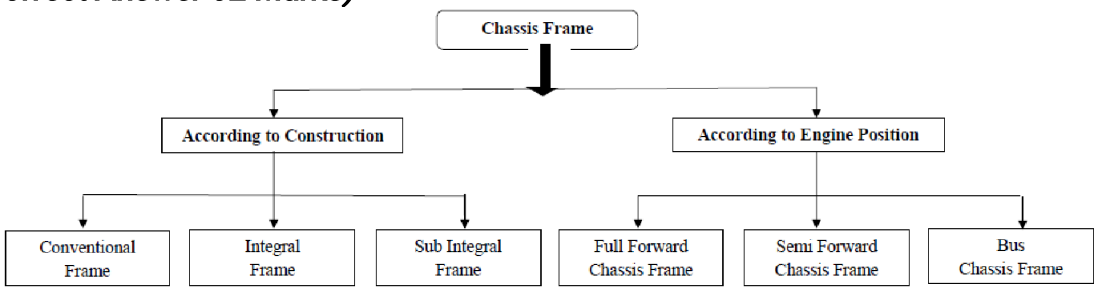
SUMMER – 19 EXAMINATION

Subject Name:VLT **Model Answer** _Subject 17307

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 anyequivalent 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
1	A	**Attempt any SIX of the Following**	**12**
	(a)	**Write the Function Of Frame.**	**02**
	Ans.	***(Any Two 01 Marks each)*** **Function of the Frame:** 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.	*Any Two 01 Marks each*
	(b)	**List the materials used for frame manufacturing**	**02**
	Ans.	***(Any two material 01 Mark each)*** **Materials used for chassis frame-** 1) Mild steel 2) Carbon steel 3) Nickel alloy steel 4) Aluminium alloy.	*Any two material 01 Mark each*
	(c)	**State the types of frame.**	**02**
	Ans.	***(Correct Answer 02 Marks)*** 	*Correct Answer 02 Marks*
	(d)	**State the Location of Clutch in an Automobile.**	**02**
	Ans.	***(Correct Answer 02 Marks)*** **Location of Clutch in an Automobile:**	*Correct Answer*

		The clutch is located in between engine and transmission (gear box).	*02 Marks*
	(e)	**List any four components of the gear box.**	**02**
	Ans.	***(Any Four ½ mark Each)*** 1 Clutch Shaft (Driving or I/P Shaft) 2 Counter or Lay Shaft 3 Main or Splined or Driven Shaft 4 Bigger Gear on Main Shaft 5 Medium Gear on Main Shaft 6 Smaller Gear on Main Shaft 7 Dog Clutches 8 Gear box casing or Housing 9 Filler Cap 10 Drain Plug	*Any Four ½ mark Each*
	(f)	**State the Function of The Propeller Shaft.**	**02**
	Ans.	***(Correct Answer 02 Marks)*** **Function of The Propeller Shaft:** In an automobile, the shaft which transmits the power from the gearbox output shaft to final drive (differential) is called as a propeller shaft. The propeller shaft is normally tubular in section and of one or two-piece construction.	*Correct Answer 02 Marks*
	(g)	**Write the necessity of rear axle.**	**02**
	Ans.	***(Correct Answer 02 Marks)*** **Necessity of Rear Axle:** Live axels are those axels through which the engine driving torque is transmitted to wheels. The drive from propeller shaft comes to the pinion shaft which is supported in bearings in the axle casings. The crown wheel is in mesh with the pinion and is mounted on shaft on the ends of which are fixed the caps which serves to restrict the wheels in axial direction. The wheels are mounted on bearing on the ends of the axle shaft. The power from differential is equally divided to both wheels.	*Correct Answer 02 Marks*
	(h)	**Write the principle of differential**	**02**
	Ans.	***(Correct Answer 02 Marks)*** **Principle of Differential:** If a vehicle travels in a straight line, the two rear wheels turn exactly at the same speed, and there is no relative movement between them. But when the vehicle takes a turn the outer wheel travels a longer radius than the inner wheel. If the two rear wheels are rigidly fixed to the rear axle. The inner wheel will slip which will cause rapid tyre wear, steering difficulty and poor road holding. Therefore there must be some device to provide the relative movement to the rear wheels when vehicle is taking turn.	*Correct Answer 02 Marks*
1	**B**	**Attempt any TWO of the Following**	**08**
	(a)	**Draw the lay out of front engine front wheel drive and justify the application of the layout.**	**04**
	Ans.	***(Lay out 02 Marks and its justification 02 Marks)***	*Lay out 02 Marks and its justification 02 Marks*

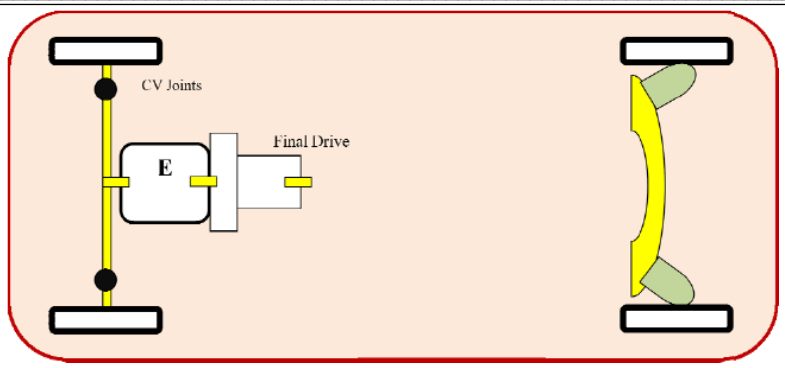


Figure: Front Engine Front Wheel Drive

Justification:

1. Lower centre of gravity and weight.
2. Provide good grip and road adhesion.
3. Avoid skidding.
4. There is a faster and safer drive due to good road holding on curves.
5. Improved fuel efficiency due to less weight.
6. No need of propeller shaft.
7. Less cost due to fewer material components and less installation complexity overall.
8. More comfortable drive.

