



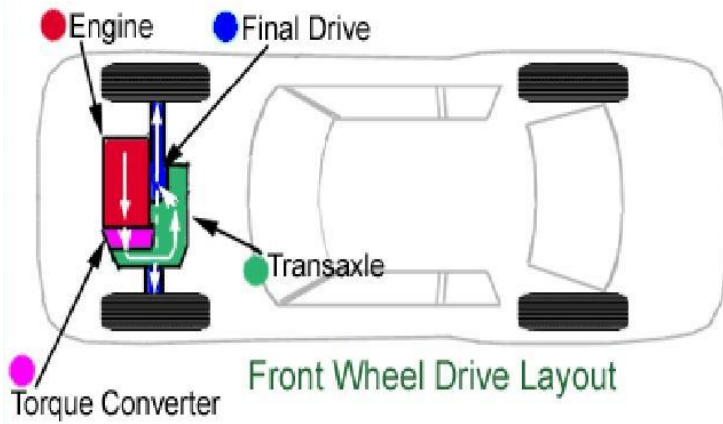
Subject Title:- Vehicle Layout and Transmission System

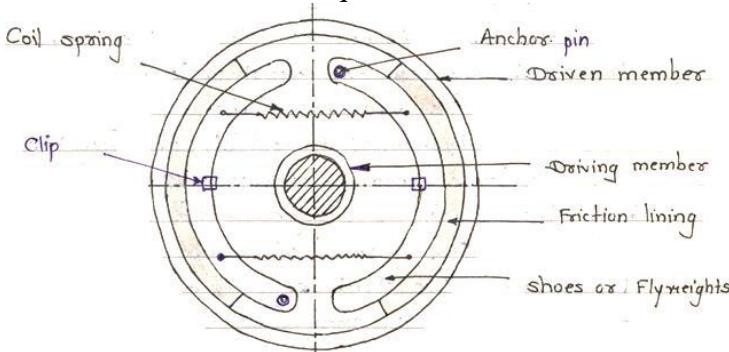
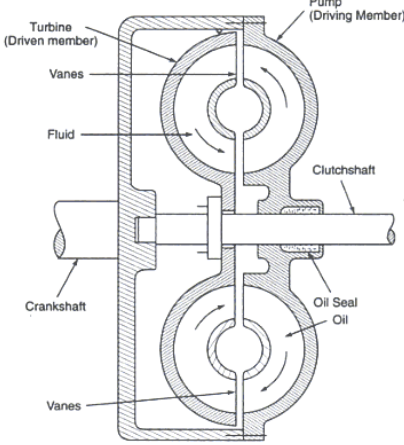
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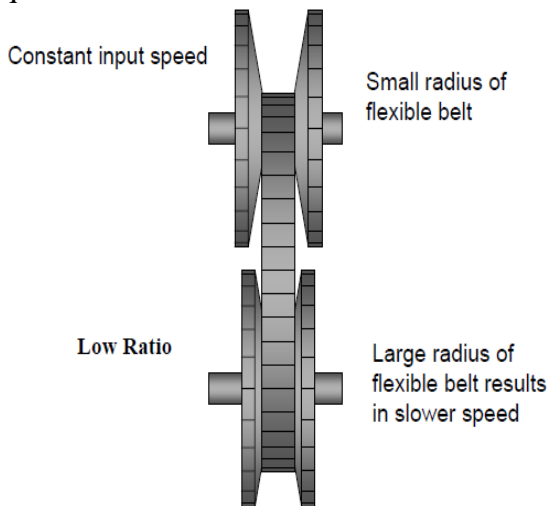
**Important Instructions to examiners:**

- 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.

Q. No.	Sub Q. N.	Answer	Marking Scheme
Q1	A)	<b>Attempt any six.</b>	<b>12</b>
	a)	<b>Enlist the function of the frame.</b>	
		Answer: <b>Function of the Frame</b> 1. To support the body and chassis components such as engine, gear box, axles, suspension system, braking system etc. 2. To withstand different types of loads acting on it.	<b>02</b>
	b)	<b>List out the material used for frame manufacturing.</b>	
		Answer: <b>Materials used for frame:</b> ( <i>Any two material- two marks</i> ) Most frames used on light vehicles are made of low-carbon steel having a carbon content of 0.15-0.25%. i) Mild sheet steel ii) Carbon sheet steel iii) Nickel alloy sheet steel iv) Aluminum alloy (Alpax).	<b>02</b>
	c)	<b>Classify the types of frames.</b>	
		Answer: <b>The types of frames are:</b> 1. Conventional Frame 2. Half Integral and Half frame 3. Integral or Unitized frame	<b>02</b>
	d)	<b>State the location of clutch in an Automobile.</b>	
		Answer: It is located between engine flywheel and the gearbox and mounted on the clutch shaft i.e. transmission input shaft.	<b>02</b>
	e)	<b>Write the material for clutch lining.</b>	
		Answer: The materials for clutch lining are: ( <i>any four materials- 1/2 mark each</i> ) 1. Leather 2. Cork 3. Fabric 4. Asbestos	<b>02</b>

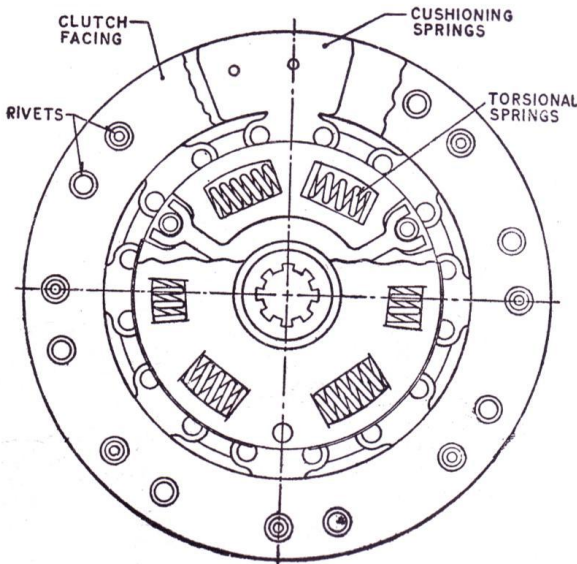
		5. Reybestos and Ferodo 6. Non- asbestos clutch lining material.	
	<b>f)</b>	<b>List any four components of gear box.</b>	
		<b>Answer:</b> (any four materials- 1/2 mark each) <b>Components of gear box:</b> i) Main shaft, ii) Lay shaft, iii) Driving Gears , iv) Driven gear, v) Reverse gear, vi) Gear Shifting lever, vii) Dog clutch (in case of constant mesh gear box) viii) Synchronizing unit.(in case of synchromesh gear box).	<b>02</b>
	<b>g)</b>	<b>State the function of propeller shaft.</b>	
		<b>Answer:</b> (Any two, 1 mark each) <b>i) Functions of propeller shaft:</b> 1. It transmits rotary motion and power from gear box to the differential at varied angle. 2. It accommodates change in length when the rear axle moves up and down. 3. It absorbs the shocks coming on the transmission system when the vehicle starts from rest.	<b>02</b>
	<b>h)</b>	<b>Write a necessity of rear axle.</b>	
		<b>Necessity of rear axle - (Any Two, Each points carry 01 mark)</b> 1. It carries the rear road wheels. 2. It transmits power to the rear wheels. 3. The rear axle sustains a major fraction of vehicles gross weight and transfers it to the ground through rear wheels. 4. It compensates for the difference in speeds (by means of differential gear) of outer and inner wheels while traversing a curve.	<b>02</b>
<b>1</b>	<b>B)</b>	<b>Attempt any two.</b>	<b>08</b>
	<b>a)</b>	<b>Draw layout of front engine front wheel drive.</b>	<b>04</b>
		<b>Answer:(Sketch - 4 Marks)</b>  <b>Fig. Front Engine Front Wheel Drive</b>	<b>04</b>

