Winter – 16 EXAMINATION
Model Answer Subject Code: 17307

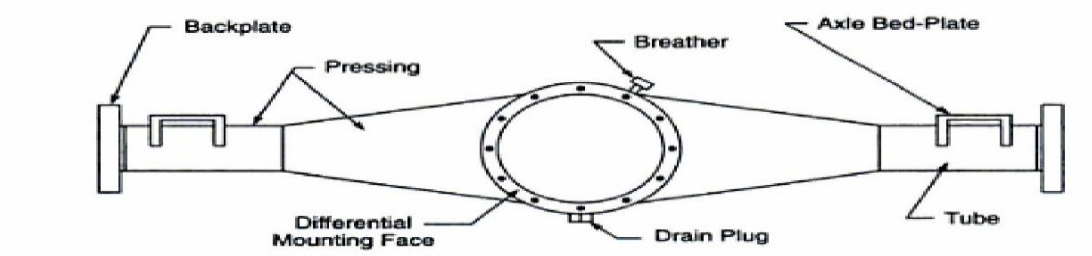
Important Instructions to examiners:

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 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. No.	Answer	Marking Scheme
1.	**A)**	**Solve Any SIX.**	**12**
	a)	**State the necessity of four wheeler chassis frame.**	**02**
		Answer : (*Any two)* 1. To provide backbone for vehicle. 2. To give extra strength for provided parts like bolted, riveted or welded cross pieces. 3. To provide a loss weight frame which offers great resistance to bending, twisting lozgenging members of the chassis.	**02**
	b)	**State four advantages of front engine rear wheel drive.**	**02**
		Answer: *(1/2 marks for each)* 1. Reasonably balanced weight distribution between the front and rear wheels providing good handling characteristics. 2. For easy front wheel steering movement engine occupies the reduced width between the wheel arches. 3. Behind the rear seats, large luggage space is available providing increased carrying capacity as well as space for easy body extension. 4. Accessibility to various components like engine, gearbox and rear axle is better in comparison to other layouts. The control linkages –accelerator, choke, clutch and gearbox are short and simple. 5. Full benefits of the natural air stream created by vehicles movement is taken by the forward facing radiator resulting in reduced power losses from a large fan.	**02**

		6. Small length of the propeller shaft permits the angularity of the universal joints to be small and easily provided by simple types.	
	c)	**State any two applications of rear engine rear wheel drive.**	**02**
		Answer : *(1 marks for each)* **1) Volkswagon Bug/ Beetle** **2) Chevrolet corvoir** **3) Minidoor** **4) Tata star bus**	**02**
	d)	**List out various friction non friction clutch.**	**02**
		Answer:- **a) Friction Clutch:** 1) Cone Clutch 2) Disc or plate clutch a) Single plate clutch b) Multi-plate clutch 3) Semi centrifugal clutch 4) Centrifugal clutch. **b) Non-friction clutch** 1. Fluid clutch or Flywheel	**02**
	e)	**List any four components of a gear box.**	**02**
		Answer:*(½ marks for each)* 1) Gear Box 2) Primary shaft 3) Layshaft 4) Main or sliding shaft 5) Reverse shaft 6) Gear change or selector Mechanism.	**02**
	f)	**Why hollow propeller shaft is used in four wheelers?**	**02**
		Answer: In Hotchkiss type rear axle drive, hollow propeller shaft is used- *(Any two points)* 1. It decreases inertia which would increase its acceleration and deceleration. 2. It withstands maximum bending stresses as compare to solid shaft. 3. It has less weight, so less chances of sagging.	**02**

	g)	**State the condition of differential locking and unlocking.**	**02**
		Answer:- When the rear wheels liking on soft mud or loose dirt & sand while other is solid ground at that times the wheels which is on soft mud and having less resistance spins about its own axis due to differential action while the wheel on solid ground is not driven does not moves from the place. Differential lock is applied to stop differential action and equal torque applied to both wheels & it gives grip to the wheel which is on solid ground and vehicle can easily come out from the obstacle. differential lock can be operated manually or automatically	**02**
	h)	**Explain two types of rear Axle Casing.**	**02**
		Answer : **1) Banjo type (or one piece) casing**- 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 center line of the car, and the rear axle gearing is enclosed in banjo at the center of the axle casing. However, in certain cases the banjo may be offset to one side or the other.	**02**



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.