	(b)	**Draw a neat sketch of two wheeler clutch plate.**	**04**
	Ans.	***(Neat Labeled Sketch 04 Marks)***	*Neat Labeled Sketch 04 Marks*

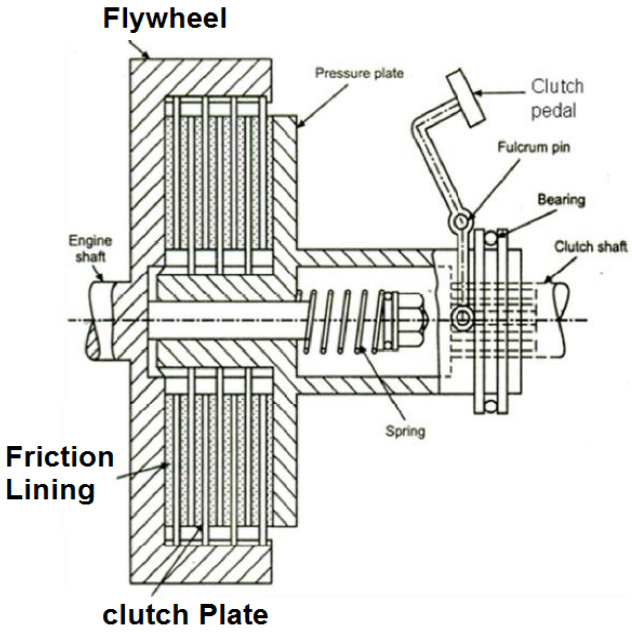


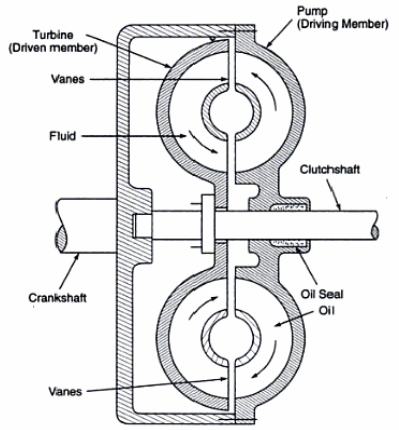
Figure: Two Wheeler Clutch(Multi-plate Clutch)

	(c)	**Explain with neat sketch construction of fluid coupling.**	**04**
	Ans.	***(Construction 02 Marks and Sketch 02 Marks)***	*Construction 02 Marks and Sketch 02 Marks*

Fluid Coupling-

Construction:

Fluid coupling or hydraulic coupling is used as clutches in cars employing automatic transmissions. It consists of two members, the driving and driven as shown in fig. The driving member is attached to the engine flywheel and the driven member to the transmission shaft. The two members do not have any

		direct contact with each other. The driven member is free to slide on splines on the transmission shaft. The two rotors are always filled with oil.  **Figure: Fluid Coupling**	
2		**Attempt any FOUR of the Following**	**16**
	(a)	**Write any two applications of multi plate clutch and centrifugal clutch.**	**04**
	Ans.	***(One Application of each 01 Mark each)*** **Application:** **Multi- plate Clutch:** 1. It is used where more torque transmission & limited space is available such as ***in racing cars.*** 2. It is used where overall space required to accommodate the clutch is constrained such as ***in Scooters & motorbikes***. 3. It is used ***in heavy vehicles for high torque transmission***, where single plate clutch of same size is not sufficient to transmit such high torques. **Centrifugal Clutch:** 1. Use in Automatic transmission ***vehicles like mopeds.*** 2. Use in semi-automatic transmission ***vehicles like Cars.***	*One Application of each 01 Mark each*
	(b)	**Explain working of Truck Clutch Plate.**	**04**
	Ans.	***(Sketch 02 Marks and Explanation 02 Marks)*** *(Equal credit should be given to Diaphragm type clutch)* Single Plate Dry Type Clutch is used in Trucks.	*Sketch 02 Marks and Explanation 02 Marks*