	<b>b)</b>	<b>Explain working principle of centrifugal clutch with neat sketch.</b>	<b>04</b>
		<p>Answer: <b>Working principle centrifugal clutch:</b> When the engine is started, the speed of the driving shaft is less, so the centrifugal force is also less. Therefore, shoes (flyweights) do not move outwards and torque is not transmitted to the rear wheel. As the speed of engine increases, the centrifugal force also increases. At certain engine speed, the shoes fly off outwards due to increased centrifugal force and they come in contact with the driven member. Now both the driving and driven members rotate together and the clutch is said to be engaged. Thus the engine torque is transmitted to the rear wheel. When the engine speed decreases, the centrifugal force also decreases. Now the shoes return back to their original position due to spring force which results in a disengagement of the clutch and torque is not transmitted to rear wheel.</p>  <p style="text-align: center;"><b>Figure: Working principle of Centrifugal Clutch</b></p>	<p><b>02</b></p> <p><b>02</b></p>
	<b>c)</b>	<b>Explain construction of fluid coupling with neat sketch.</b>	<b>04</b>
		<p>Answer: <b>construction of fluid coupling with neat sketch:</b></p>  <p style="text-align: center;"><b>Fig. Fluid Coupling.</b></p> <p><b>Construction-</b> It consists of the driving and driven as shown in above fig. The driving member is attached to the engine flywheel and driven member, to the transmission shaft. The member do not have direct contact with each other</p>	<p><b>02</b></p> <p><b>02</b></p>

2		<b>Attempt any four.</b>	<b>16</b>
	a)	<b>State any two applications of multi plate clutch and centrifugal clutch.</b>	<b>04</b>
		<p><b>Answer: (Any Two applications of each type- 1 mark for each application)</b></p> <p><b>Application of Multi plate Clutch</b></p> <ol style="list-style-type: none"> <li>1. Multi plate wet clutch used in Two-Wheeler where space is limited</li> <li>2. It is also used in racing cars where torque transmission criteria is maximum.</li> <li>3. It is used in Heavy Transport vehicles and special purpose vehicles.</li> </ol> <p><b>Application centrifugal clutch</b></p> <ol style="list-style-type: none"> <li>1. Use in Automatic transmission vehicles like mopeds.</li> <li>2. Use in semi-automatic transmission vehicles like Cars.</li> </ol>	<p><b>02</b></p> <p><b>02</b></p>
	b)	<b>Draw neat labeled sketch of variator drive and explain its operation.</b>	<b>04</b>
		<p><b>Answer: Operation of Variator Drive:</b> Vario-drive provides various drive ratios between the engine and rear wheel according to the engine speed and load. It consists of two set of split pulleys – drive and driven pulley and drive belt between the pulleys. The drive pulley is attach to the crankshaft and driven to rear wheel. The variator (drive pulley) consists of a fixed face and a movable face. The movable face is capable of sliding axially on the boss of the fixed face. The ramp plate is fixed by a nut and is pushes in the weight rollers against the drive face.</p> <p>As the speed of the engine increases, centrifugal force on the weight roller is also increased. This pushes the movable drive face inward. The unit then acts with a reduced drive ratio by allowing the drive belt to run on a pulley of greater diameter. The driven pulley and clutch weights are attached over the drive shaft. The force of the driven face spring is increased, the driven pulley turns and the clutch connects automatically. The effective diameter of the drive pulley is increased. The movable face is forced outward by means of the belt until equilibrium is reached between the torque tension of the belt and force of the spring. When this occurs, the drive ratio decreases and less torque is delivered to the final reduction.</p> <div data-bbox="599 1367 1143 1869" data-label="Diagram">  <p>Constant input speed</p> <p>Small radius of flexible belt</p> <p>Low Ratio</p> <p>Large radius of flexible belt results in slower speed</p> </div> <p><b>Figure: Variator Drive</b>  <i>(Note: equivalent credit should be given to any other suitable diagram)</i></p>	<p><b>02</b></p> <p><b>02</b></p>