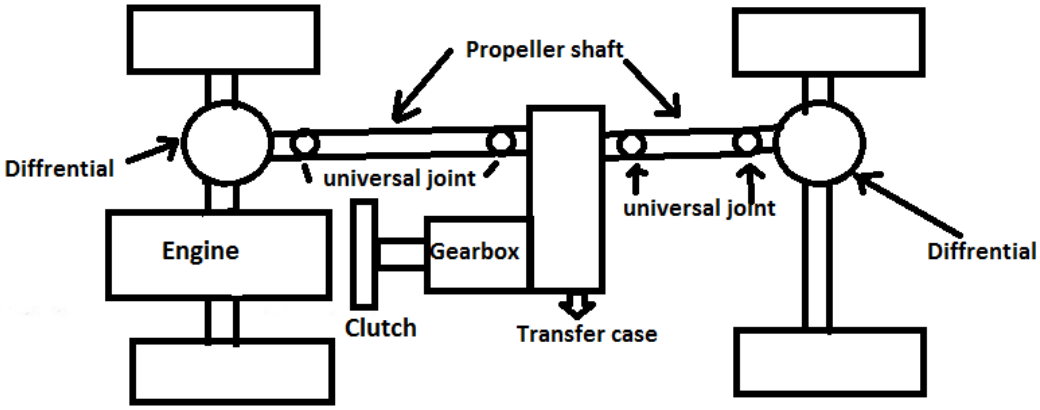
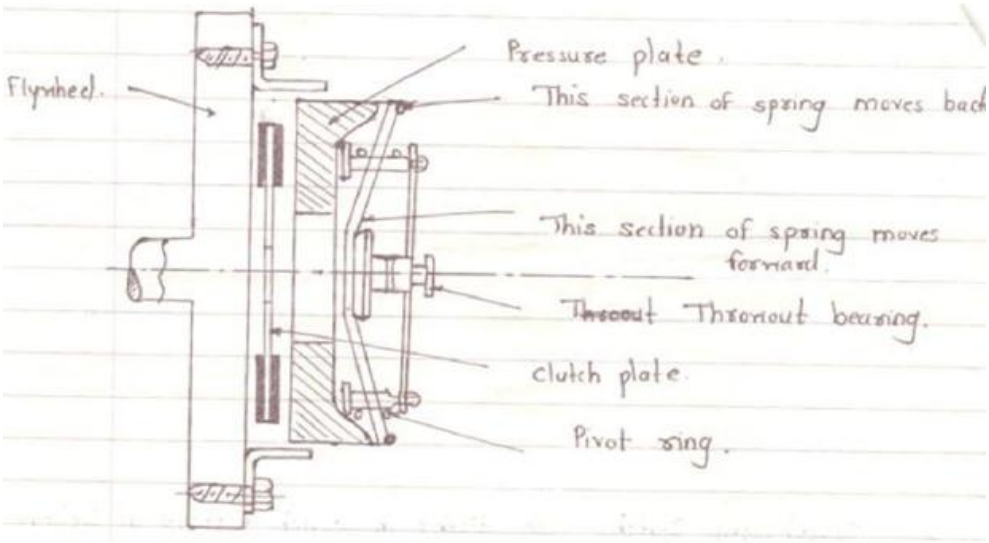
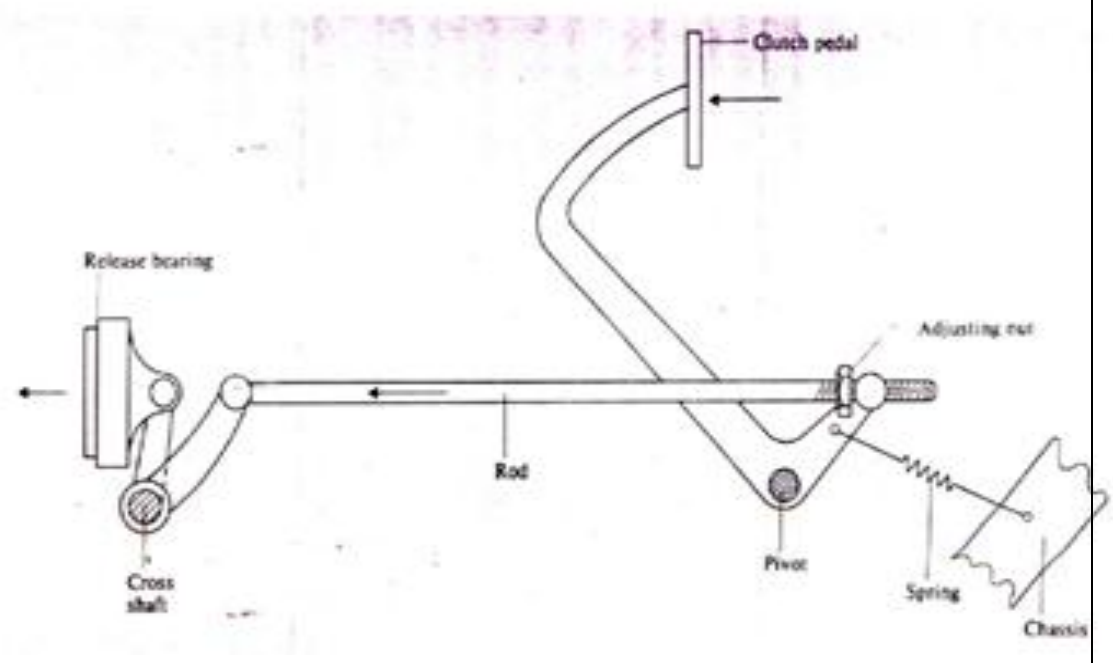
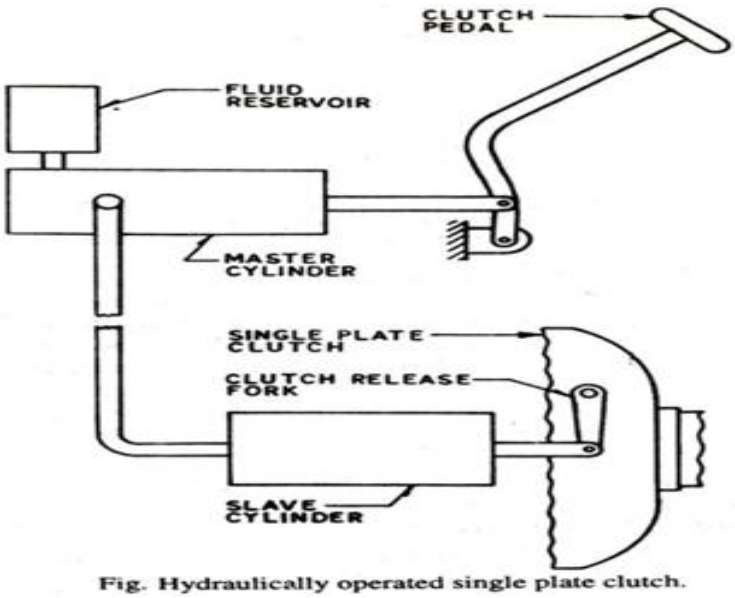
