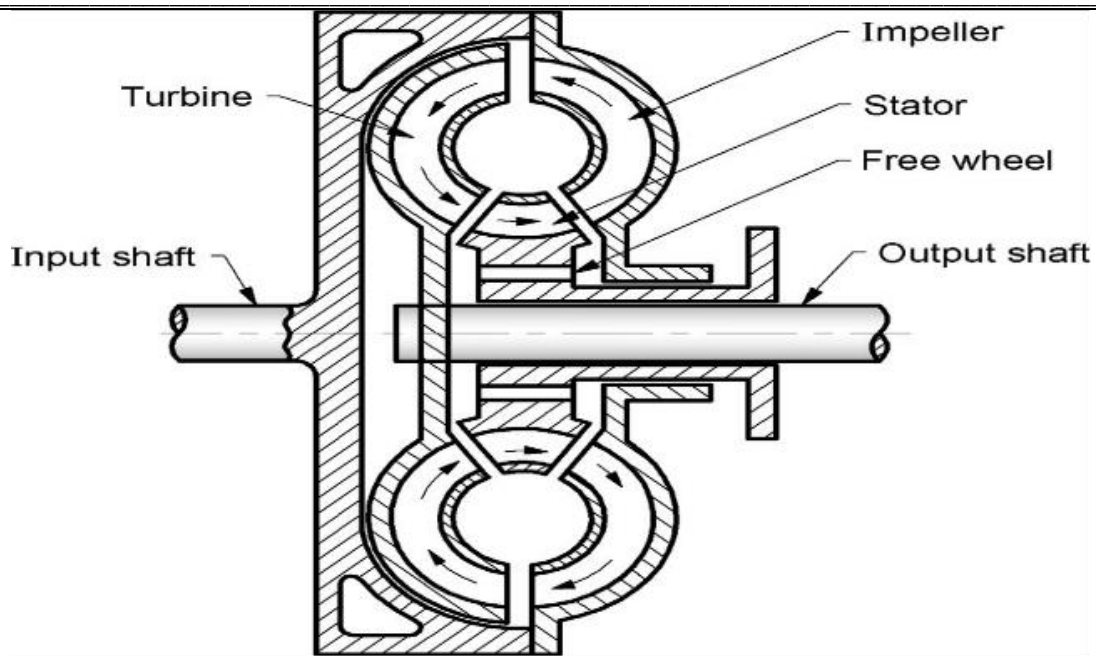
12

a  
Ans

**Describe the torque converter with a neat sketch. Compare it with a fluid flywheel.**

**Torque Converter:**  
The cut section of the torque converter as shown in Fig. Torque converter is a device that performs the same function as that of the gearbox. It transfers the torque by using fluid which acts as the connecting link. It is directly coupled to the engine flywheel. It increases torque in the ratio of 2: 1 to 4: 1. Generally, good quality engine oil is used as the fluid.

Description - 02 M



Sketch 02 M

**Figure: Torque Converter**

**Working of Torque Converter:**

(a) When the engine is started, the impeller starts rotating. Due to centrifugal force at the impeller, its vane pushes oil into the turbine. This high-velocity jet of oil strikes the turbine vanes and forces it to rotate the turbine. As engine speed increases, this force also increases. When sufficient force is developed the turbine starts rotating and the vehicle move.

(b) The turbine vane angle is such that it changes the direction of oil flow so that it comes out of the turbine at the center; its direction is effectively backward. A stator is used to provide proper direction for oil to strike back on the impeller blades in a favorable direction. So, it avoids dragging action and prevents power loss.

(c) This flow of oil from the impeller to the turbine to the stator and back to the impeller goes continuously and the phenomenon associated is called torque multiplication. The maximum torque multiplication occurs when the turbine is stationary and the impeller is running fast at the engine speed this is called 'STALL'. The maximum torque multiplication at the stall is about 2.1 to 2.6 and goes on decreasing as engine speed increases.

(d) Torque multiplication will become unity when the impeller and turbine speed become equal this is known as direct speed.

**Advantages of Torque Converter:**

- [Simple in design.
- Less maintenance.
- No skill needed to operate.
- No frequent calibration is required.
- Smooth transfer of drive without any shock/jerk.
- No wear of moving parts because of no meshing gears.



- It is more economical than fluid flywheel at low speed.

**Comparison between Torque Converter and Fluid Flywheel Converter**

Fluid Flywheel	Torque Converter
Stator is absent	Stator is Present
It transmits the same torque as given as to it by engine shaft	It transmits more torque in the ratio 2:1 or 3:1
It merely acts as Hydraulic Coupling.	It serves the same purpose as that of the gearbox.