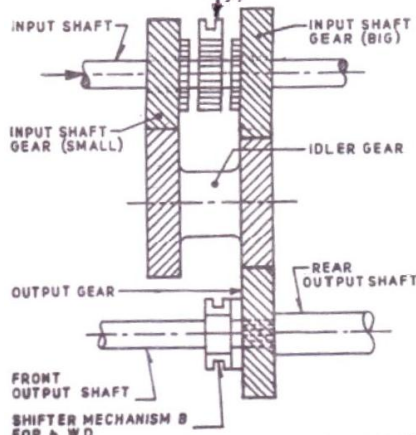


	c)	<b>Where and why we use multiplate clutch and explain working of multiplate clutch.</b>	<b>04</b>																											
		<b>Answer: Multiplate Clutch:</b> <i>(Note: Diagram not necessary)</i> <b>Use:</b> Multiplate dry clutch is used in heavy duty transport vehicles for example tractor trailer in which requirement of power and torque is more or higher. <b>OR</b> Multiplate wet clutch is used in motorcycles and racing cars because space available to locate the clutch is very small and natural cooling is not possible. <b>Working:</b> Multiplate clutch consist of a number of clutch plates. The plates are alternately fitted to the engine and gear box shaft. They are firmly pressed by strong coil springs and assembled in a drum. Each of the alternate plate slides in the groves on the flywheel and the other slides on splines on the pressure plate. To disengage the clutch, pressure will be applied on the clutch pedal; due to this the pressure plate moves to right and against the spring force. The movement of the pressure plate to the right makes the clutch plates free which mean that torque will not be transmitted from the engine shaft to the transmission. When the clutch pedal is released, because of spring force the pressure plates move forward and keeps the pressure on the clutch plates holding them against the flywheel. Now the torque is transmitted to the transmission.	<b>02</b>          <b>02</b>																											
	d)	<b>Differentiate between single plate clutch and multiplate clutch. (any 4 point).</b>	<b>04</b>																											
		<b>Answer: Difference between single plate clutch and multiplate clutch:</b> <i>(Any 4 points, 1 mark each)</i> <table><tr><th>Sr</th><th>Single Plate clutch</th><th>Multi-plate clutch</th></tr><tr><td>1</td><td>It consists of only one clutch plate.</td><td>It consists of two or more number of clutch plates.</td></tr><tr><td>2</td><td>Number of pairs of friction surfaces in contact are two.</td><td>Number of pairs of friction surfaces in contact are more than two.</td></tr><tr><td>3</td><td>It does not ensure smooth engagement.</td><td>It ensures smooth and gradual engagement.</td></tr><tr><td>4</td><td>It requires more space.</td><td>It requires less space.</td></tr><tr><td>5</td><td>For same power transmission, larger in size.</td><td>For same power transmission, smaller in size.</td></tr><tr><td>6</td><td>For same size, torque transmission capacity is less.</td><td>For same size, torque transmission capacity is more.</td></tr><tr><td>7</td><td>Frictional power loss is less.</td><td>Since it has number of friction plates instead of single, frictional power loss is more.</td></tr><tr><td>8</td><td>Application- Trucks, Jeeps, cars etc.</td><td>Application- Two wheelers, racing cars, some heavy duty trucks.</td></tr></table>	Sr	Single Plate clutch	Multi-plate clutch	1	It consists of only one clutch plate.	It consists of two or more number of clutch plates.	2	Number of pairs of friction surfaces in contact are two.	Number of pairs of friction surfaces in contact are more than two.	3	It does not ensure smooth engagement.	It ensures smooth and gradual engagement.	4	It requires more space.	It requires less space.	5	For same power transmission, larger in size.	For same power transmission, smaller in size.	6	For same size, torque transmission capacity is less.	For same size, torque transmission capacity is more.	7	Frictional power loss is less.	Since it has number of friction plates instead of single, frictional power loss is more.	8	Application- Trucks, Jeeps, cars etc.	Application- Two wheelers, racing cars, some heavy duty trucks.	
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e)	<p><b>Explain construction and working of clutch plate with neat sketch.</b></p> <p><b>Answer: (Sketch-2 marks, construction and working- 2 marks)</b></p>  <p><b>Construction-</b> It consists of steel plate with a splined central hub. Annular friction facing are attached to the steel plates by rivets. Special resins are also used to bind the friction facing. The curved cushioning spring segments are attached rigidly to the centre plate and friction facing are riveted to these springs. Centre hub-assembly consists of a splined hub with radially placed slots in the flange of the hub. There are similar type of slots in each of the two plates situated on either side of the hub flange.</p> <p><b>Working-</b> On engagement the load applied first compress the spring segments to the flat condition, resulting in greater degree of clutch control and therefore smoother engagement. Longer life is obtained because the friction materials contacts the pressure plate and flywheel under more uniform pressure, thereby allowing uniform heat generation over the entire friction surface.</p>	04
f)	<p><b>Describe the construction and working of transfer case.</b></p> <p><b>Answer: (2 marks for construction, 2 marks for working)</b> <b>Note: Due Credit may be given to sketch)</b></p> <p><b>Construction -</b> It consists of three shafts- input shaft, counter shaft and two output shafts. The input shaft takes power from the main gear box. The two gears gear1 and gear 2 on input shaft are free to rotate on it. These two input shaft gears have bosses on the inner side having axial teeth, which can be meshed with central member. The input shaft carries on central member C.M. having axial teeth on both, side faces. The gear G1 is smaller in diameter than G2.</p> <p><b>Working</b> When the shifter-A is at the central position as shown in fig. here neither the gear G1 and nor the gear G2 is connected to the input shaft, it is known as neutral position. When the shifter-A connects the input shaft with big input gear G2, and the shifter-B disconnects the front output shaft from the rear output shaft. In this position, rear two</p>	04



wheel drives with the high gear is obtained.  
Similarly when the shifter-A connects the input shaft with small input gear G1, and the shifter-B connects the front output shaft from the rear output shaft. In this position, four- wheel drive with the low gear is obtained.



Q3

Attempt any FOUR of the following

16

a)

Describe the working of four speed sliding mesh gear box.

04

Ans.

**Working of four speed sliding mesh gear box with power flow diagram:**

04

**Neutral:** In neutral main shaft gear is not meshed with any of the lay shaft gears. Hence only clutch shaft and lay shaft rotates. Power is not transmitted to main shaft.

**First gear:** The selector fork (A) moves bigger gear (6) on main shaft to mesh with gear (5) on the lay shaft. The power flow is 1-2-5-6- main shaft. This ratio provides the greatest torque increase and greatest speed reduction.

**Second gear:** The selector fork (A) moves back to neutral and the fork (B) moves the gear (4) of main shaft to right to mesh with gear (3) of lay shaft. The power flow is 1-2-3-4- main shaft. The output torque is more than that of first gear but the output speed is increased.

**Top gear:** The selector fork (B) is moved in opposite direction to engage gear (4) with clutch gear (1) by means of dog clutch. This connects the two shafts firmly and main shaft is directly driven at crank shaft speed.

**Reverse:** The selector fork (A) is moved in opposite direction to engage gear (6) to mesh with reverse idler (8). The power flow is 1-2-7-8-main shaft. The idler changes the rotation of main shaft opposite to that of first gear, this provides reversal of direction of drive.

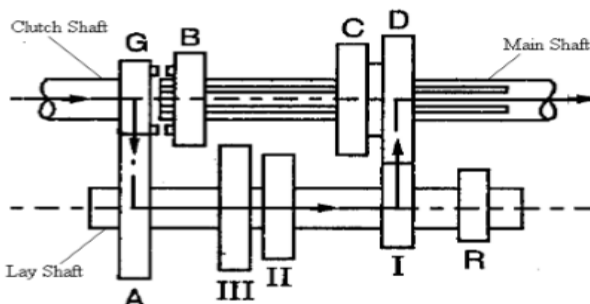
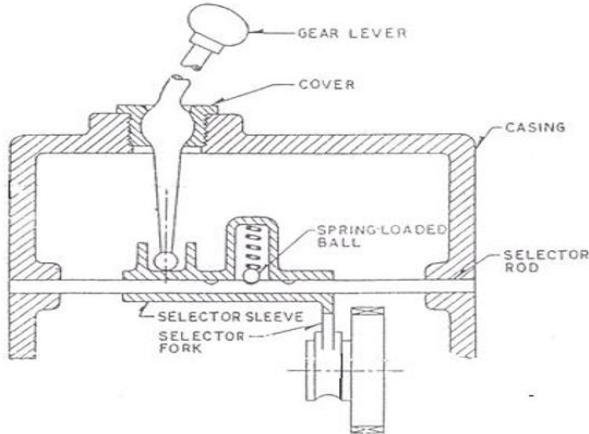
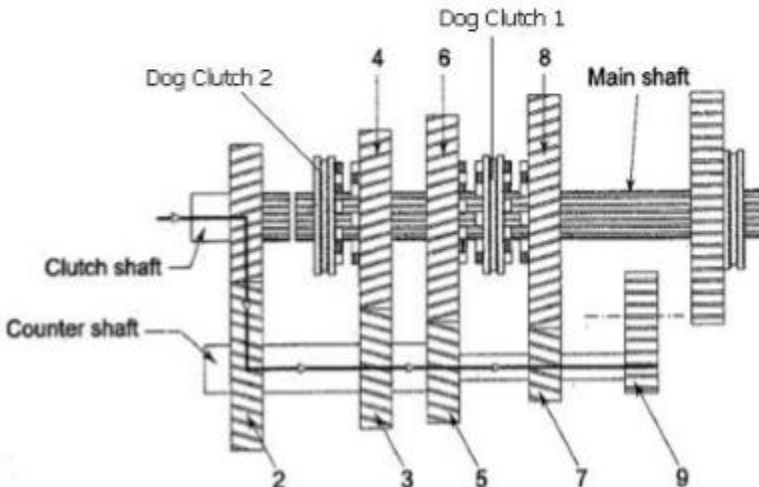
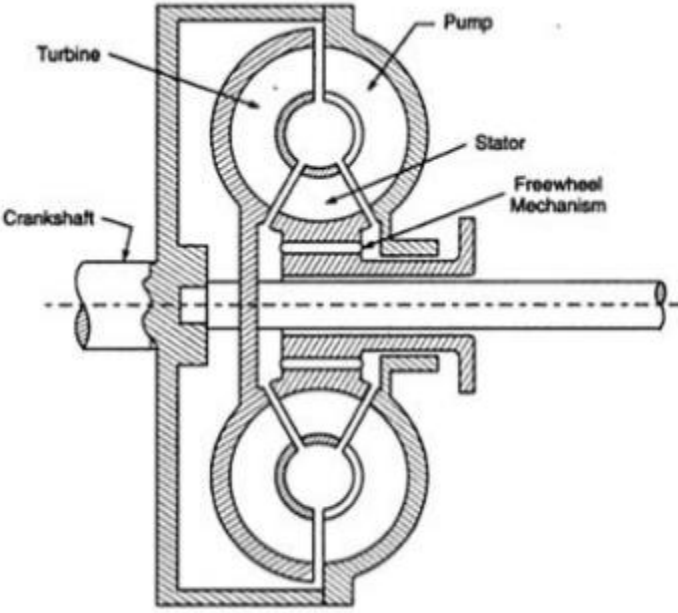