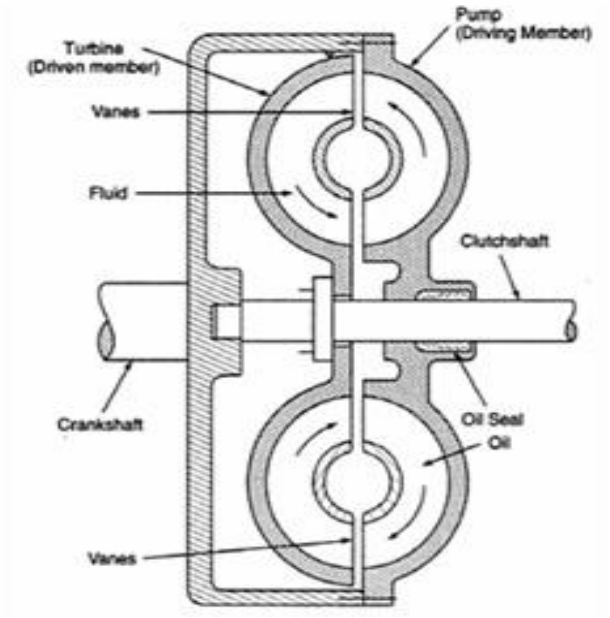
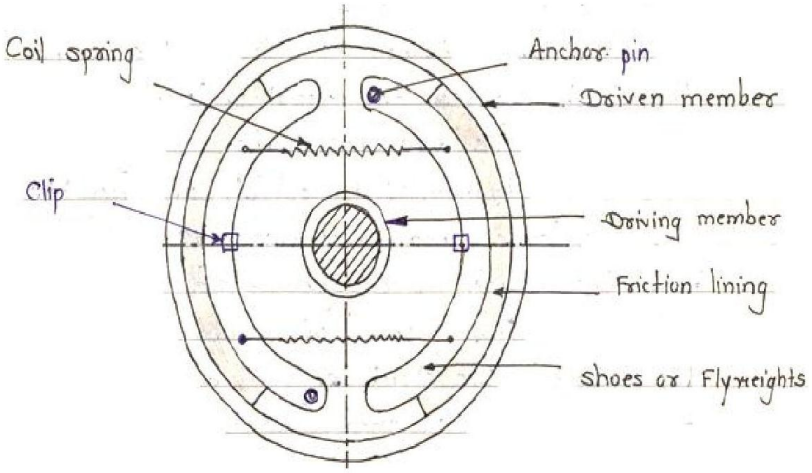
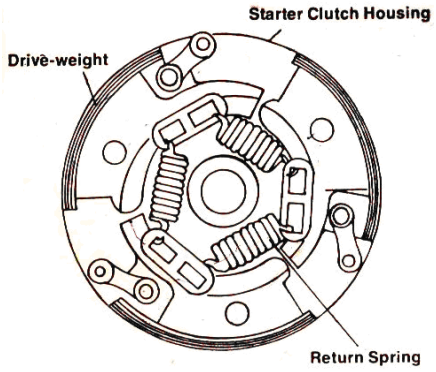
			
