

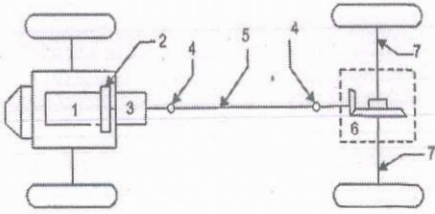
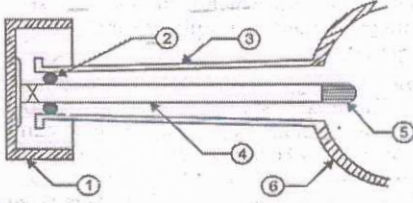
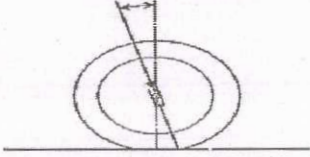
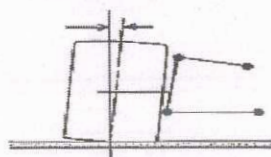
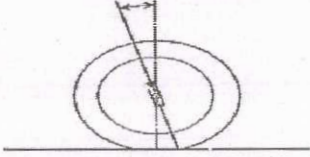
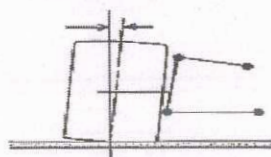
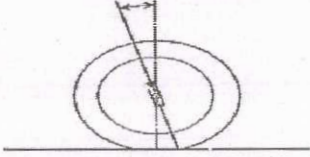
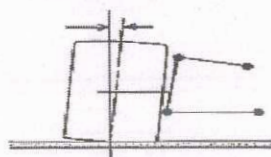
Scoring Indicators

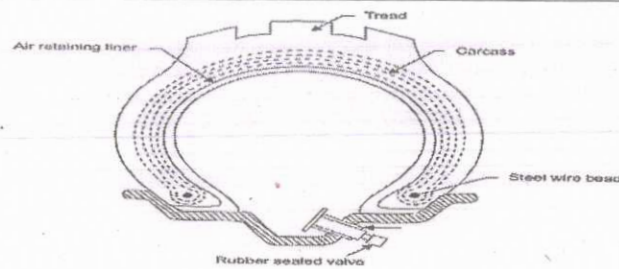
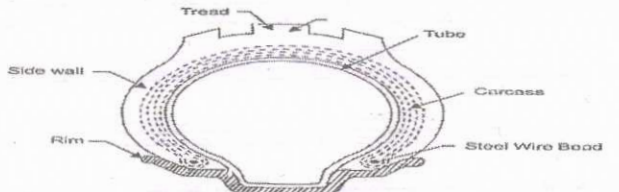
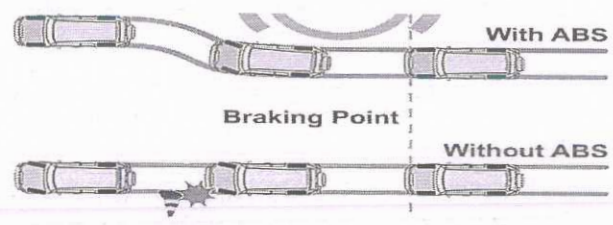
COURSE NAME :AUTOMOBILE ENGINEERING