Figure: Sliding Mesh gear box with power flow when I gear is engaged.

(Note: Equivalent credit should be given to power flow diagram with any one gear is in engaged position )

	b)	<b>Explain construction and working of Gear selector mechanism with gear lever on top of gear box.</b>	<b>04</b>
	Ans.	<p><b>Gear selector mechanism with gear lever on the top of gear box-</b> A typical mechanism for a 4-forward speeds and reverse gear box where the gear lever is ball mounted in the gear box cover. This facilitates its movement in any direction. The lower end of gear lever fits into a slot in the selector sleeve. There are forks on the sleeves on three separate selector rods which are supported in the gear box casing. Each selector sleeve can slide on its rod, but just to avoid unwanted engagement of the gears, slots are made on the selector rods and the sleeves are provided with spring-loaded balls. These balls resist the movement of the forks until some force is applied to gear lever to overcome their resistance. In some cases the forks are fixed on the selector rods by means of pins and the assembly can slide. Grooves are provided on the gear bosses where the selector forks can fit in. Transverse motion of the gear lever selects the forks which are to be engaged and the longitudinal movements then slides the fork and its gear to engage the selected gear.</p>  <p>Figure: Gear selector mechanism with gear lever on the top of gear box.</p>	<p><b>02</b></p>
	c)	<b>Draw the proportionate sketch of 4 speed constant mesh gear box.</b>	<b>04</b>
	Ans.	<p>Answer:</p>  <p>Figure: 4 Speed Constant Mesh Gear Box.</p>	<b>04</b>



	<b>d)</b>	<b>Draw a neat sketch of torque converter.</b>	<b>04</b>
	Ans.	<b>Answer:</b>  <p style="text-align: center;"><b>Fig: Torque converter</b></p>	<b>04</b>
	<b>e)</b>	<b>State two advantages and disadvantages of synchromesh gear box.</b>	<b>04</b>
	Ans.	<b>Advantages of synchromesh gear box: (any two)</b> 1) No need of double declutching as in case of constant mesh gearbox. 2) Smooth engagement of higher gears due to synchromesh device. 3) Less noisy as helical gears are used. 4) Less vibration. <b>Disadvantages of synchromesh gear box: (any two)</b> 1) Synchromesh is a fine machined element and hence is costly. 2) Service of gears and synchromesh device is difficult. 3) More space is required. 4) Use of synchromesh device for low speed gears is uneconomical.	<b>02</b>          <b>02</b>
	<b>f)</b>	<b>Explain a construction of a hollow propeller shaft in brief.</b>	<b>04</b>
	Ans.	<b>Construction of hollow tube propeller shaft:</b> Propeller shaft is the shaft which transmits the drive from the transmission to the bevel pinion or worm of the final drive in front engine rear wheel drive vehicles and from the transfer box to the front and rear axles in the all-wheel drive vehicle. It is also called as drive shaft. It consists mainly of three parts: <b>a) Shaft:</b> As the shaft has to withstand mainly torsional loads, it is usually made of tubular cross-section. The shaft has to be well balanced to avoid whirling at high speeds. Shaft is made of steel, aluminum or composite materials <b>b) Slip joint:</b> Single slip joint is used at front end of hollow tube near the front universal joint. This serves to adjust the length of the propeller shaft when demanded by the rear axle movement. Slip joint is formed by the internal splines on the sleeve attached to the left universal joint and external splines on the propeller shaft as shown <b>c) Universal joints:</b> In hollow tube propeller shaft arrangement, two universal joints – one at front end and other at rear end are used. The universal joints account for the up and down movements of the rear axle when the vehicle is running.	<b>04</b>

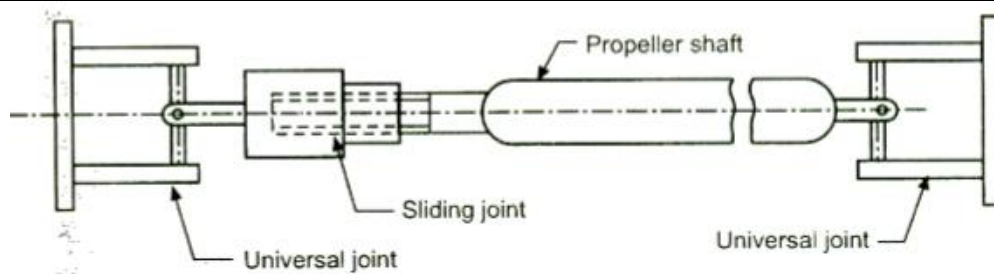




Figure: Propeller shaft.