1	B)	**Solve Any Two.**	**08**
	a)	**Redraw and complete the fig. No. 1 labels it and identifies the layout of vehicle.**	**04**
		Answer:- Four Wheel Drive layout 	**1** **3**
	c)	**Explain the constructional details of single plate (diaphragm type) clutch with neat sketch.**	**04**
			**02**

		Fig. Single plate (diaphragm type) clutch **Constructional features of diaphragm spring type clutch:** In diaphragm clutch, instead of helical springs diaphragm type spring is used, which apply the pressure on the pressure plate for engaging the clutch. The spring is either tapered finger type or crown type and is mounted on the pressure plate. As shown in the figure, the diaphragm spring is supported on a fulcrum retaining ring so that any section through the spring can act as a simple lever. The pressure plate is movable axially, but it is fixed radially with respect to cover. This is done by providing a series of equally spaced lugs cast upon the back surface of pressure plate. In the conical position of the spring, the clutch plate remains gripped between the flywheel and the pressure plate.	**02**
	c)	**Explain rod type clutch operating mechanism with block diagram.**	**04**
		Answer: The mechanical clutch linkage is shown in the fig. when the clutch pedal is pressed it pivots on the pivot point and it moves the rod further. This rod turns cross shaft, which moves the fork lever and actuates the release bearing. This movement is further conveyed to the clutch levers to disengage the clutch. Generally mechanical leverage from 10:1 to 12:1 is employed that would require a paddle force of about 100-120 N when using travel of 75 mm.  **Fig:- Rod type / Mechanical Clutch operating mechanism**	2 2

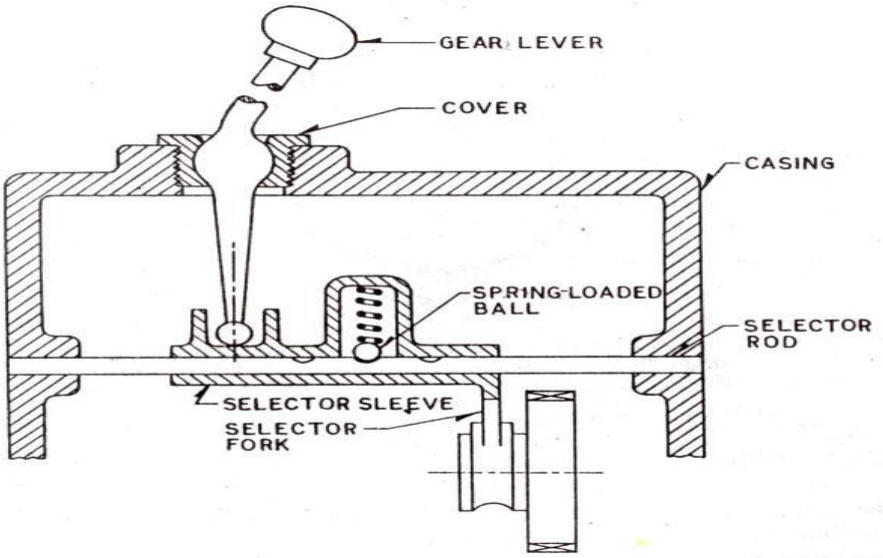
2		**Solve ANY FOUR**	**16**
	a)	**Explain hydraulic clutch operating mechanism work in four wheeler.**	**04**
		Answer: *(Explain: 2 marks, sketch: 2 marks)* **Operation of hydraulic clutch mechanism –** When the clutch pedal is pressed fluid under pressure from the master cylinder reaches the slave cylinder which is mounted on clutch itself. The fluid under pressure actuates slave cylinder push rod and plunger permits the seal spring to press the valve shank and seal against its seat. This disconnects the cylinder from the reservoir. Further movement of the plunger displaces the fluid through the pipelines to the slave cylinder and disengages the clutch.  Fig. Hydraulically operated single plate clutch.	**02** **02**
	b)	**Differentiate between single plate clutch and multi-plate clutch.**	**04**
		Answer:*(Any four points)*	**04**

Sr. No.	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 Contacts is two.	Number of pairs of friction surfaces in Contact is 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.	
	c)	**Explain with neat sketch how fluid coupling is different from torque convertor.**			**04**
		Answer: 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 radial ribs to form number of passages which avoids the formation of eddies and as guide to flow in desired direction.  **Fig. Fluid coupling**			2 2

	d)	**Explain construction and working of centrifugal clutch.**	**04**
		Answer: Working of centrifugal clutch: 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 2 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.	**02**
		 **Fig. Centrifugal Clutch**	**02**
		OR 	

	e)	**Explain the need of clutch in Automobile.**	**04**
		Answer: Need of clutch: • To engage and disengage the engine power from transmission as required when the vehicle is to stop by applying brakes. • To facilitate the easy gear shifting from 1st to 2nd or from top to 1st gear whenever required by disconnecting the engine from transmission. • To reduce the noise in transmission by providing suitable means. • To reduce the vibrations during high speed power transmission.	**04**
	f)	**Classify gear selector mechanisms. Explain gear lever on top with neat sketch.**	**04**
		Answer: Classify gear selector mechanisms: 1) Steering column gear selector. 2) Floor board type of mechanism. 3) Gear lever on top of gear box.	**1**
		Gear selector mechanism with gear lever on top of gear box. A typical 4-forward and a reverse speed floor mounted mechanism is shown in the figure. The gear lever is ball mounted in the gear box cover, the lower end of the lever fits into a slot in the selector sleeve. The sleeve has a fork by which it can move the gears. There are three selector rods supported in the gear box casing. On the selector rods the sleeve can slide. The slots are cut on the rod and the sleeves are provided with spring loaded balls to avoid unwanted engagement of gears. These balls resist the movement of the forks until some force is applied to the gear lever to overcome their resistance. A suitable interlocking mechanism is provided to ensure that at any time no two gears are engaged. This can be possible by a mechanism which ensures that any gear can be engaged only after the neutral has been obtained. Further a provision is also made to prevent accidental engagement of the reverse gear instead of a forward gear. This may be done by means of a stiff spring which has to be overcome by applying extra force. Grooves are provided on the gear bosses where the selector forks can fit in. Transverse motion of the gear lever selects the forks which is to be engaged and the longitudinal movements then slides the fork and its gear to engage the selected gear.	**1**