Comparison - 02 M

b

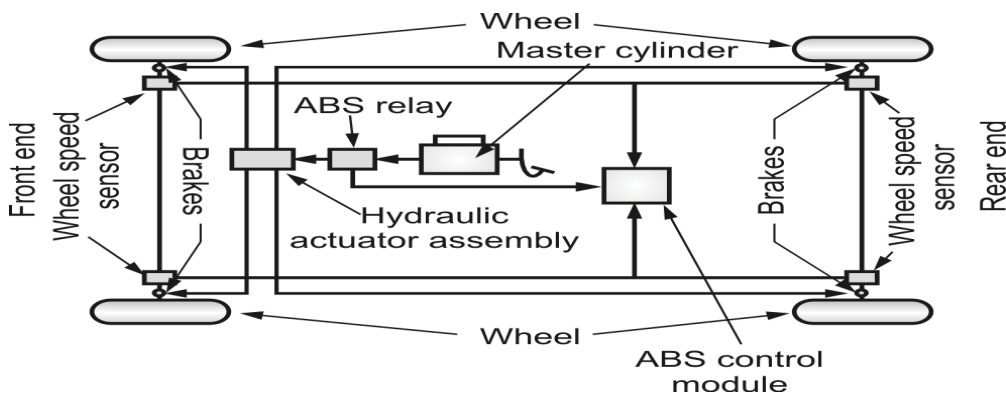
Ans

**State need of ABS .Draw typical layout of ABS. Write in Brief role different components**

**Need of ABS**

It is also known as anti-skid braking system. Wheels skid when they slow down faster than the vehicle. To prevent skidding of the vehicle the wheels must not be lock up. This is the purpose of antilock braking system.

**Layout of ABS:-**



1.5 M for the need of ABS,

1.5 M for Layout of ABS,

**Role of Different Components:-**

**1. Electronic Control Unit (ECU)**

It is heart of ABS.

It monitors and controls antilock brake function when required.

Its function based on input from wheel speed sensors and hydraulic unit to decide whether antilock operation is necessary or not.



## 2. Accumulator

It is used to maintain high pressure in braking system by storing hydraulic fluid.

It also provides residual pressure for power assisted braking.

## 3. Wheel Speed Sensor

It is mounted on each wheel.

It is used to measure speed of wheel.

It sends signal to ECU.

## 4. Hydraulic Unit

The brake lines from the master cylinder are connected to it.

It modulates the brake pressure as per the signals provided by the ECU.

**Role of any 2 major components of ABS in brief, 1.5 M each**

C  
Ans

**List Factor affecting tyre life. State the meaning of all terms involved in following tyre Designation: P215/65R16 95 H.**

### Factors affecting Tire Life:

#### [1] Inflation Pressure:

The tyre must be run on specified air pressure given by the manufacturer. If tyre inflated with less pressure i.e. Under Inflated Pressure it will result in :

- (i) More flexing
- (ii) Uneven tread wear
- (iii) More tyre wear on sides
- (iv) Cracking of the side wall
- (v) Lack of directional stability
- (vi) Increased rolling resistance.

(vii) If tyre is inflated with more tyre pressure i.e. Over Inflated Pressure it will result in;

- (viii) Reduces the road grip
- (ix) Less cushioning effect
- (x) Reduce the tread contact area
- (xi) More wear in the center of the tread

#### [2] Wheel Alignment:

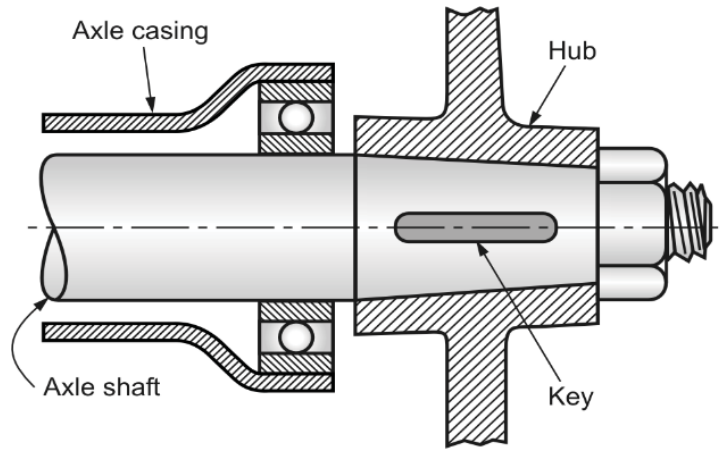
Due to improper wheel alignment rapid wear of tyre thread takes place. Unequal camber results in excessive wear of tyre by pulling the wheels to one side. Too little or too much castor causes the wheel to wander resulting in spotty wear. If wheel balancing is not proper uneven load will occur on tyres, again radial and lateral run-out will also cause wear of the tyres. Badly adjusted brakes result in faster tyre wear in spots. The brake heat may also cause the failure of the tube and valve.