COURSE CODE : TED (21) – 4023

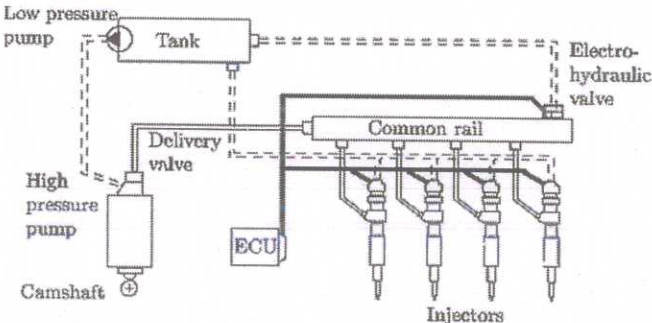
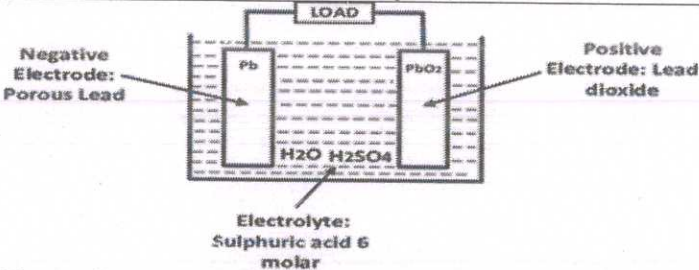
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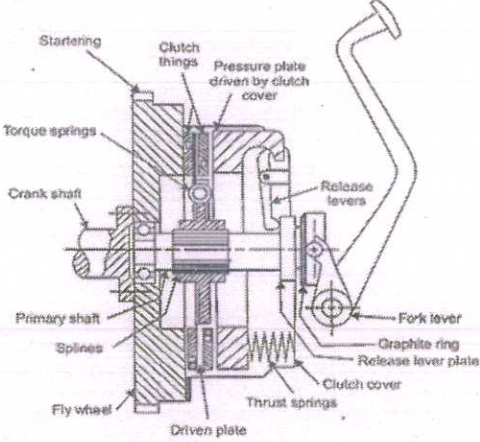
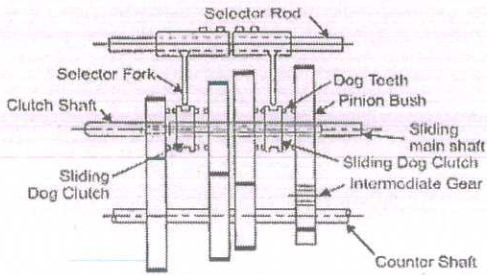
Q No	Scoring Indicators	Split score	Sub Total	Total score
PART A				9
I. 1	(1).Dry liner (2) Wet liner	0.5*2	1	
I. 2	(1)Overhead valve (OHV) (2) Overhead Camshaft (OHC)	0.5*2	1	
I. 3	Thermostat:- for optimum cooling of engine (overcooling reduce engine efficiency) and It helps engine to reach the operating temperature as early as possible.	1	1	
I. 4	Transmitting the torque from the engine to the drive train. Smoothly deliver the power from the engine to enable smooth vehicle movement. Perform quietly and to reduce drive-related vibration.	1	1	
I. 5	Slip joint is attached to the driven yoke to increase or decrease the length of propeller shaft. It has outside splines on the shaft and matching internal splines in a mating hollow shaft or yoke.	1	1	
I. 6	The basic principle of Ackerman Steering system is to obtain true rolling.	1	1	
I. 7	The wheels support the inner weight of the vehicle and also absorb shocks.	1	1	
I. 8	The Electronic Braking Distribution (EBD) is a development of the ABS. It maintains that each wheel receives the proper amount of force. The concept behind EBD is that not every tyre on a vehicle require the same amount of braking force.	1	1	
I. 9	“Certificate of registration” means the certificate issued by a competent authority to the effect that a motor vehicle has been duly registered.	1	1	
PART B				24
II. 1	Automobile classification according to 1. application 2. load capacity 3. Number of wheels & Axles 4. Fuel used 5. Suspension system used 6. Type of Body system 7. Drive of the Vehicle 8. Special Vehicles	0.5*6	3	
II. 2	<pre> graph TD FT[Fuel tank] --> FP[Fuel pump] FP --> FF[Fuel filter] AF[Air Filter] --> CM[Inlet manifold] FF --> CM CM --> E[Engine] </pre>	1*3	3	