<b>Q4</b>		<b>Attempt any FOUR of the following</b>	<b>12</b>
	<b>a)</b>	<b>State the function of universal joint and slip joint.</b>	<b>04</b>
	Ans.	<p><b>Function of – Universal Joints:</b></p> <p>In front engine rear wheel drive vehicles, the transmission rigidly fixed to the frame or body is normally at higher level than wheels. The rear axle is suspended to the frame through springs. The driveshaft hence requires some flexibility at the bend near the transmission and at the axle. So the universal joints are used at front and rear end of propeller shaft which transmit the power to the wheels even if the heights of transmission and rear axle are different. Also whenever the axle moves up and down due to road irregularities, the angle of drive changes continuously and universal joint allows transmission of power and rotary motion at a varied angle.</p> <p><b>Slip Joints:</b></p> <p>When the rear wheel comes across a bump, the spring compresses or expands as the differential with the rear axle housing and the wheel moves up and down. This not only changes the angle but also varies the length of propeller shaft. So the slip joint permits the effective length of propeller shaft depending upon the road conditions. If there is no slip joint, the propeller shaft will buckle or brake.</p>	<p><b>02</b></p> <p><b>02</b></p>
	<b>b)</b>	<b>Explain loads acting on rear axle.</b>	<b>04</b>
	Ans.	<p><b>The various loads acting on the rear axle are-(Any 04 points each carry 01 mark)</b></p> <p><b>1) Driving thrust-</b>Driving torque produced in the engine causes the thrust to be produced in the road wheels, which has to be transmitted from the axle casing to the chassis frame and the body of the vehicle.</p> <p><b>2) Torque Reaction-</b>If the rear axle is held rigidly when the road wheels are prevented from rotation, (due to driving needs or road conditions) the bevel pinion of the final drive tends to rotate around the crown wheel. It produces a tendency in the whole vehicle to rotate about the rear axle, or to lift off the front of the vehicle. This effect is known as torque –reaction.</p> <p><b>3) Braking torque or thrust-</b>The axle casing experiences the brake torque when the brakes are applied to the vehicle.</p> <p><b>4) Side thrust-</b>When the vehicle is taking the turn, the rear axle subjected to the side thrust or pulls due to any side load on the wheel.</p> <p><b>5) Weight of the body-</b>The rear axle may be considered a beam supported at ends loaded. This weight causes bending and shears force in the axle shaft.</p>	<b>04</b>

	<b>c)</b>	<b>State functions and types of constant velocity joint.</b>	<b>04</b>
	Ans.	<p><b>Functions of Constant Velocity Joint:</b></p> <p>1. To transmit the power when angle of drive is more than 300 as in front wheel drive car. 2. To allow shafts to slide in and out at large operating angles, when there is irregularity of rotation angle at more torque and fluctuation cause steering control problem. 3. To maintain constant speed even at corners.</p> <p><b>Types of inboard and outboard type CV Joints: (Any two)</b> 1. Rzeppa joint 2. Tripod joint 3. Bendix-weiss joint 4. Thomson coupling 5. Double carden joints</p>	<b>02</b>
	<b>d)</b>	<b>State various types of rear axle casing and explain any one with neat sketch.</b>	<b>04</b>
	Ans.	<p><b>Types of rear axle casing: (Types-1 mark, Explanation of any one with sketch-3 marks)</b></p> <p>1. Banjo or separate carrier type (or one piece) casing</p> <p>2. Split (or two piece) casing</p> <p>3. Salisbury or Integral Carrier type casing</p> <p><b>1) Banjo type (or one piece) casing:</b> It is named so, because its shape like the musical instrument banjo. It is also called separate carrier type casing because the complete differential unit is carried in a separate carrier which is bolted to the axle casing. The two half shafts are put-in or taken-out from the sides during assembly or repairs. In majority cars the propeller shaft lies along the centre line of the car, and the rear axle gearing is enclosed in banjo at the centre of the axle casing. However, in certain cases the banjo may be offset to one side or the other.</p> <div data-bbox="553 1010 1195 1142" data-label="Image">  </div> <p style="text-align: center;">Figure: Banjo type Casing</p> <p style="text-align: center;">OR</p> <p><b>2) Split (or two piece) casing-</b>The casing is made in two-pieces which are bolted together to form a casing. This type is obsolete now because in case of a fault, the whole rear axle unit has to be taken out before its dismantling.</p> <div data-bbox="591 1409 1179 1562" data-label="Image">  </div> <p style="text-align: center;">Figure: Split type casing</p> <p style="text-align: center;">OR</p> <p><b>3) Salisbury or Integral carrier type:</b> This is similar in construction to the banjo type except that in this the carrier i.e. differential housing has permanent housing tubes pressed and welded in its sides. According to SAE nomenclature, it is called the unitized carrier housing.</p>	<b>04</b>