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OR

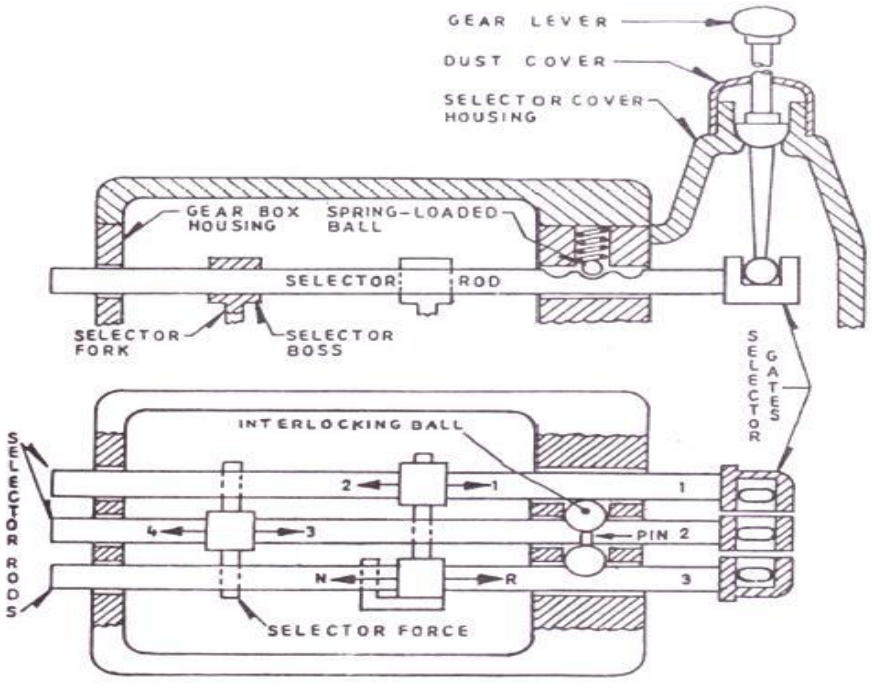
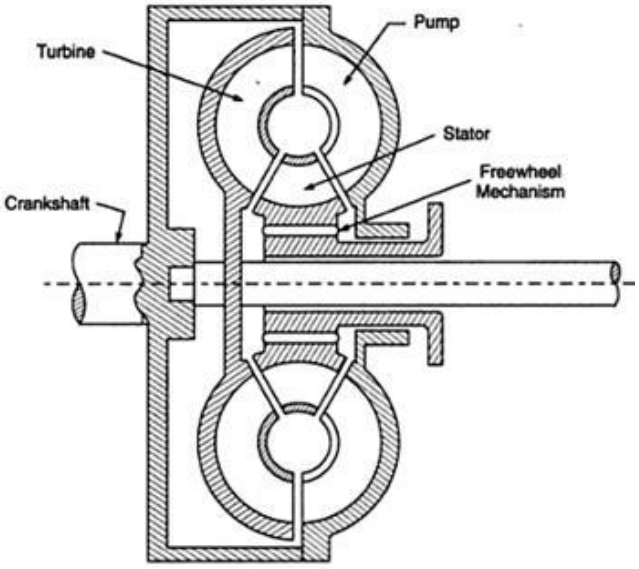


Figure: Gear selector mechanism with gear lever on top of gear bo

3		Solve any Four	16
	a)	Explain function & necessity of Gear box in Automobile	4
		Answer : *(Function: 2 marks, necessity: 2 marks)* **Necessity of gear box:** The engine delivers its full power at high speed and its direction of rotation is not reversible. When a vehicle starts from rest, hill climbing, accelerating and meeting other road resistances, high torque (tractive effort) is required at driving wheels. Hence a gear box is used to permit the engine crankshaft to revolve a relatively high speed, while the wheels turn at slower speeds. The vehicle speed is also changed with the help of gear box keeping the engine speed same with certain limit. This is the main purpose of gearbox to provide speed variations in road wheels by keeping engine speed constant.	2
		Function: 1. To vary torque & speed as per requirement. 2. In low gear it provide high torque at the time of starting vehicle acceleration & climbing up a hill 3. To provide more forward speed in top gear. 4. To reverse the vehicle 5. To control the speed of vehicle. 6. To start engine even clutch remains in engaged position & gears in neutral position. 7. To start engine when battery get discharged. 8. It act as parking brake in stationary condition of vehicle and gears in engaged stage	2
	b)	**Describe construction of Torque converter with label sketch**	**4**
		Answer: The torque converter is modified form of fluid flywheel. Torque converter is used to transmit the power with varied torque as per the requirement. It consists of following components : 1. Driving member (impeller) - connected to the crankshaft, 2. Driven member (turbine) - connected to output shaft, and 3. Reaction member also (stator) - mounted on overrunning clutch on stationary component	