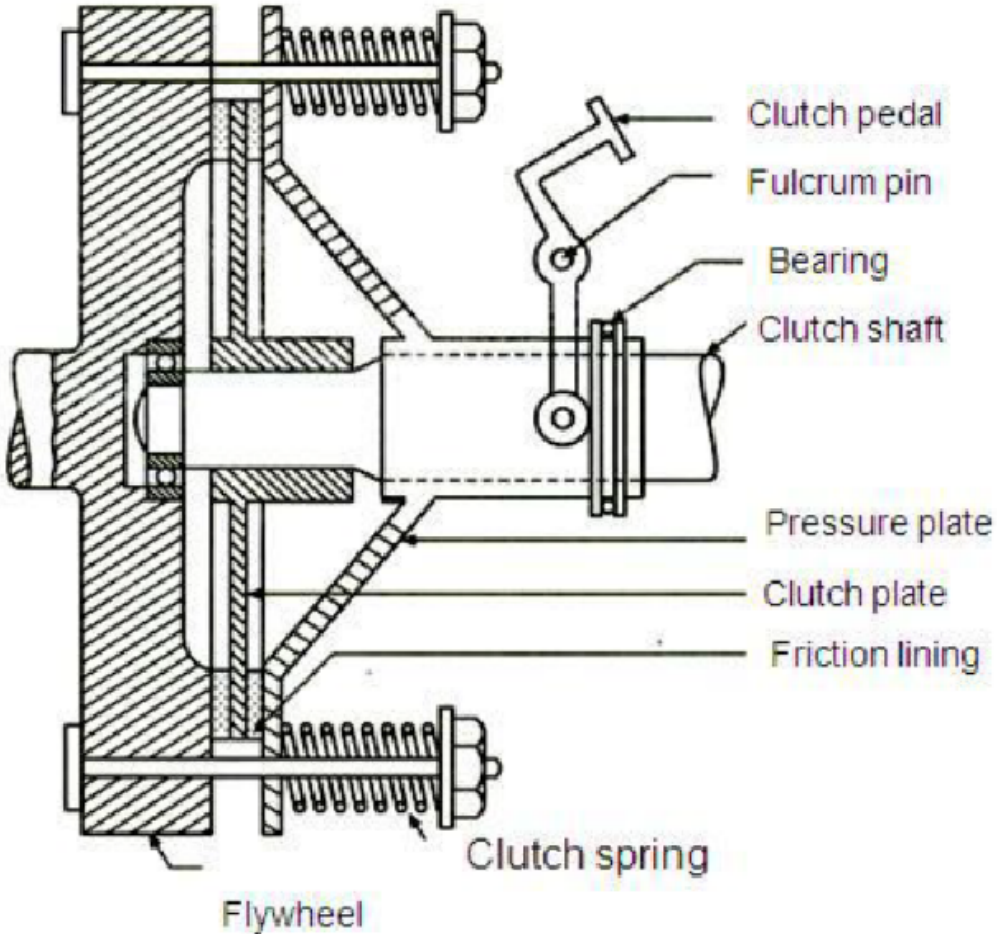


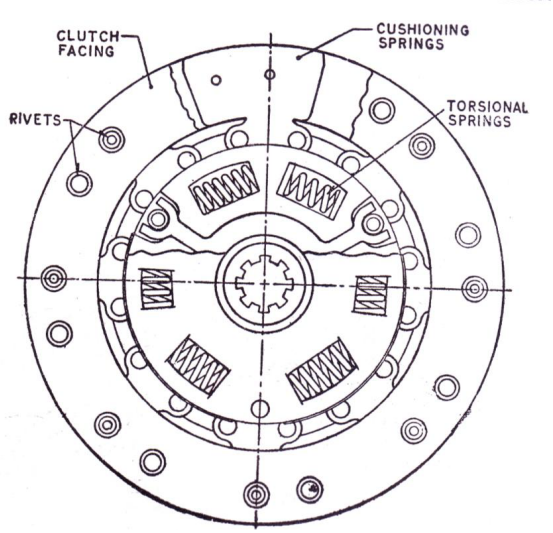
Figure: Single Plate Clutch

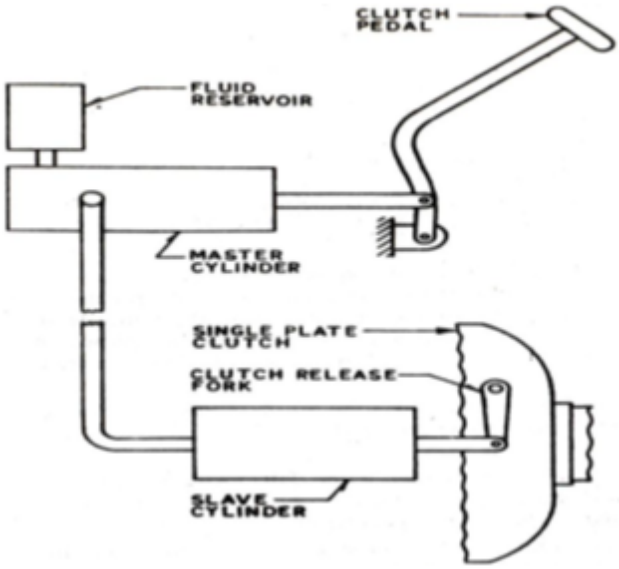
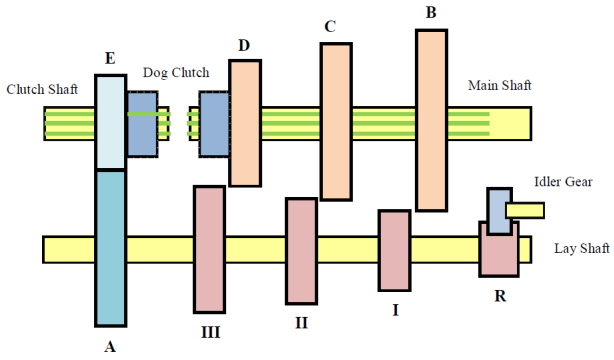
Working:

When the clutch pedal is pressed, the pressure plate moves back against the force of springs and the clutch plate becomes free between the flywheel and the pressure plate. Thus the flywheel remains rotating as long as the engine is running and clutch shaft speed reduces slowly and finally it stops rotating, i.e. clutch is disengaged

	©	**Differentiate between dry clutch and wet clutch.**	**04**
	Ans.	***(Any Four points 01 Mark Each)***	*Any Four points 01 Mark Each*

S. N.	Dry Clutch	Wet Clutch
1	When the clutch is operated dry i.e. without oil, it is called as a dry clutch.	When the clutch is operated in an oil bath, it is called as wet clutch. In this, clutch plates are always wetted by oil circulation.
2	Torque transmission capacity is higher.	Torque transmission capacity is lower (35- 50% of dry clutch), since the clutch plates are wetted by oil.
3	Due to metal and air contact heat dissipation is fair.	Due to metal and oil contact heat dissipation is much better.

		4	Single plate dry clutch is used in light motor vehicles for e.g. Jeep, Car, Bus, Truck etc.	Multi-plate clutch is used in motor cycles, racing cars, heavy duty vehicles.
		5	Coefficient of friction is high, since the friction materials are operating dry.	Since the friction materials are operating in oil, coefficient of friction is low.
		6	Clutch plate is non-perforated type.	Clutch plate has perforations.
		7	Tolerance to engagement time is comparatively smaller.	Tolerance to engagement time is longer.
		8	Life is less.	Life is longer as compare to dry clutch.
		9	Cost is less.	Cost is high.
	(d)	**Explain construction of Clutch Plate with neat sketch.**		**04**
	Ans.	***(Construction 02 Marks and its sketch 02 Marks)*** **Construction-** 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 types of slots in each of the two plates situated on either side of the hub flange.  **Figure: Clutch Plate**		*Construction 02 Marks and its sketch 02 Marks*
	(e)	**Explain the working of Hydraulically Operated Clutch with neat sketch.**		**04**
	Ans.	***(Sketch 02 Marks and Explanation 02 Marks)*** **Hydraulic Clutch Operating Mechanism-** A hydraulically operated clutch mechanism is shown in the figure. The		*Sketch 02 Marks and*

		mechanism consists of master and slave cylinders. The cylinders are connected by hydraulic lines. When the clutch pedal is pressed the fluid under pressure from the master cylinder reaches the slave cylinder which is mounted on the clutch itself. The fluid under pressure actuates the slave cylinder push rod which further operates the clutch release fork to disengage the clutch. In India, this type of clutch has been used in Standard 20, Swaraj Mazda and Eicher Mitsubishi's vehicles.  **Figure: Hydraulically Operated Clutch**	*Explanation 02 Marks*
	(f)	**Describe the working of four speed sliding mesh gear box.**	**04**
	Ans.	***(Description 02 Marks and Sketch 02 Marks)*** **Sliding Mesh gear Box:**  **Figure: 4 Speed Sliding Mesh Gear Box** It derives its name from the fact that the meshing of the gear takes place by sliding of gears on each other. Splines are provided on the main shaft for sliding the gears on main shaft while in operation. The power comes from the engine to the clutch shaft and thence to the clutch gear which is always in mesh with a gear on the layshaft (Counter Shaft). All the gears on the lay shaft are rigidly fixed to it and as such they are all the time rotating when the engine is running and the clutch is engaged. A reverse idler gear is mounted on another shaft called as reverse shaft and always remains connected to the reverse gear of the counter shaft. The required speed is obtained by shifting the gears in counter shaft by selective mechanism.	*Description 02 Marks and Sketch 02 Marks*
3		**Attempt any FOUR of the Following**	**16**
	(a)	**Explain construction and working of Gear Selector Mechanism with gear lever on**	**04**