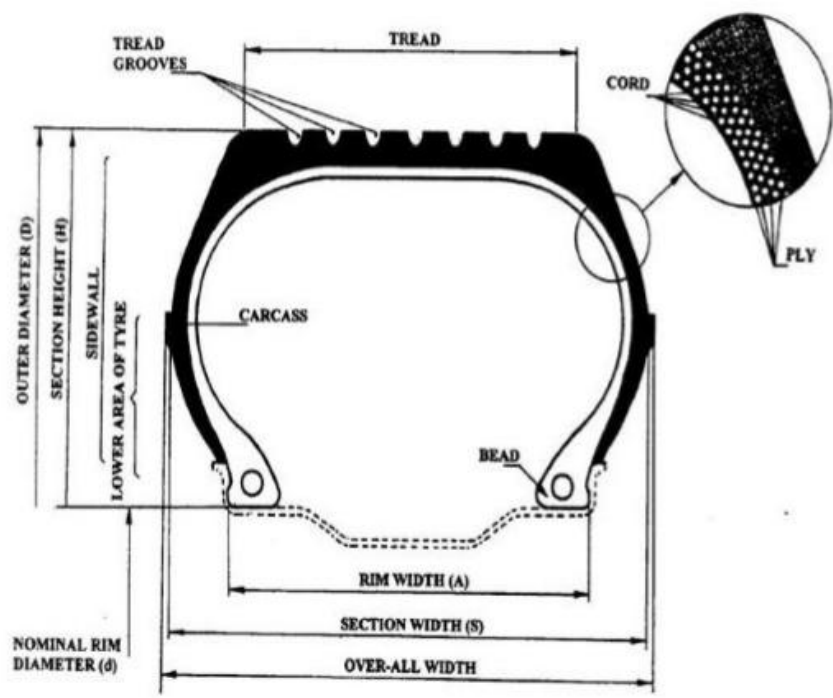
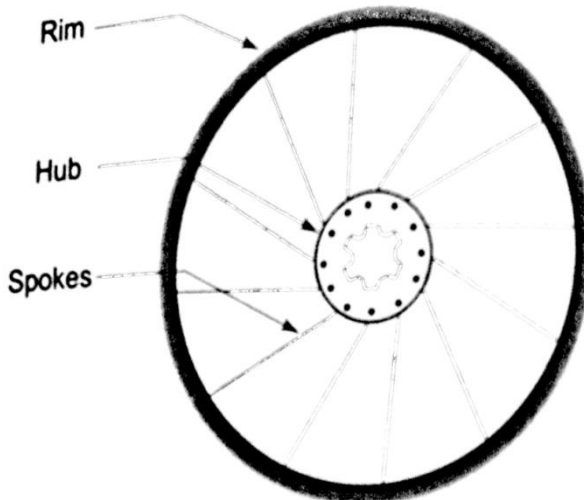
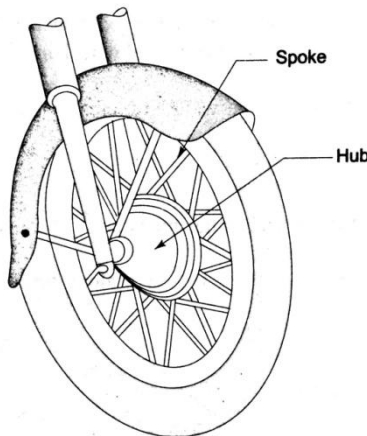
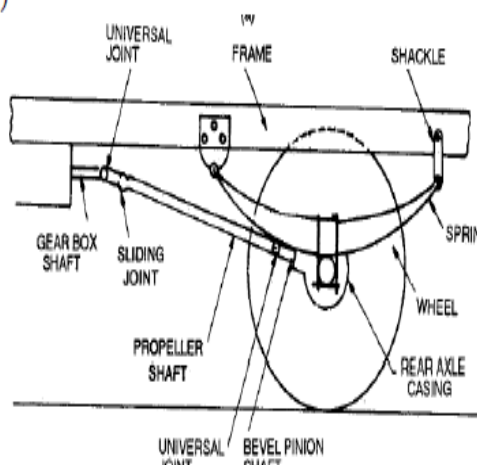
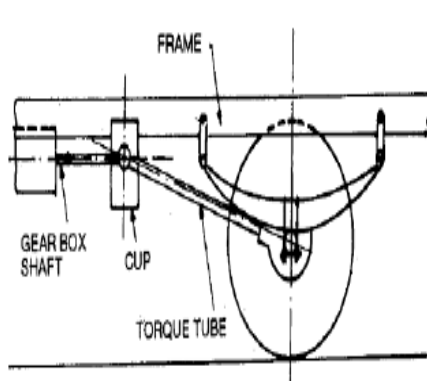
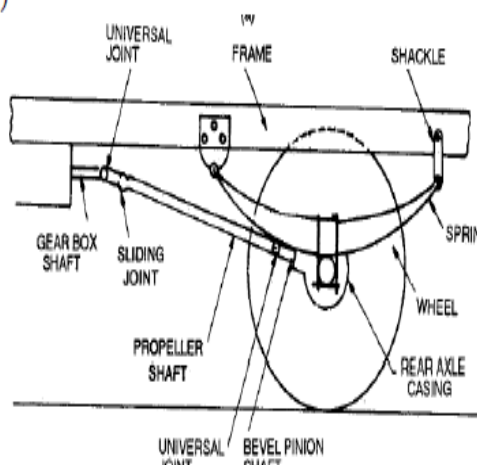
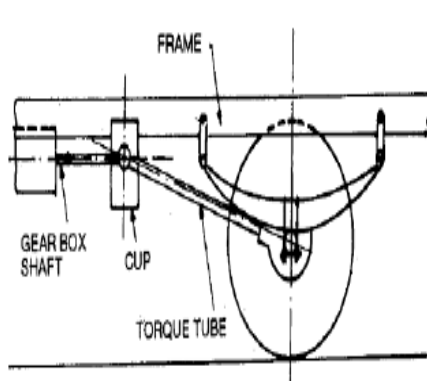
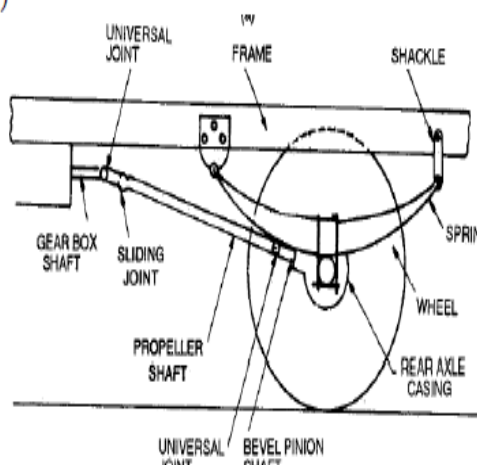
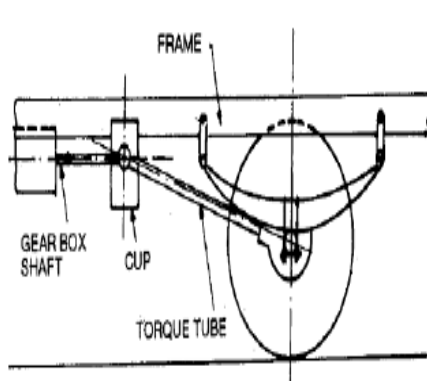
e)	<b>Explain tyre terminology with sketch.</b>	<b>04</b>
Ans.	<p><b>Tyre Terminology: (Any four terms- 2 marks, Sketch -2 marks)</b></p> <ol style="list-style-type: none"> <li><b>1. Tread:</b> That portion of a tire that comes into contact with the road. It is distinguished by the design of its ribs and grooves. Provides traction in a variety of conditions, withstands high forces, and resists wear, abrasion, and heat.</li> <li><b>2. Tread Depth:</b> The depth of usable tread rubber, the distance from the top of the tread to the grooves in a tire. The measurement is taken at the centerline of a tire.</li> <li><b>3. Tire Size:</b> The combination of tire width, construction type, aspect ratio, and rim size used in differentiating tires.</li> <li><b>4. Sidewall:</b> That portion of a tire between the tread and the bead. Protects the tire against impacts with curbs, etc. This is also where the sidewall markings can be found which tell you important information regarding the tire</li> <li><b>5. Section height:</b> The height of a tire, measured from its rim to its outer tread.</li> <li><b>6. Section width:</b> The distance between the outside of a tire's sidewalls, not including any lettering or designs.</li> <li><b>7. Ribs:</b> A pattern of tread features aligned around the circumference of a tire. There are usually multiple ribs across the tread area of a tire.</li> <li><b>8. Carcass:</b> The supporting structure of the tire consisting of plies anchored to the bead on one side and running in a radius to the other side and anchoring to the bead.</li> <li><b>9. Bead:</b> The part of the tire that sits on the wheel made of steel wires, reinforced by body ply cords, shaped to hold firmly the tire against the wheel rim.</li> <li><b>10. Aspect Ratio:</b> The relationship of a tire's sidewall height to its section width. In a tire size designation, it is 65 in "195/65R15". It is also referred to as the tire's profile or the series.</li> <li><b>11. Load Index:</b> Is a number that corresponds to the maximum load in kilograms that a tyre can support when properly inflated.</li> </ol> 	<b>04</b>