#### [3] Overloading:

**Any 03 factors 01 mark each**



		<p>In case of overloading the tyre has an insufficient amount of air to support the dead weight carried. This results in a decrease in tyre mileage.</p> <p><b>[4] Driving manners:</b> This includes sudden acceleration, high speeds, sudden braking, driving on bad roads, etc. all cause faster tread wear.</p> <p><b>5. Miscellaneous Factors-</b> These includes;</p> <p><b>Heat:</b> Faster thread wear, radial side wall cracking, etc. may occur due to high temperature.</p> <p><b>Road conditions:</b> On poor-quality roads tyre life decreases. Season (Weather condition): In winter the mileage is more and heat failure is less as compared to the summer season.</p> <p><b>Position of tire:</b> Front tyres generally wear slower than rear ones.</p> <p><b>Meaning of Tyre Designation: P215/65R16 95 H</b></p> <p>The meaning of each marking is explained below;</p> <p>The first marking indicates the application/type of tire;</p> <p><b>P-</b> P - Passenger Cars, <b>C</b> - Commercial Vehicle, <b>LT</b> - Light truck, <b>T</b> - Temporary (spare), <b>ML</b> - mining and logging, <b>ST</b> - special trailer, <b>TR</b> - truck.</p> <p><b>215:</b> Second marking indicate the section width in mm of an inflated tyre.</p> <p><b>215/65:</b> The third part indicates i. e. figure after the slash (/) aspect ratio of tire.</p> <p>Aspect Ratio = Section Height/ Section Width</p> <p><b>R-</b> Fourth part indicate the construction type</p>	<p><b>Tyre Designatio 03 marks</b></p>
6		<p><b>Attempt any TWO of the following. (2 x 6)</b></p>	12
	<p>a</p> <p>Ans</p>	<p><b>State the significance of the Live &amp; Dead axle. Describe Semi Floating axle with sketch.</b></p> <p><b>Significance of live and dead Axle:</b></p> <p>(a) It facilitates steering to turn the vehicle right or left as required. (b) It provides space for attachment of the suspension system, wheels, etc. (c) It prevents interference due to front engine location. (d) A live front axle contains the differential mechanism through which the engine power flows toward the front wheels. (e) It also acts as an anchorage for pivoting the stub axle. (f) Dead axle does not rotate and has no function to transmit power to road wheels.</p> <p><b>Semi Floating axle:</b> The arrangement of the semi-floating axle is shown in Fig. It is also called as the half-floating rear axle. The driving wheel is directly bolted to the axle shaft at its outer end. The inner end of the axle shaft is splined and is supported by the differential unit. It has a single ball bearing which is mounted on the axle shaft and inside the axle casing.</p>	<p><b>2 M for Significance of Live and Dead Axle, Brief description of Semi Floating axle, 2M, Neat Labelled sketch, 2 M</b></p>



**Figure: Semi Floating Rear Axle**

**Working of Semi Floating Axle:**

The vehicle load is received by each of the half shafts through casing and bearing. This causes a bending load and tendency to shear at marked point P. The axle shafts also have to take end thrust and torque loads caused by the skidding, turning, and wobbling of the wheels.

**Advantages of Semi Floating Axle:**

- [1] Simple design.
- [2] Low cost.

**Limitation:**

- [1] As the axle shafts have to carry all loads, they have to be of larger diameter for the same torque transmission as compared to the other two types' arrangements.
- [2] Difficult to tow the vehicle if the half shaft is broken.

**Application of Semi Floating Axle:** Mostly used in cars and light-duty vehicles.

b **Draw an Electronic ignition system. Compare it with a Conventional ignition system (Any four points)**

Ans

**Electronic ignition system**

- Electronic ignition systems use some solid state devices like transistors and capacitors, etc. to generate the right sparking voltage at right time.
- These systems have overcome the limitations of conventional (battery ignition and magneto-ignition) ignition systems. Modern automobiles make use of these systems. Two systems, common in use, are:
  - a. Capacitive discharge ignition and
  - b. Transistorized coil ignition.
- These systems are more reliable and require less maintenance. Wear and tear of components are reduced and the life of spark plugs is increased with the use of electronic ignition.