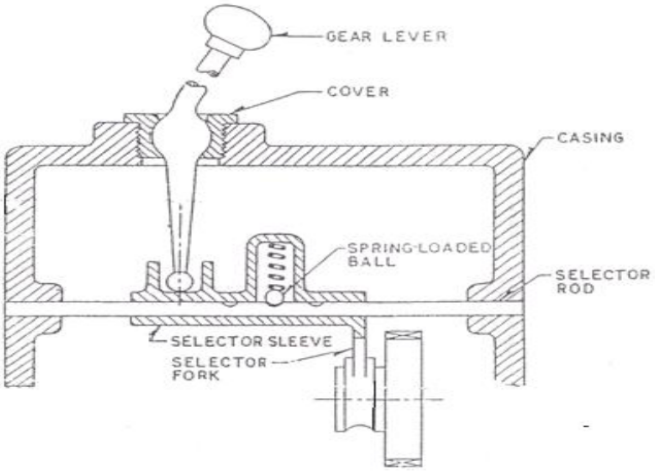
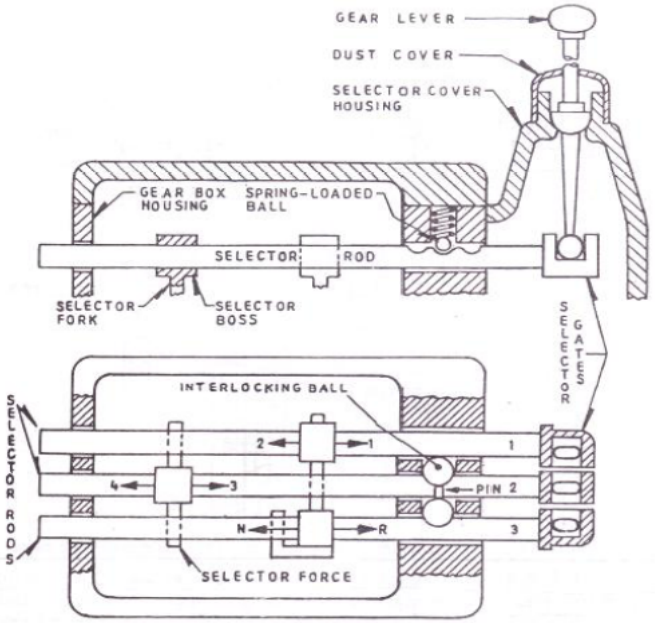
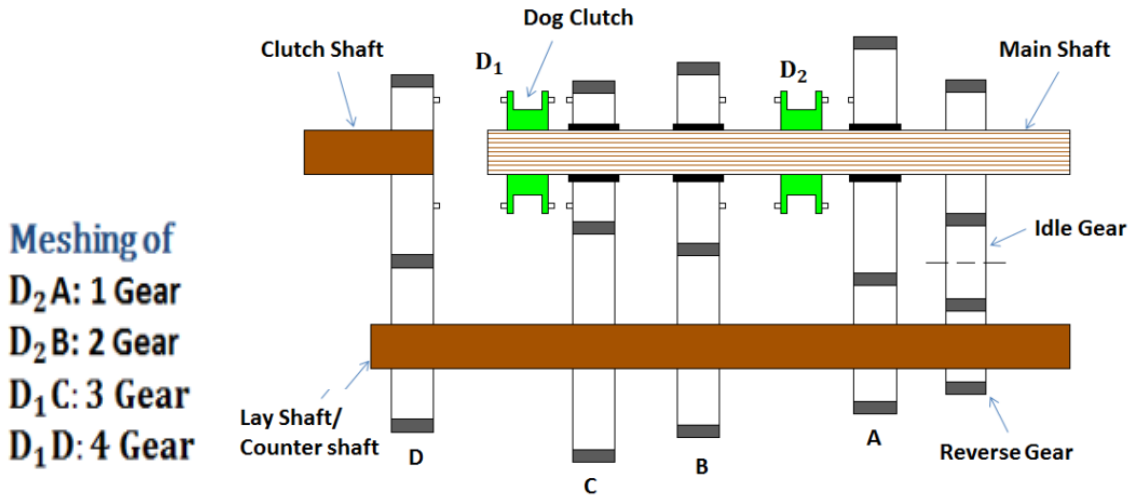
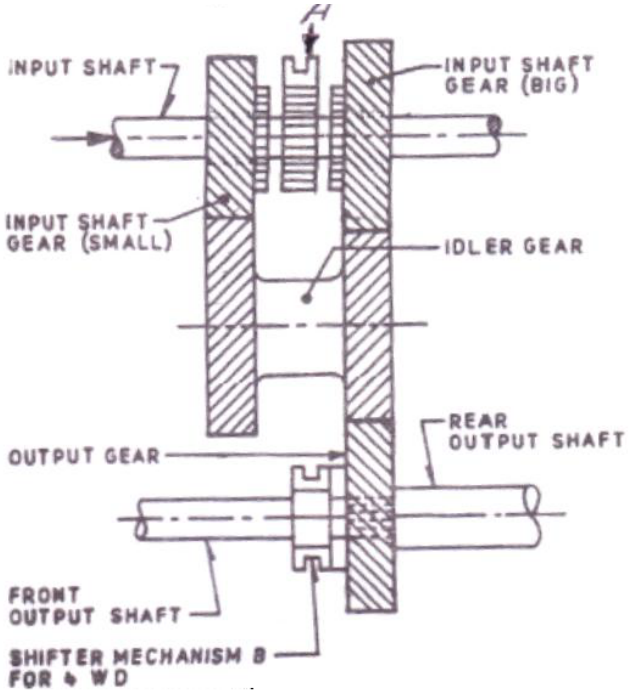
		the top of gear box.	
	Ans.	***(Description 02 Marks and Labeled Sketch 02 Marks)*** **Gear Selector Mechanism Mounted on the Top of Gear Box-** A typical mechanism for a 4-forward speeds and reverse gear box where the gear lever is ball mounted in the gear box cover. This facilitates its movement in 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.  **Figure: Gear Selector Mechanism.** **OR**  	*Description 02 Marks and Labeled Sketch 02 Marks*

		Figure: Gear Selector Mechanism.	
	(b)	**Draw the proportionate sketch of 4 speed constant mesh gear box.**	**04**
	Ans.	***(Neat Labeled sketch 04 Marks)*** 	*Neat Labeled sketch 04 Marks*
	©	**State the function and types constant velocity joints.**	**04**
	Ans.	***(Function 02 Marks and its Type 02 Marks)*** **Function Constant Velocity Joints:** When the angle of drive is more than 30 degree, irregularity of rotation angle at more torque and speed fluctuation causes steering problem in case of universal joint so the type of joint used to overcome this problem is known as CV joint. **Types of Constant Velocity joint-** 1. Rzeppa or double offset CV joint 2. Tripod joint.	*Function 02 Marks and its Type 02 Marks*
	(d)	**Write down the advantages and dis advantages of the torque converter over the manual transmission gear box.**	**04**
	Ans.	***(Any Two advantages and dis advantages 01 Mark each)*** **Advantages of the Torque Converter over the Manual Transmission Gear Box:** 1. Better fuel efficiency. 2. No Loss of torque transmission from engine to the driving wheels during gear shifts. 3. Very smooth gear shifting operation. 4. Servicing of torque converter is not necessary. 5. Less wear due to less effect of slip. **Dis Advantages of the Torque Converter over the Manual Transmission Gear Box:** 1. Overall Cost is more. 2. Lack of control by driver… 3. Cannot be applied to manual transmission,	*Any Two advantages and dis advantages 01 Mark each*
	(e)	**State two advantages and disadvantages of synchromesh gear box with applications.**	**04**
	Ans.	***(Any Two advantages and disadvantages ½ Mark each and its Application 02 Marks)*** **Advantages of Synchromesh Gear Box:** [1] Noise is less [2] No wear and tear on moving parts [3] Smooth and easier operation [4] Gear shifting is easy [5] No skill required to operate it	*Any Two advantages and disadvantages ½ Mark each and*