		 Fig. Torque converter	
	c)	**Explain how universal joint & slip joint play important role in propeller shaft while transmitting power.**	**4**
		Answer: **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. **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.	**2** **2**

	d)	Explain working of synchromesh gear box & draw its power flow diagram for four speed gearbox.	4

Answer:-

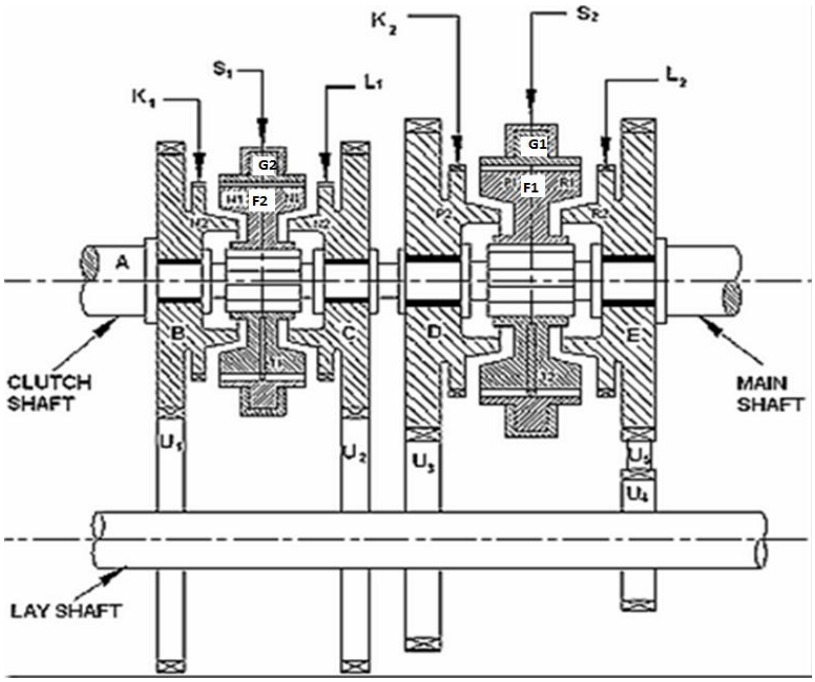


Fig:- Synchromesh Gear Box

Working:-

Neutral;- All the synchronizer remain at center position & no power transmit to main shaft 1

1st gear:- When a right side synchronizer slides towards left side there frictional surfaces comes in frictional contact with each other which synchronize speed & Synchronizer sleeve teeth mesh with 1st main shaft gear teeth and1st gear ratio obtain.

2nd gear :- When a left side synchronizer slides towards right side there frictional surfaces comes in contact with each other which synchronize speed & Synchronizer sleeve teeth mesh with 2nd main shaft gear teeth and 2nd gear ratio obtain.

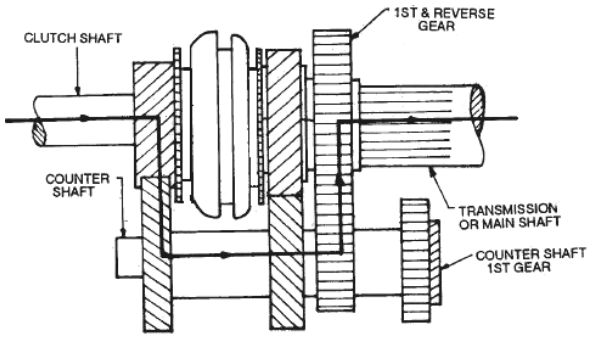
3rd gear:- When a left side synchronizer slides towards left side there frictional surfaces comes in contact with each other which synchronize speed & Synchronizer sleeve teeth mesh with 3rd main shaft gear teeth and 3rd gear ratio obtain.

Reverse Gear:- When a right side synchronizer slides towards right side there frictional surfaces comes in frictional contact with each other which synchronize speed & Synchronizer sleeve teeth mesh with reverse main shaft gear teeth and1st gear ratio obtain

1

1

1 First Gear:-



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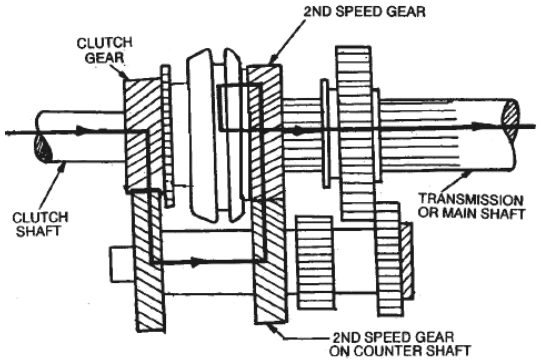
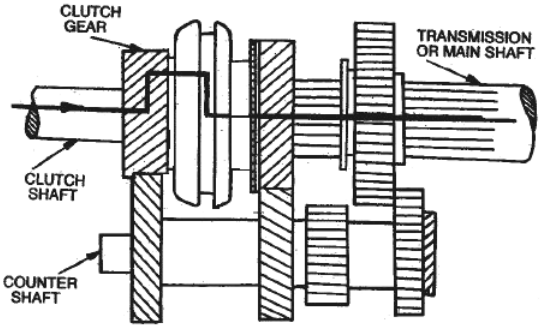
2 Second Gear:-