<p>II. 3</p>	 <p style="text-align: center;">Fig. 3.1 Elements of Transmission System</p> <p>1. Engine 2. Clutch 3. Gear box 4. Universal Joint 6. Propeller Shaft 6. Differential 7. Rear Axles</p>	<p>1*3</p>	<p>3</p>					
<p>II.4</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Fluid coupling</th> <th style="text-align: center;">Torque converter</th> </tr> </thead> <tbody> <tr> <td style="vertical-align: top;"> <ol style="list-style-type: none"> 1. Contains only two members impeller and turbine. 2. Simply a torque transmission unit. 3. Serves as an automatic clutch. 4. Efficient at high speeds. 5. Impeller and runner are locked up and oil movement stops when centrifugal force is the same on both the member. </td> <td style="vertical-align: top;"> <ol style="list-style-type: none"> 1. Three members impeller, turbine and a stator. 2. Torque multiplication unit 3:1 to 4:1. 3. Serves as an automatic clutch as well as a torque multiplier. 4. Inefficient at high speeds but more efficient under load. 5. No such locking and oil flows continuously. </td> </tr> </tbody> </table>	Fluid coupling	Torque converter	<ol style="list-style-type: none"> 1. Contains only two members impeller and turbine. 2. Simply a torque transmission unit. 3. Serves as an automatic clutch. 4. Efficient at high speeds. 5. Impeller and runner are locked up and oil movement stops when centrifugal force is the same on both the member. 	<ol style="list-style-type: none"> 1. Three members impeller, turbine and a stator. 2. Torque multiplication unit 3:1 to 4:1. 3. Serves as an automatic clutch as well as a torque multiplier. 4. Inefficient at high speeds but more efficient under load. 5. No such locking and oil flows continuously. 	<p>3*1</p>	<p>3</p>	
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<p>II. 5</p>	 <p style="text-align: center;">Fig. 3.45 Semi Floating Axle</p> <p>1. Brake Drum 2. Bearing 3. Axle Housing 4. Axle Shaft 5. Splines 6. Different Casing.</p> <p>It is splined on the differential end and uses this end for driving purpose only. This end floats and carries no weight. A bearing is placed between the axle shaft and the housing at the outer end to carry the weight of the vehicle.</p>	<p>2</p>	<p>3</p>	<p>1</p>				
<p>II. 6</p>	<ol style="list-style-type: none"> 1. To safe guard the passengers and goods against road shocks, 2. To prevent the road shock from getting transmitted to the vehicle body. 3. To preserve the stability of the vehicles while in motion. 4. To provide proper road hold when driving cornering and braking. 5. To maintain proper steering geometry. 6. To keep the body perfectly in proper level while traveling - uneven path. 7. To bear the torque and braking reaction. 8. To provide suitable riding and cushioning properties. 	<p>6*0.5</p>	<p>3</p>					
<p>II. 7</p>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center; border: 1px solid black;"> <p>CASTER ANGLE</p>  </td> <td style="width: 50%; text-align: center; border: 1px solid black;"> <p>CAMBER ANGLE</p>  </td> </tr> <tr> <td colspan="2" style="padding-top: 10px;"> <p>Caster:- it is the inclination of the steering axis from vertical in the longitudinal plane. (wheel viewed from the side)</p> <p>Camber:- It is the inward or outward tilt of a wheel to the vertical axis at the centre of the wheel in the lateral plane.</p> </td> </tr> </table>	<p>CASTER ANGLE</p> 	<p>CAMBER ANGLE</p> 	<p>Caster:- it is the inclination of the steering axis from vertical in the longitudinal plane. (wheel viewed from the side)</p> <p>Camber:- It is the inward or outward tilt of a wheel to the vertical axis at the centre of the wheel in the lateral plane.</p>		<p>1.5</p>	<p>3</p>	<p>1.5</p>
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<p>II 8</p>	 <p>The conventional type is of tubed type. This type has an inner and a tyre casing. The inner tube receives air and inflates the tyre. The outer cover makes the contact with the road. Both tube and tyre casing are mounted on the wheel rim.</p>  <p>In this type, there is not separate tube. The air under pressure in the tyre itself serves this purpose. A non-return valve is fitted to the rim as shown in Fig. 6.9. The construction of the tyre is the same as that of a tubed tyre. But a special air retaining liner is provided and the amount of the air pressure required depends upon the tyre.</p>	<p>1.5</p> <p>1.5</p>	
<p>II.9</p>	<p>In standard braking (without ABS), when you press the brake pedal, the brake pads press tightly against the wheels' discs to instantaneously stop the wheels' rotation, causing them to lock up, regardless of what speed the vehicle is on.</p> <p>When the wheels stop rotating, they can't be steered, which means the driver loses all control over the wheels, and now the vehicle skids as a result of the momentum it is in. This can cause fatal accidents more often than not.</p>  <p>With ABS, as you apply the brakes, the speed sensors track the decreasing rotation of the wheels. When the brakes are about to stop rotation, they send a signal to the electric control unit (ECU). The ECU partially releases the brake pads from the wheels through valves and pumps, allowing the wheel to continue rotating. With ABS, the wheels can continue rotating, allowing you to maintain control over the car in a heavy braking situation.</p>	<p>6*0.5</p>	<p>3</p>
<p>II.10</p>	<p>The current EV design challenges —</p> <ul style="list-style-type: none"> • Limited driving range, • High costs, • Battery issues, • Long charging time, • Inadequate charging infrastructure along with • issues with various power semiconductors and other devices <p>(any three with brief description)</p>	<p>3*1</p>	<p>3</p>