		[6] Life and accuracy is more **Disadvantages of Synchromesh Gear Box:** [1] Complicated in construction [2] High initial and operating cost due to provision of synchronizer unit [3] Maintenance cost is more **Applications:** It is used in bikes like KTM Duke 390cc. Most of the race cars like formula-1 uses synchromesh gearbox.	*its Application 02 Marks*
	(f)	**Describe the construction and working of transfer case. Write down its application.**	**04**
	Ans.	***(Construction (Credit Should be given to sketch also) 02 Marks and its working 02 Marks)*** **Construction -** 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.  **Figure: Transfer Case** **Working** When the shifter-A is at the central position as shown in fig. here neither the gear G1and 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 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.	*Construction 02 Marks and its working 02 Marks (Credit Should be given to sketch also)*
4		**Attempt any FOUR of the Following**	**16**
	(a)	**Explain loads acting on the rear axle.**	**04**

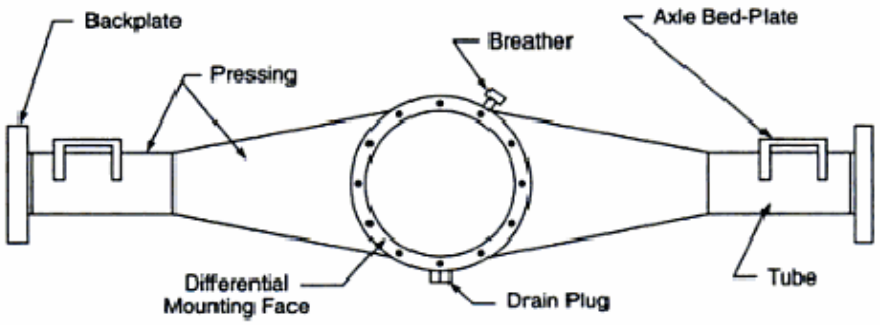
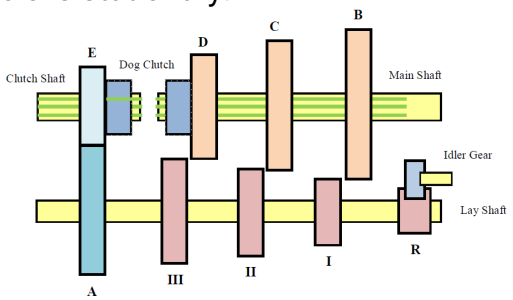
	Ans.	*(Any Four Points Each Carry 01 Mark each)* **The various loads acting on the rear axle are:** **1) Driving Thrust**-. Driving torque produced in the engine causes the thrust to be produced in the road wheels, which has to be transmitted from the axle casing to the chassis frame and the body of the vehicle. **2) Torque Reaction-** 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. **3) Braking Torque or Thrust-** The axle casing experiences the brake torque when the brakes are applied to the vehicle. **4) Side Thrust**- 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. **5) Weight of the Body**- The rear axle may be considered a beam supported at ends loaded. This weight causes bending and shears force in the axle shaft.	*Any Four Points Each Carry 01 Mark each*
	(b)	**State the various types of rear axle casing and explain any one with neat sketch in brief.**	**04**
	Ans.	*(List of Axle Casings 01Mark and Explanation of Any One 01 and its sketch 02 Marks)* **Types of Rear Axle Casings-** **1) Banjo Type (or One Piece) Casing**- It is named so, because its shape is 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.  **Figure: Banjo Type (or One Piece) Casing** **2) Split (or Two Piece) Casing-** 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. This type is obsolete now.	*List of Axle Casings 01Mark and Explanation of Any One 01 and its sketch 02 Marks*

Figure: Split (Or Two Piece) Casing

	©	**Why the universal joint and slip joint is used in transmission system.**	**04**
	Ans.	***(Function of each 02 Marks)*** **Function of Universal Joints:** 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. **Function of Slip Joints:** 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.	*Function of each 02 Marks*
	(d)	**Explain the power flow diagram of sliding mesh gear box.**	**04**
	Ans.	***(Any one Sketch 02 Marks and its Explanation 02 Marks)*** **Neutral Gear Position:** When the engine is running and clutch is engaged, the clutch shaft gear drives the lay shaft (Counter shaft) gear. The lay shaft rotates opposite in direction of the clutch shaft. Note that in neutral position only the clutch shaft gear is connected to the lay shaft gear. Other gears are free, and hence the transmission main shaft is not turning. The vehicle is stationary.  **Figure: Neutral Gear Position** **First (Low) Gear Position:** In this position, when first gear position is selected by the shift lever, the gear E on the clutch shaft transmits the motion to the gear A on the counter shaft. All the gears on the counter shaft are fixed. The gear I come in contact with the gear B on the main shaft. Hence the motion is transmitted from gear E to Gear A and Gear I to Gear B. In this type of gear box the gears on the main shaft slide axially.	*Any one Sketch 02 Marks and its Explanation 02 Marks*

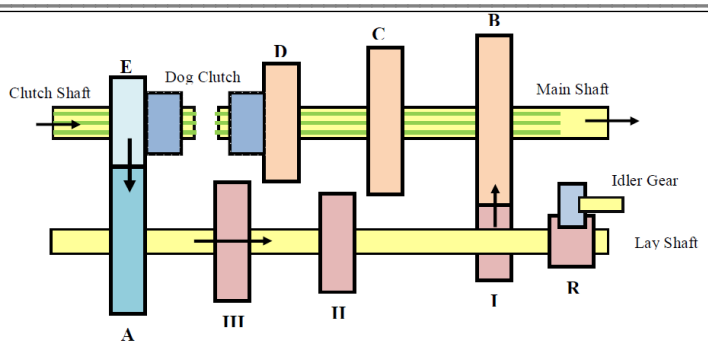


Figure: First Gear Position

Second Gear Position:

In this position, when second gear position is selected by the shift lever, the gear E on the clutch shaft transmits the motion to the gear A on the countershaft. The gear C slides on the main shaft and come in contact with the gear II on the counter shaft. Hence the motion is transmitted gear E to gear A and gear II to gear C.