3 Third Gear/Top Gear



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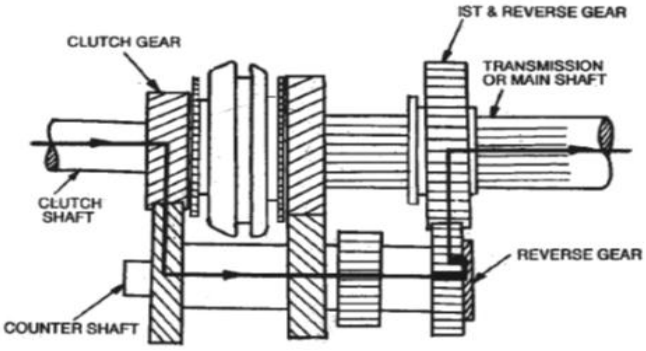
4. Reverse Gear:-



e) Differentiate sliding mesh gear box with constant mesh gear box — 4

Answer:- *(any four points)* — 4

Sr. No.	Sliding mesh Gear Box	Constant mesh Gearbox
1	It consists of spur gear.	It consists of helical gear.
2	The main shaft gears are not in mesh constantly with the counter shaft gears, which can slide and mesh	All the gears on the main shaft are in constant mesh with the corresponding gears on the countershaft.
3	Selector fork unit is used in this gear box for engaging the gears.	Dog clutch unit is used in this gear box forEngaging the gears.
4	The size of gearbox is very large.	The size of gearbox is small as compare to sliding mesh gearbox.
5	This gearbox produces more noise.	It gives quieter operation and makes gear Changing is easier.
6	Wear of dog teeth on top gear of main shaft on account of engaging & disengaging is more because only two or three teeth are involved.	Wear of dog teeth on account of engaging disengaging is less because here all teeth of dog clutches are involved
7	This gear box cannot be used for higher speed ratios.	This gear box can be used for higher speed ratios.
8	It is the oldest type of gearbox used in motor vehicles.	Constant mesh gear box has been used in 2& 3-wheelers.

f) Explain the working of transfer case also draw the condition of transfer case in 2WD & 4 WD — 4

Answer:

- 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.(as shown in fig A) 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. (as shown in fig B) In this position, four- wheel drive with the low gear is obtained.
- Similarly when the shifter-A connects the input shaft with Big input gear G1, and the shifter-B connects the front output shaft from the rear output shaft. (as shown in fig C) In this position, four- wheel drive with the low gear is obtained.