PART C

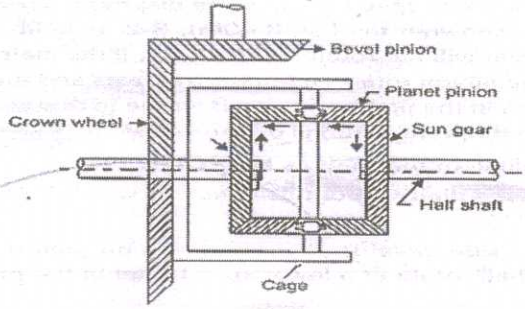
<p>III. 1</p>	<p>Air cooling</p> <p>Direct cooling system.</p> <p>Not dependent on coolant supply.</p> <p>No leakage problem.</p> <p>Minimum maintenance.</p> <p>Uniform cooling.</p> <p>Failure of system not affecting much.</p> <p>Easy installation.</p> <p>.Used for small capacity engines.</p>	<p>Water cooling</p> <p>Indirect cooling system.</p> <p>Dependent on water.</p> <p>Leakage of water leads to serious defects.</p> <p>Max (more) maintenance.</p> <p>Non uniform cooling.</p> <p>Failure of system leads to damage.</p> <p>Comparatively difficult installation.</p> <p>Used for medium and large capacity engines.</p>	<p>7*1</p>	<p>7</p>		
<p>III. 2</p>	<p align="center">Crdi</p>  <p>In common rail engine system, the high pressure fuel pump stores a reservoir of fuel at a pressure of at about 29,000 psi in a common rail. This common rail is actually a tube which branches off to computer controlled fuel injector valves that comprise a precision-machined nozzle and a plunger driven by a solenoid valve. The fuel reservoir then pumps out the fuel to multiple injectors that are electronically controlled by the engine control unit. Under the control of an on-board computer, the engine regulates the fuel quantity and pressure. It also controls the precise moment when the actual process of fuel injection occurs and also increased the pressure at which fuel is injected. This in turn results in better fuel atomization and combustion, eventually leading to lower exhaust emissions, lower fuel consumption, and increased fuel efficiency.</p>			<p>4</p>	<p>7</p>	
<p>III. 3</p>	 <p>A lead-acid battery is a type of rechargeable battery that is commonly used in vehicles, UPS systems, and other applications that require a high burst of power. The battery consists of several cells, each containing lead plates and an electrolyte solution made of sulfuric acid and water.</p> <p>Construction:</p> <p>Each cell of a lead-acid battery consists of two lead plates – a positive plate made of lead dioxide (PbO₂) and a negative plate made of sponge lead (Pb) – immersed in an electrolyte solution of sulfuric acid (H₂SO₄) and water. The plates are separated by a separator made of porous material, which allows the electrolyte to flow between them but prevents them from touching each other.</p> <p>Working:</p> <p>When the battery is charged, the lead dioxide on the positive plate reacts with the sulfuric acid to form lead sulfate (PbSO₄), releasing oxygen gas (O₂) and hydrogen ions (H⁺) in the process. At the same time, the sponge lead on the negative plate reacts</p>			<p>4(fig)</p>	<p>7</p>	