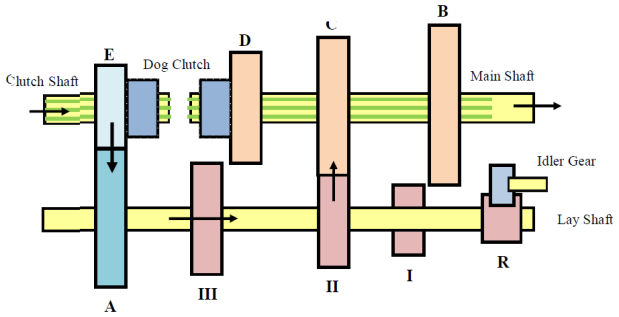


Figure: Second Gear Position

Third Gear Position:

In this position, when third gear position is selected by the shift lever, the gear E on the clutch shaft transmits the motion to the gear A on the counter shaft. The gear D slides on the main shaft and comes in contact with the gear III on the counter shaft. Hence the motion is transmitted from gear E to gear A and gear III to gear D.

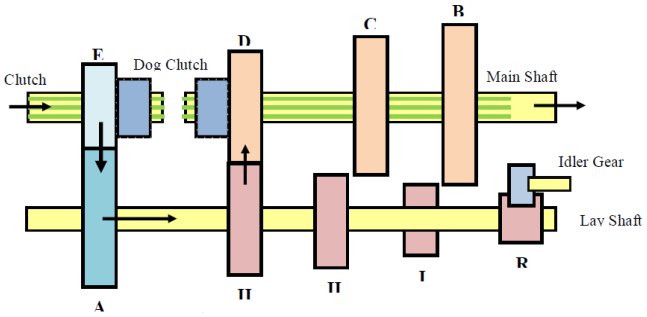


Figure: Third Gear Position

Fourth or Top or Direct Gear Position:

In this gear position, when fourth gear position is selected by the shift lever, the dogs on gear E engaged directly to the main shaft and the motion is transmitted directly from the clutch shaft to the main shaft. In this case, the gears on the counter shaft are only revolving but do not engaged with any of the gears on the main shaft. In this case the gear ratio is 1: 1. It can be noted that the clutch gear is directly connected to engine crankshaft and main shaft is connected to the wheels through propeller shaft in direct gear position.

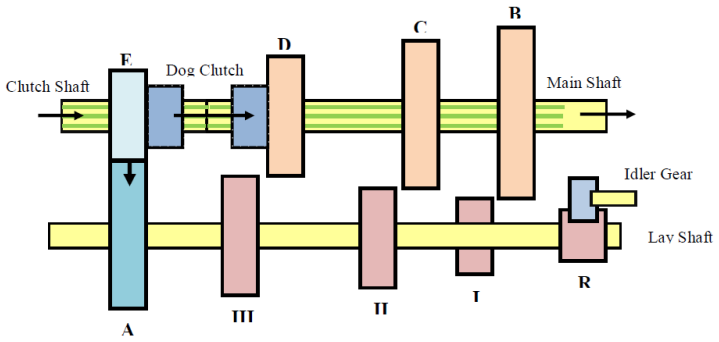


Figure: Fourth or Top or Direct Gear Position

Reverse Gear Position:

Reverse gear is used to obtain the reverse direction of vehicle. The basic purpose of reverse gear is to make the main shaft rotate in direction opposite to that of clutch shaft. Thus, if the clutch shaft rotates in clockwise direction, the countershaft rotates in anticlockwise direction and the reverse gear shaft (including between counter and main shaft and carrying a reverse gear) rotates in clockwise direction, then due to the reverse gear mounted on reverse shaft the main shaft rotates in anticlockwise direction. This reverses the rotation of the wheels so that the vehicle get backs.

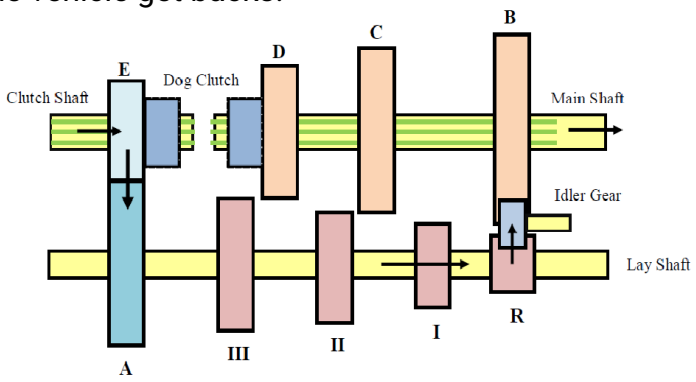
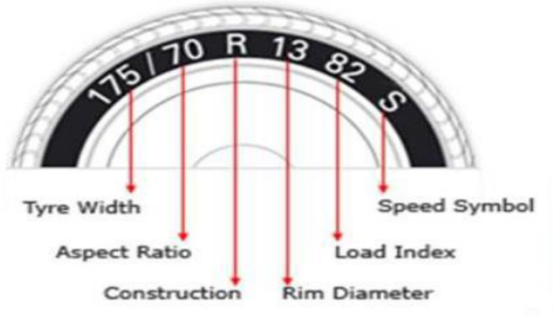


Figure: Reverse Gear Position

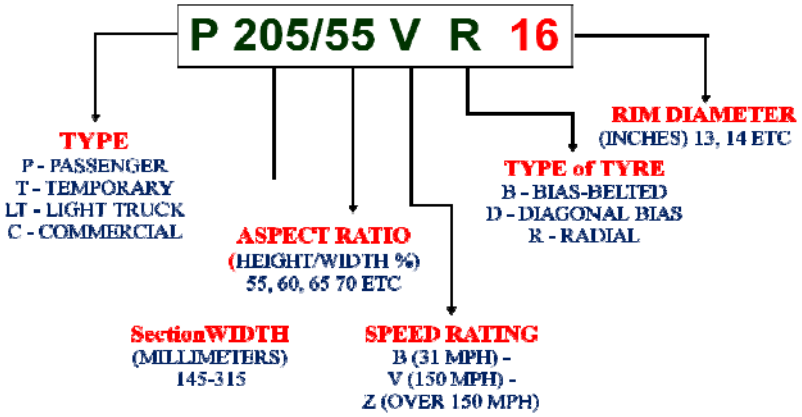
	(e)	**Explain tyre terminology with neat sketch.**	**04**
	Ans.	***(Any One Suitable Sketch and its Correct Explanation 04 Marks)***	

Tyre Terminology:



Any One Suitable Sketch and its Correct Explanation 04 Marks

OR



OR

145	SR	13

W = Width of Tyre = 145 mm(Generally Cross Ply Tyre specified in Inch & Radial Ply Tyre in mm)
D = Diameter of Rim = 13 inch
SR = Speed Rating
SR = Up to 210 Km/hr
VR = Above 210 Km/hr

OR

9.00	20	12	PR

W = Width of Tyre = 9 Inch
D = Diameter of Rim = 20 Inch
PR = Ply Rating
No. of Plies = 12

(f) Describe with the help of simple sketch construction of wired spoke wheel. 04

Ans. **Wire Wheel:** Wire wheels are light weight, high strength and provide much better cooling of the brake drum. Wire wheels have separate hub, which is attached to the rim through number of wire spokes. Components of wire wheels are – Spoke, Hub and Rim

Spokes:
Each spoke is individually hooked at one end of the hub while its other end is pushed through a hole in the wheel rim, where tapered nut called nipple, is screwed down pulling the spoke tight. If a spoke is too loose or too tight, the rim will distort. Spokes are mounted in complicated criss-cross fashion in all the three planes. Spoke carries weight of vehicle and passengers. It transmits driving & braking torque as well as withstands side forces while cornering (i.e. cornering load and side thrust).