**Note- Consider any One Diagram**

01



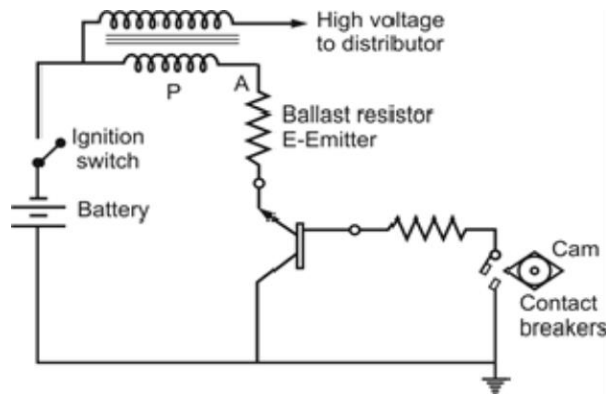


Diagram –Transistorized coil ignition

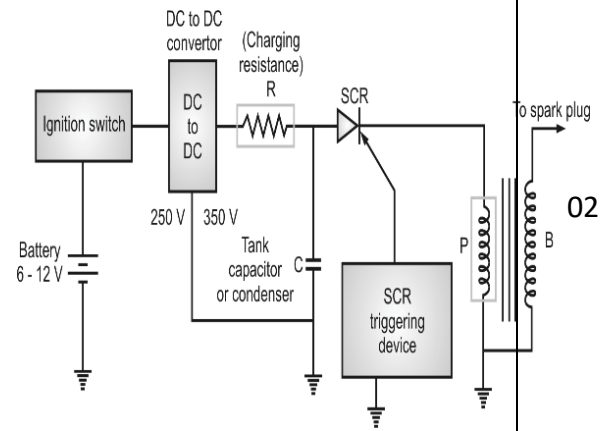


Diagram -Capacitive discharge Ignition system-

Compare it with a Conventional ignition system (Any four points)

- Because of arcing, pitting of contact breaker point and which will lead to regular maintenance problems.
- Poor starting: After a few thousand kilometers of running, the timing becomes inaccurate, which results in poor starting (Starting trouble).
- At very high engine speeds, performance is poor because of the inertia effects of the moving parts in the system.
- Sometimes it is not possible to produce spark properly in fouled spark plugs.

02

03

C

Describe in brief different passenger safety systems adapted in Modern Vehicles

Ans

**Passenger Comfort and Safety Systems:**

**[1] Air Bags:**

Airbags are passive safety features designed. Airbags are strong fabric bags that are folded and concealed behind various parts inside the vehicle. Many vehicles have a driver airbag in the steering column and a front-passenger airbag in the dashboard. Newer vehicles may also have side airbags located in the interior side panels, the roof, or the doors.

**Features of Air Bags:**

It provides added protection to seatbelts. It reduces injury by either cushioning the occupant's contact with the interior of the vehicle or preventing contact completely in the event of a crash.

It inflates and deflates very rapidly in the event of a severe crash.

**[2] Seat Belts:**

Seatbelts are a passive vehicle safety feature designed to minimize the severity of injuries sustained by drivers and passengers in the event of a crash. When a vehicle stops or accelerates suddenly, a great deal of force is placed on everything inside the vehicle, including the people in the vehicle. Seatbelts help to reduce the effects of this force by distributing it across the strongest parts of the body – the chest and pelvis.

Any six systems 01 mark each.



**Features of Seat Belts:**

It helps to prevent injuries resulting from colliding with other objects or people in the vehicle. It prevents the ejection of the occupant from the vehicle, which can often result in fatal injury. It prevents or minimizes the second impact in a crash, which causes injuries. The working of seat belts in case of immediate braking.

**[3] Collapsible Steering Column:**

The collapsible steering column is a type of advanced steering column. It is a part of the passive safety system in cars. Most passenger vehicles commonly employ the collapsible version instead of the regular steering column. It is also known as an 'Energy absorbing steering column'.

**Features of Collapsible Steering Column:**

It reduces the risk of injuries occurring to the driver in case of frontal impacts by collapsing. Energy dissipation management in the event of a frontal collision. Provide mounting for the multi-function switch, column lock, column wiring, column shroud, transmission gear selector, gauges, etc. Offer (height and/or length) adjustment to suit driver preference.

**[4] Anti-lock Braking System (ABS) with EBD:**

When a brake is applied suddenly with huge force the wheels get locked and go out of control resulting in an accident. ABS with electronic brake-force distribution prevents the wheels from locking and skidding. Ensuring better control even during sudden braking.

**[5] Electronic Stability Control (ESC):**

Many car accidents happen because the car loses control due to oversteer or understeer in corners, low traction in wet roads, etc. ESC monitors the steering wheel angle along with the car's individual wheel rotation. During an emergency, ESC applies the brake and balances the engine power to regain control.

**6. Adjustable Steering:**

When you are behind the wheel, you need to be comfortable. Having adjustable steering commonly known as tilt and telescopic steering will help the driver to adjust the height of the steering wheel and the distance from the driver. This reduces any sort of discomfort to the driver.

**7. Tyre Pressure Monitoring System (TPMS):**

A sensor is placed in each wheel to monitor the tyre pressure. TPMS sends an alert to the instrument cluster when the tyre pressure is low. It increases your car's safety on the road with better handling, reduced braking distance and better fuel economy.

**END**



**Model Answer**

**Subject Name:**

**Subject Code:**

XXXXX

Q. No.	Sub Q. N.	Answer	Marking Scheme