	<p>with the hydrogen ions in the electrolyte to form lead sulfate and release electrons (e-).</p> <p>During discharge, the process is reversed. The lead sulfate on both plates reacts with the electrolyte to form sulfuric acid and lead, releasing electrons in the process. The electrons flow through an external circuit, providing power to the device connected to the battery. At the same time, the lead sulfate on both plates is replenished with hydrogen ions and oxygen gas, which are released into the electrolyte.</p> <p>Over time, as the battery is charged and discharged, the lead sulfate on the plates builds up and reduces the battery's capacity. To prevent this, the battery must be periodically charged to convert the lead sulfate back into lead dioxide and sponge lead. This process is known as recharging the battery.</p>			
<p>III. 4</p>	<p>1)Hit and Miss method of governing: In this method, the supply of fuel is stopped for one or more cycles when the speed of engine increases. Once the supply is cut off, engine performs idle cycles which will reduce the engine speed.</p> <p>2)Quality governing: This method is employed for high speed diesel engines (CI engines). In this method the quality of fuel supplied is valued by altering the air fuel ratio. For quality governing the amount of air drawn into cylinder is constant, but the supply of fuel varies. Thus the quality of the mixture is varied.</p> <p>3)Quantity Governing: This method is employed in spark ignition engines. In this method, the quality of fuel is not altered but the quantity of mixture supplied to the engine varied by regulating the throttle valve.</p> <p>4)Combined method: It is the combination of the quality and quantity governing methods. The disadvantages in each of the governing method can be eliminated in the combined method.</p>	<p>2</p> <p>2</p> <p>2</p> <p>1</p>	<p>7</p>	
<p>III. 5</p>	<p style="text-align: center;">Clutch</p>  <p>When pressure is applied to the foot pedal, the pressure is transmitted through the release finger, fork and release bearing. Then, the springs are compressed and it moves back the pressure disc thus releasing the clutch plate. Now the clutch is said to be disengaged. At this stage, the pressure plate and fly wheel are free to rotate clutch plate stationary. Similarly, when the clutch pedal is released, spring pressure is fully applied on the clutch plate. The plate is held between the fly wheel and the pressure plate and rotates as a single unit. Thus the clutch is said to be engaged.</p>	<p>4(fig)</p> <p>3</p>	<p>7</p>	
<p>III. 6</p>	 <p>Fig. Shows a simple arrangement of the constant mesh gear box. It has three shafts</p>	<p>4 (fig)</p>	<p>7</p>	

namely primary shaft, main shaft and lay shaft. The clutch shaft gear is in mesh with the biggest gear of the counter shaft and the other gears of the counter shaft are also in constant mesh with the corresponding gears on the main shaft as shown in the figure. The gears on the counter shaft rotate along with the shaft but the main shaft gears are free to rotate on bushes. The main shaft is a splined shaft. Dog clutches are provided which are free to slide on the main shaft. Selector forks are also provided to move the dog clutches to be engaged with the other set of dog clutches. The gear blanks are also provided with dog teeth on their faces. The power flow is the same as in the sliding mesh gear box. When the second dog clutch is slid to the right side, it engages the larger gear on the main shaft to the smallest on the counter shaft, to rotate as a single unit. So, now the power flow is through the clutch shaft to the largest gear on the lay shaft and then through the above unit it comes out from the splines to the main shaft. Similarly when the second dog clutch is slid to the left and gets engaged, second gear is obtained. When the first dog clutch is slid towards left, the clutch directly engages with the clutch shaft, and power is directly transmitted as in sliding mesh gear box.