Hub: Hub is provided with internal splines and is mounted on the axle shaft.

Rim: Rim has holes at the centre for attaching spokes. The only disadvantage of this rim is that tubeless tyre cannot be mounted on it because of holes on the rim.

Application: Two wheelers & bicycles.

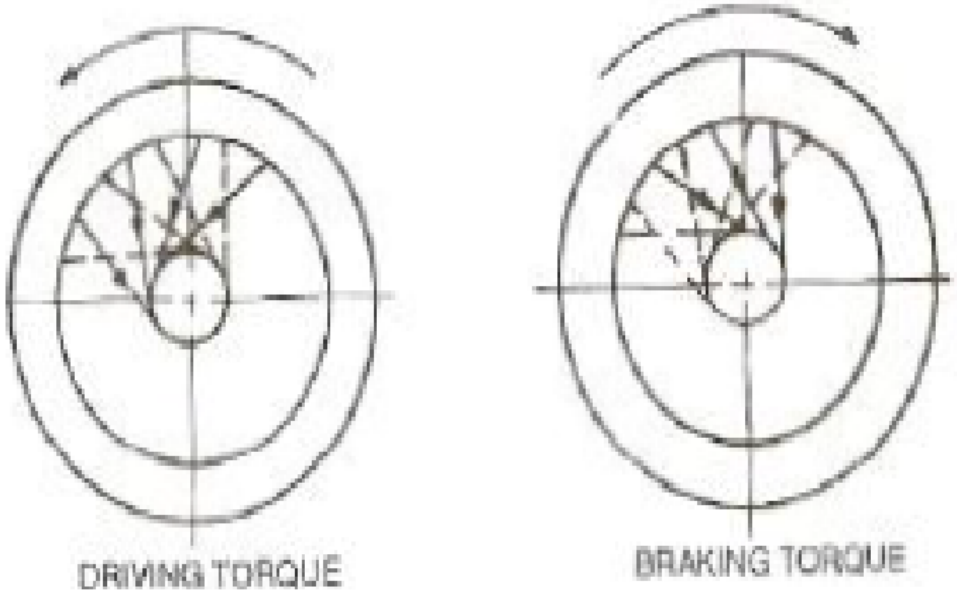


Figure: Wire Wheel

5		**Attempt any TWO of the Following**	**16**
	(a)	**Explain working of differential with neat sketch.**	**08**
	Ans.	***(Principle of Working 02 Marks, Sketch 02 Marks and its Working 04 Marks)***	*Principle of Working 02 Marks, Sketch 02 Marks and its Working 04 Marks*

Principle of Working :

If a vehicle travels in a straight line, the two rear wheels turn exactly at the same speed, and there is no relative movement between them. But when the vehicle takes a turn the outer wheel travels a longer radius than the inner wheel i.e. there is relative movement between the two rear wheels. Also inner wheel makes larger angle with stub axle than outer wheel. If the two rear wheels are rigidly fixed to the rear axle.

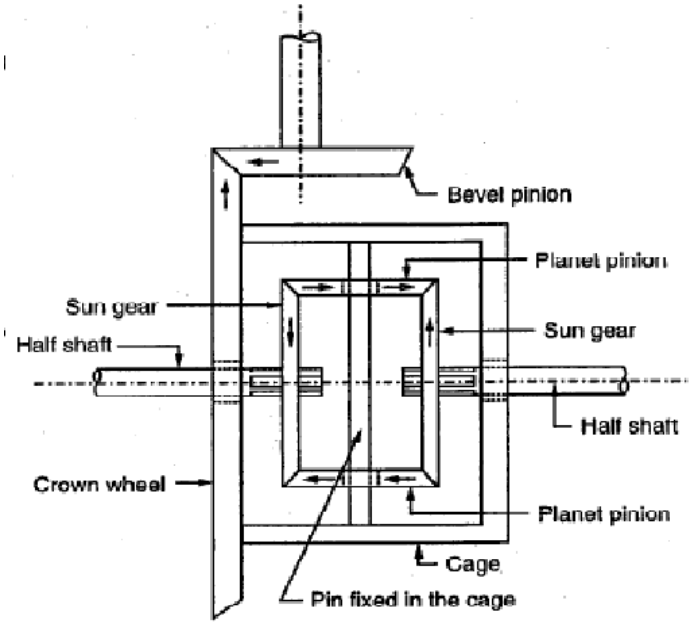
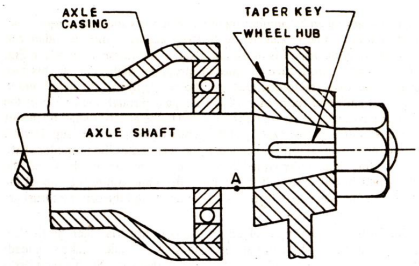
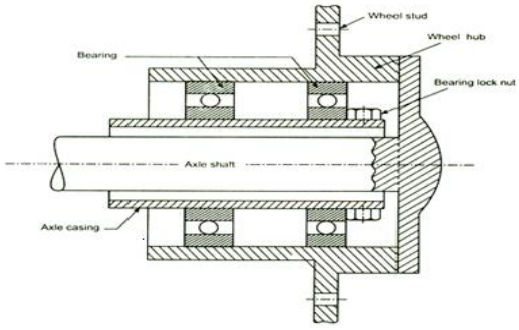