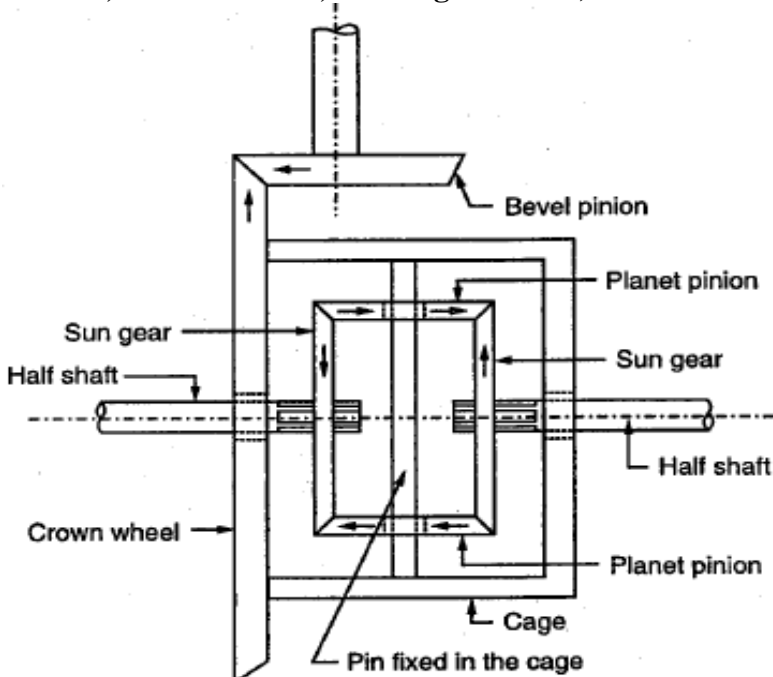
Figure: Tyre Terminology

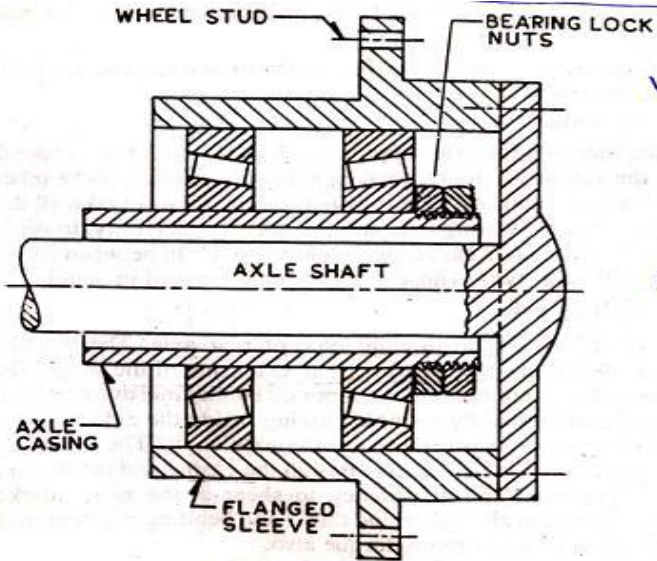
	<b>f)</b>	<b>Discuss with the help of simple sketch the construction of wind spoke wheel.</b>	<b>04</b>
	Ans.	<p><b>Construction of Wire spoke wheel</b></p> <p>The wire spoke wheel is made by connecting the wheel hub to rim by wire spoke as in a bicycle. These wheels were widely used during the early days but their application is very much restricted on modern automobiles except on sports models for the sake of aesthetic appearance. The spokes tend to break and their replacement is cumbersome. For high speed passenger cars their balancing may be a problem and could be expensive. There are two sets of wire spokes about the periphery of the wheel, one set opposing the other in its disposition from the hub to the periphery. Depending on the direction of rotation of the wheel, one set resists tension and the other compressive forces.</p> <p>Spoked wheels are difficult to make and keep clean though they permit better cooling by air circulation. On sports car wheels, which are small, they offer the advantage of better cooling and put up a very good appearance.</p> <div data-bbox="581 816 1161 1312" data-label="Image">  </div> <p style="text-align: center;">Fig-Wire Wheel <b>OR</b></p> <div data-bbox="717 1425 1081 1858" data-label="Image">  </div> <p style="text-align: center;">Fig-Wire wheel for motor cycle (Note: Equivalent credit shall be given to any other suitable sketch if drawn)</p>	<p><b>02</b></p> <p><b>02</b></p> <p><b>02</b></p>

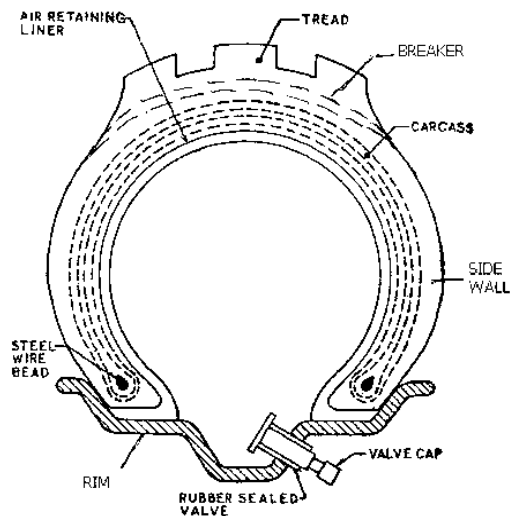


5		Attempt any two.	16																		
	a)	Differentiate between Hotchkiss and Torque tube drive with the help of suitable sketch.	08																		
		Answer: <b>Difference between Hotchkiss and torque tube drive:</b> (Sketches-4 marks, Any four remaining points-4marks)																			
		<table><tr><th>Hotchkiss Drive</th><th>Torque Tube Drive</th></tr><tr><td>1) </td><td>1) </td></tr><tr><td>2) Open type propeller shaft is used.</td><td>2) Propeller shaft is housed in a tube called torque tube.</td></tr><tr><td>3) Two universal joints is used one at front &amp; second at rear end of the propeller shaft.</td><td>3) Only one universal joint is used at the front end of the propeller shaft.</td></tr><tr><td>4) Slip joint is used to accommodate change in length.</td><td>4) No slip joint is used.</td></tr><tr><td>5) Torque reaction, driving thrust, side thrust, weight of the body &amp; braking torque all are taken by leaf spring.</td><td>5) Weight of the body &amp; side thrust are taken by leaf spring. Torque reaction, driving thrust, braking torque are taken by the torque tube.</td></tr><tr><td>6) Leaf spring is shackled at the rear and bracketed at front end.</td><td>6) Both end of the leaf spring are shackled.</td></tr><tr><td>7) The centre axis of propeller shaft and bevel pinion shaft is not coinciding when axle moves up and down.</td><td>7) Axis of propeller shaft and bevel pinion shaft coincide always.</td></tr><tr><td>8) It is used in heavy vehicles like bus, truck.</td><td>8) It is used in light vehicles like cars.</td></tr></table>	Hotchkiss Drive	Torque Tube Drive	1) 	1) 	2) Open type propeller shaft is used.	2) Propeller shaft is housed in a tube called torque tube.	3) Two universal joints is used one at front & second at rear end of the propeller shaft.	3) Only one universal joint is used at the front end of the propeller shaft.	4) Slip joint is used to accommodate change in length.	4) No slip joint is used.	5) Torque reaction, driving thrust, side thrust, weight of the body & braking torque all are taken by leaf spring.	5) Weight of the body & side thrust are taken by leaf spring. Torque reaction, driving thrust, braking torque are taken by the torque tube.	6) Leaf spring is shackled at the rear and bracketed at front end.	6) Both end of the leaf spring are shackled.	7) The centre axis of propeller shaft and bevel pinion shaft is not coinciding when axle moves up and down.	7) Axis of propeller shaft and bevel pinion shaft coincide always.	8) It is used in heavy vehicles like bus, truck.	8) It is used in light vehicles like cars.	
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b)	<b>Explain working of differential with neat sketch.</b>	08
	<p><b>Answer: (sketch- 3, construction-1, working- 4 marks)</b></p> <div data-bbox="474 338 1243 1010" data-label="Image">  </div> <p><b>Fig- working of differential</b></p> <p><b>Construction:</b> It consists of a cage, which is bolted to the inner side of the crown wheel and rotates with it. The two planet pinions are mounted upon a spider shaft and are in mesh with two sun gears which support and drive the inner end of the half shafts.</p> <p><b>Working:</b> <b>Vehicle Running Straight:-</b> When vehicle moves in a straight line, the power comes from propeller shaft to the bevel pinion which drives the crown wheel. Then it is carried to the differential cage in which a set of planet pinions and sun gears are located. From the sun gear it is transmitted to the road wheels through axle half shafts. In this case, the crown wheel, differential cage, planet pinions and sun gears all turn as a single unit and there is no any relative motion between the sun gear and planet pinion. The planet pinions do not rotate about their own axis. The road wheels, half shafts and sun wheels offer the same resistance to being turned and the differential gearing does not therefore operate. Both the road wheels turn at the same speed</p> <p><b>Vehicle Cornering:-</b> When vehicle takes a turn, the inner wheel experiences a resistance and tends to rotate in opposite direction. Due to this the planet pinions starts rotating about their own axis and around the sun gear and transmit more rotary motion to the outer side sun gear. So that outer sun gear rotates faster than the inner sun gear. Therefore the outer road wheel runs faster than the inner road wheel and covers a more distance.</p>	<p>03</p> <p>01</p> <p>02</p> <p>02</p>