3

III. 7



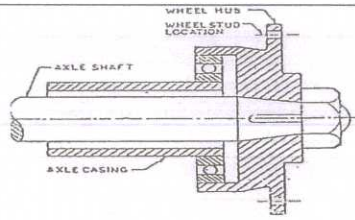
4 (Fig) 7

When the vehicle is moving straight, there is no relative movement among the differential gears. The cage and the gears rotate as a single unit. If we assume the cage to be stationary during turn, one sun gear will cause the other to rotate in the opposite direction. That is to say, when the vehicle takes a turn, a binding force acts on the inner wheel. In that particular side the sun gear is held to rotate slowly with respect to the movement of the cage. This results in the star pinion rotating the outer side sun gear with a loss in the inner wheel speed and gain on the outer wheel speed. So the outer wheel moves faster. This rotation is super-imposed on the normal speed. Suppose, the vehicle is turning towards the right, at that time, there will be a resistance to motion on the right wheel.

3

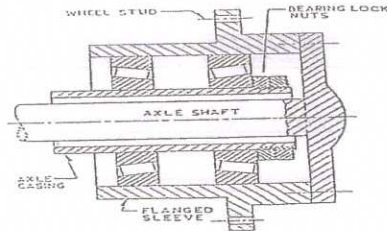
Due to the result of differential action, if the right wheel rotates at 'N' rpm, the left wheel rotates in the opposite direction with 'n' rpm. This arrangement makes the resultant speed of the left wheel as (N + n) rpm and speed of the right wheel as (N - n) rpm. But, the torque transmitted is equal to both the rear wheels.

III 8



Three-quarter Floating Axle

- Bearing located between the axle casing and the hub
- Shafts do not have to withstand any shearing or bending action due to weight of the vehicle(taken up by axle casing through hub and the bearing)
- Shaft takes up the end loads and the driving torque
- Popular in cars and light commercial vehicles in earlier days



Full Floating Axle- Robust one and used for heavy vehicles

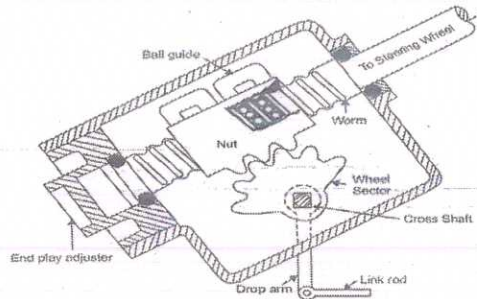
- Shafts have flanges at outer end which are connected to flanged sleeves by means of bolts
- Two taper roller bearing supporting the axle casing in the hub, takes the side loads axle shaft only the driving torque Weight is carried by the wheels and the axle casing
- As weight is not in axle shaft, removal of axle shaft does not affect wheels
- Shafts can be taken out without jacking up of vehicles. Even an be towed with broken half shaft

3

4

7

III.9



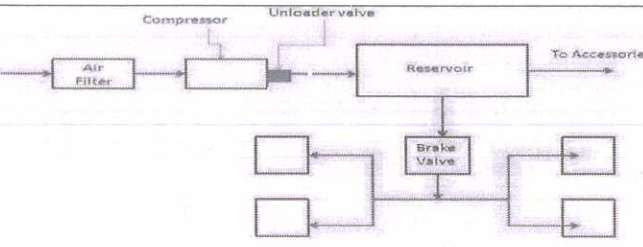
A recirculating ball gear has a driving gear and a driven gear. The driving gear is a worm gear with spiral threads. The driven gear is a sector gear, connected to the pitman arm.

This is a screw and nut type of steering gear box. A simplified arrangement is shown in the figure. The lowest end of the steering shaft carries a screw and a screw nut. The outer surface of the nut is provided with a threaded portion engaged with the sector wheel. The sector wheel is connected to the drop arm through cross shaft. The inner threads of the nut and the thread form of the screw are shaped as semi-circular grooves or a recirculating ball race is provided between the nut and the screw.