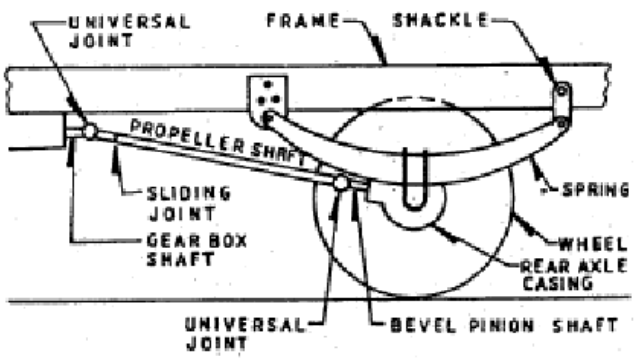
Figure: Differential

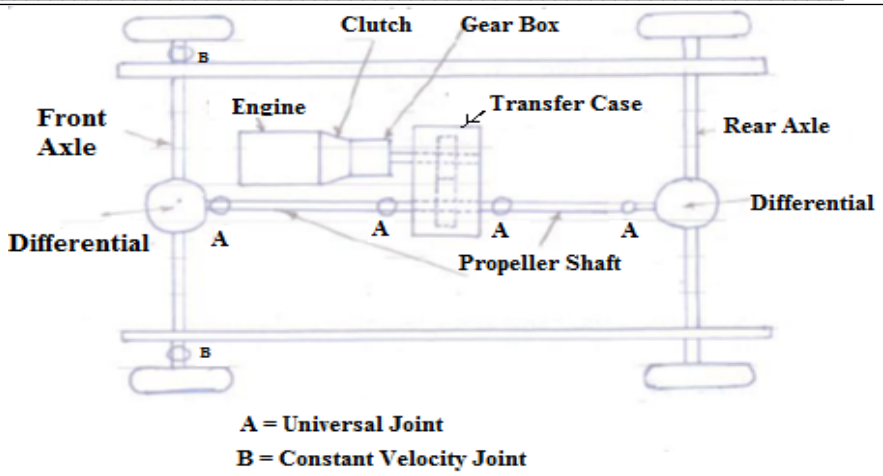
Working:

Vehicle Running Straight:-

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 ***Vehicle Cornering:-*** 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.	
	(b)	**Explain with neat labeled diagram for semi floating rear axle and full floating axle with applications.**	**08**
	Ans.	***(Sketch 02 Marks Each, Explanation 01 Mark each and any one application of each 01 Mark each)*** **Semi Floating Rear Axle:**  **Figure: Semi Floating Rear Axle** The figure shows a schematic diagram of the semi floating rear axle. A single ball bearing is inside the axle casing. The axle of the wheel is at the centre of the axle casing and the wheels are fitted at the end of the axle. This is done by means of key, bolt and nut. The whole weight of the vehicle is first transmitted to the suspension spring. From there it is transmitted to the axle casing from there to the axle and wheel. Finally it is transmitted to the ground. The axle can be removed by first placing a support below the axle casing. **Applications:** This is used in under most 1/2 ton and lighter trucks and SUVs. Fiat, Jeep and modern passenger cars Maruti Gypsy, Mahindra Scorpio etc. **Full Floating Type Rear Axle:**  **Figure: Full Floating Rear Axle** The figure shows the full floating axle. The wheel is on the axle casing. Two roller	*Sketch 02 Marks Each, Explanation 01 Mark each and any one application of each 01 Mark each*

		bearings are between the wheel and axle casing. 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 casings. 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. **Applications:** Fully floating rear axle is used in heavy commercial vehicles.	
	©	**Describe with neat labeled diagram of Hotchkiss drive and torque tube drive.**	**08**
	Ans.	**Hotchkiss Drive:**  Hotchkiss drive **Working of Hotchkiss Drive-** This is the simplest & most widely used. The springs be sides taking weight of the body also take the torque reaction, driving thrust & side thrust. The propeller shaft is provided with two universal joints & also sliding joint. The spring is fixed rigidly in the middle to the rear axle. The front end of the spring is fixed is fixed to the frame by the front half of the springs. Due to torque reaction, the spring deflects as shown in fig. & is taken up by the springs. Similarly to take up the braking torque, the springs would deflect in the opposite direction. When the rear axle moves up & down due to the road condition, it has to move in a circle with the front spring support at the frame as centre. But for the propeller shaft motion, the centre is at the front of the universal joint. This means that during this movement of the rear axle, the length of propeller shaft has to vary. This is provided for by means of a sliding joint in propeller shaft.	
6		**Attempt any TWO of the Following**	**16**
	(a)	**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.**	**08**
	Ans.	***(Neat Labeled Sketch 04 Marks any two merits 02 Marks and any two demerits***	*Neat Labeled Sketch 04 Marks any two merits 02 Marks and any two demerits 02 Marks*



02 Marks)

Figure: Layout of 4 Wheel Drive Vehicle

Merits of 4-Wheel drive over 2-Wheel Drive:

1. Better traction on smooth surface in all conditions (wet and wintry weather)
2. Increased drive off and climbing capacity irrespective of load.
3. Better acceleration in lower gear.
4. Reduced sensitivity to side wind.
5. Better stability.
6. More balanced axle load distribution.
7. Equal tire wear.

Demerits of 4-Wheel drive over 2-Wheel Drive:

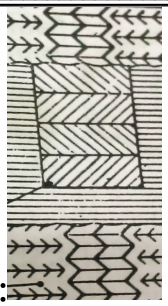
1. More weight of vehicle.
2. Lower maximum speed.
3. Increased fuel consumption by 5 to 10%.
4. As extra components are required manufacturing cost is more.

(b) Differentiate between Cross Ply and Radial Ply Tyre (Any 8 Points) — 08

Ans. *(Any Eight Points 01 Mark Each)*

S. N.	Cross Ply Tyre	Radial Ply Tyre
1	Piles are running diagonally opposite from bead to bead.	Plies are running radially straight from bead to bead
2	Stiffness of tyre is more, so less comfortable.	Stiffness of tyre is less, so it gives ultimate comfort at high speed.
3	Steering is easy.	Steering is harder.
4	Tyre has lesser grip with road.	Tyre has firm grip with road.
5	Cross ply tyre has less tread life	Radial ply tyre has more tread life.
6	Less braking grip.	More braking grip.
7	Cheaper than radial ply tyre.	Costlier than cross ply tyre

Any Eight Points 01 Mark Each

		8	Figure:  Figure: 	
	(c)	**State the different types of tread patterns and explain the effect of inflation pressure on the tyre life.**		**08**
	Ans.	***(Types of Tread 02 Marks and any six effect 01 Mark each)*** **Types of Tread:**  symetrical tread asymetrical tread directional tread **Effect of Inflation Pressure on the Tyre Life:** **Effects of Under-inflation:** (Any THREE = 03 Marks) 1) Uneven tread wear, more wear at tyre sides. 2) Lack of directional stability. 3) Increased rolling resistance leading to increased fuel consumption. 4) Excessive flexing of sidewall causes build up. 5) Vehicle will roll on curves. **Effects of Over-inflation:** (Any THREE = 03 Marks) 1) Reduced tread contact area with road surface. 2) Reduced tyre grip. 3) Increased vibration resulting in uncomfortable ride. 4) Increased stresses may causes tread separation and crack in the side wall. 5) The centre of tyre will be worn rapidly.	*Types of Tread 02 Marks and any six effect 01 Mark each*