	c)	<p><b>Explain with neat sketch the full floating axle of a truck.</b></p> <p><b>Answer: Sketch-4 marks, explanation- 4marks)</b></p> <p><b>Full Floating rear axle:</b></p>  <p><b>Fig: Fully-Floating rear axle.</b></p> <p>The figure shows the full floating axle. The wheel is on the axle casing. Two roller bearings are between the wheel and axle casings. The axle end is fitted with the wheel by means of a flange, bolt and nut. There are two roller bearings between the wheel and axle casing. This is the advantage of the fully floating axle, over other two types of axles. To remove the axle the bolt and nut are first loosened. The flange and axle can then be very easily removed. The vehicle continues to be supported by the wheel and the axle casing. Fully floating rear axle is used in heavy commercial vehicles.</p>	08
6.		<b>Attempt any two.</b>	16
	a)	<p><b>i) Explain tubeless tyre and its features.</b></p> <p><b>ii) Explain different types of pattern used in automobile.</b></p>	08
		<p><b>Answer: i) Tube less tyre &amp; its features: (Credit should be given to appropriate answer)</b></p> <p>The material &amp; design of carcass &amp; tread remains similar to tubed type tyre. In this no tube is placed inside the tyre. The inside of casing is lined with soft rubber lining which forms an air tight seal with rim, it is known as “air-retainer liner”. This lining retains the air &amp; seals itself on being puncture. A “non return valve” is fitted to rim through which the air is forced inside the tyre. The rim used for such tyres is specially designed.</p>	04



**Fig. Tubeless tyre**

**ii) Different types of tread patterns are as shown in figure below:**

Pattern (a): Good midway adhesion. Good grip.

Pattern (b): Little sideways adhesion but good fore and aft grip. Rapid, irregular wear and noisy running.

Pattern (c): Good sideways, fore and aft grip. Irregular wear on hard roads, noisy running.

Pattern (d): Good wear resistance and steering characteristic. Used on trailers and farm implements.

Pattern (e): Used on rough and loose surfaces, giving maximum grip and side ways stability.



(a)



(b)



(c)



(d)



(e)

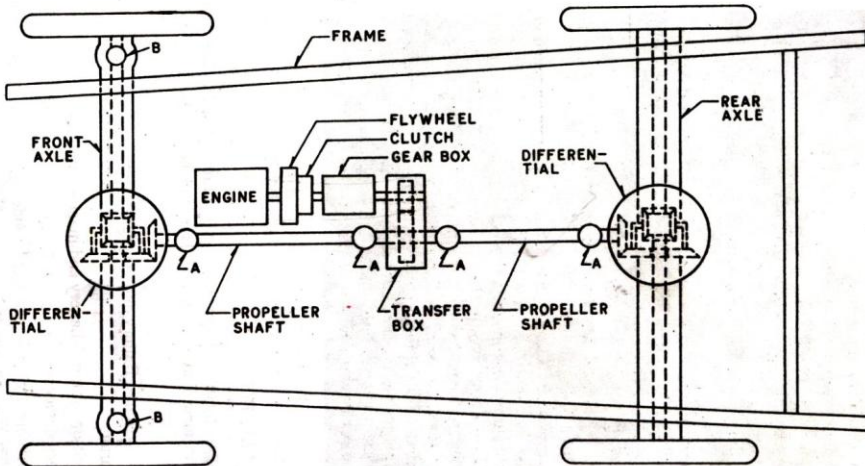
04

**b) Differentiate between cross ply and radial-ply type on basis of**  
**i) Construction / trade pattern    ii) Materials/constituents**  
**iii) Performance/efficiency    iv) Application/purpose.**

08

**Answer: (2marks for each point)**

Sr.	Point	Cross Ply	Radial Ply
1	Construction / trade pattern	Piles are running diagonally opposite from bead to bead.	Piles are running radially (i.e. in the direction of tyre axis) straight from bead to bead.
2	Materials / constituents	It consists of cord ply woven at an angle. Breaker strips are not provided, thus continuous grip on road surface is not possible.	It consists of cord ply woven in radial direction. Breaker strips are provided to make continuous flat contact with road surface.

		3	Performance and efficiency	Stiffness of tyre is more, so less comfortable. Steering is easy. Tyre has lesser grip with road. More rolling resistance as compare to radial ply tyres. Also it has less trade life. It has wobbling characteristics.	Stiffness of tyre is less, so it gives ultimate comfort at high speed. Steering is harder at low speeds. Tyre has firm grip with road. This tyre has low rolling resistance, hence better fuel efficiency. Also it has more trade life. It provides better directional stability.	
		4	Application/ purpose.	Motorcycles, agricultural purpose vehicles	Passenger cars	
	c)	<b>Draw a neat labeled diagram of four wheel drive vehicle layout. State two merits and two demerits of four wheel drive over two wheel drive.</b>				<b>08</b>
		<b>Answer: ( sketch 4 marks, merits-2marks, demerits-2 marks)</b>  <b>Fig: Four Wheel Drive layout.</b> <b>Merits of 4-Wheel drive over 2-Wheel Drive: (any two merits)</b> <ol style="list-style-type: none"> <li>1. Better traction on smooth surface in all conditions (wet and wintry weather)</li> <li>2. Increased drive off and climbing capacity irrespective of load.</li> <li>3. Better acceleration in lower gear.</li> <li>4. Reduced sensitivity to side wind.</li> <li>5. Better stability.</li> <li>6. More balanced axle load distribution.</li> <li>7. Equal tire wear.</li> </ol> <b>Demerits of 4-Wheel drive over 2-Wheel Drive: (any two demerits)</b> <ol style="list-style-type: none"> <li>1. More weight of vehicle.</li> <li>2. Lower maximum speed.</li> <li>3. Increased fuel consumption by 5 to 10%.</li> <li>4. As extra components are required manufacturing cost is more.</li> </ol>				<b>04</b>
						<b>02</b>
						<b>02</b>