By turning the steering wheel, the balls in the worm, roll along the grooves. This movement causes the nut to travel along the worm. The balls are recirculate through the return guides shown. The up and down movement of the ball nut causes the wheel sector to turn to the required angle. The wheel sector actuates the drop arm and thereby the link rod. This results in the steering of the front wheels.

4(Fig) 7

3

<p>III. 10</p>	 <p style="text-align: center;">Layout of Air Brake System</p> <p>Air brake can better understand by the layout diagram as shown in figure. This system mainly consist a compressor, air filter, reservoir, valves and brake pads. The compressor takes air from atmosphere through an filter and compressed it. This compressed air sent to a reservoir through the unloader valve, which gets lifted or opened at a predetermined reservoir pressure. This air supply to brake chambers which is also called the diaphragm units situated at each wheel, through the brake valve. The brake valve is controlled by the driver who can control the intensity of braking according to the requirement.</p> <p>When the driver pushes the brake lever, pressure in the reservoir decreases which pushes the brakes pad toward types and apply brakes.</p> <p>□ Advantage of air brake:</p> <p>□ 1. Air brake system are much more powerful than the ordinary mechanical or hydraulic brakes and that is the reason they are exclusively used in heavy vehicles.</p> <p>□ 2. They are easy to install on chassis because it is interconnected by pipes.</p>	<p>4 (Fig) 7</p>	<p>7</p>
<p>III. 11</p>	<p>Fuel cell hybrid vehicles (FCHVs) use a combination of fuel cells and batteries to power the vehicle. To effectively manage the energy consumption of FCHVs, an energy management strategy (EMS) is required. An effective EMS can maximize the efficiency of the vehicle, extend the driving range, and reduce emissions.</p> <p>Strategies for energy management in FCHV (explain any 3)</p> <ol style="list-style-type: none"> Optimal control of fuel cell and battery power: The fuel cell and battery system can be optimized to work together for the most efficient use of energy. Predictive power management: Predictive power management involves predicting the power demand of the vehicle and adjusting the fuel cell and battery output accordingly. This can be done using algorithms that analyze driving patterns, terrain, and other factors that affect energy consumption. Regenerative braking: Regenerative braking captures the kinetic energy of the vehicle when it is braking and converts it into electrical energy that can be stored in the battery. This energy can then be used to power the vehicle, reducing the load on the fuel cell and extending the range of the vehicle. Intelligent thermal management: Thermal management is critical to the performance and durability of the fuel cell. An EMS can monitor the temperature of the fuel cell and adjust the cooling and heating systems to maintain optimal temperature ranges. Optimal routing and speed control: The EMS can optimize the vehicle's routing and speed to minimize energy consumption. This can be done by analyzing traffic patterns, road conditions, and other factors that affect energy consumption. 	<p>1</p>	<p>7</p>
<p>III. 12</p>	<p>For a cleaner environment and to address the growing concerns about global warming, the Indian government has fast-forwarded the BS6 pollution norms to 1 April 2020. Hence, the jump from BS4 to BS6 instead of moving to BS5 and then to BS6. Below are the differences between pollution norms between BSIV and BSVI:</p> <p>A BS6 vehicle using BS4 fuel will not adhere to the required emission norms due to higher levels. Hence, a BS6 vehicle has to use only BS6 fuel to achieve the desired emission levels.</p>	<p>1</p>	<p>7</p>

Fuel Type	Pollutant Gases	BS6(BSVI)	BS4 (BSIV)			
Petrol Passenger Vehicle	Nitrogen Oxide (NOx) Limit	<60mg>	<80mg>	3		
	Particulate Matter (PM) Limit	<4.5mg/km	-			
Diesel Passenger Vehicle:	Nitrogen Oxide (NOx) Limit	<80mg>	<250mg>	3		
	Particulate Matter (PM) Limit	<4.5mg/km	<25mg>			
	HC + NOx	170mg/km	<300mg>			