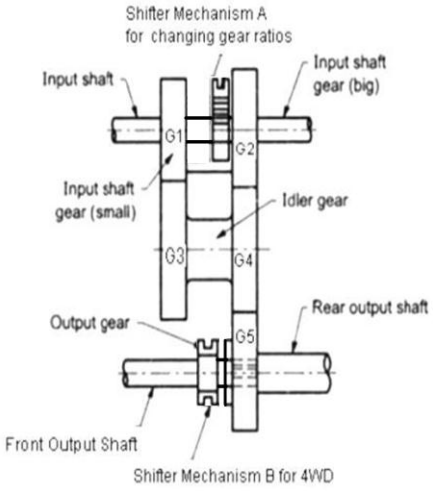


Fig A :- 2WD

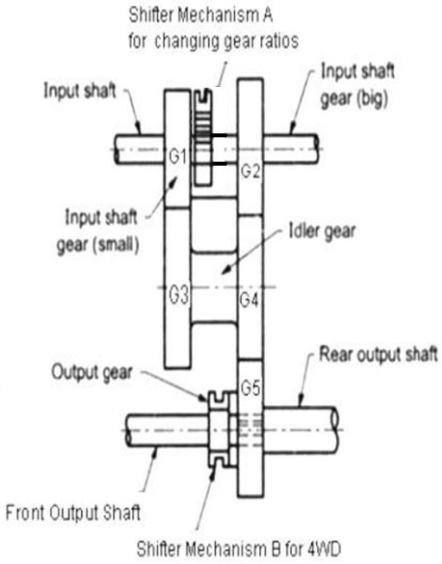


Fig B:- 4 WD with low gear

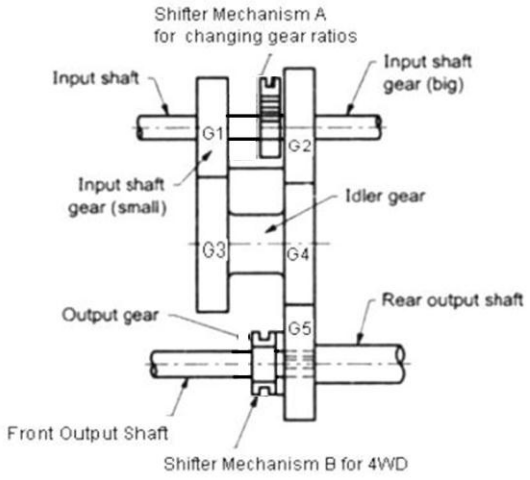
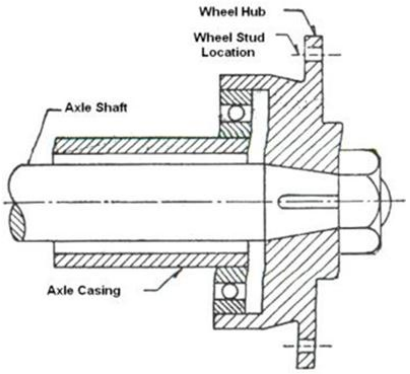


Fig C:- 4WD with high gear

4		**Solve any Four**	**16**
	a)	**Classify rear axles .Explain three quarter floating in details.**	**4**
		Answer : Tyes of rear axles 1. Full Floating 2. Semi floating 3. Three quarter Floating 4. **Three quarter Floating rear Axle** It as shown in fig. it is combination of semi floating & full floating type rear axle..In this type weight of vehicle is carried by differential casing while side thrust, cornering force & driving thrust are carried out by the axle.	1 1



Fig;- Three quarter floating — 3

b) Explain construction of differential with label sketch. — **4**

Answer:

Construction of differential: The construction of differential is shown in figure. In this, two sun gears are mounted on each rear axle half shaft at inner end. A differential cage is assembled on the left axle. The crown gear also called as a ring gear is attached to a differential cage and is in mesh with the bevel pinion. So the cage rotates with crown gear. The bevel pinion mounted on the propeller shaft end gives power to the crown gear. The cage and crown gear are free on the left rear axle. The two planet pinions are supported in the cage and are always in mesh with the sun gears. When the cage rotate, both the sun gear rotates which causes both rear wheels to rotate as the rear wheels are attached to outer end of rear axle. — 2

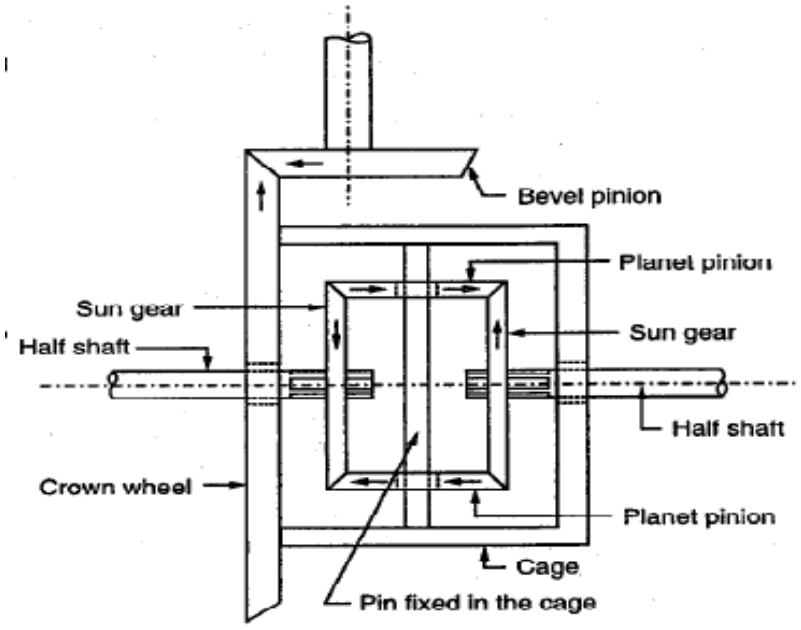


Fig:- Differential — 2

	C)	Describe various types of constant velocity joints	4

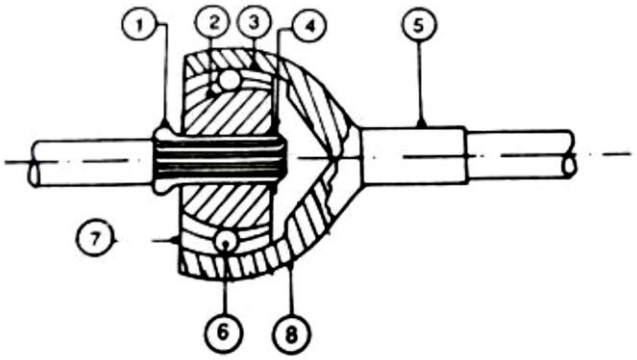
Answer:-

Types of C V joint-

1. Rzeppa joint
2. Tripod joint

1. Rzeppa joint:-

A Rzeppa joint consist of a spherical inner with 6 grooves in it, and a similar enveloping outer shell. Each groove guides one ball. The input shaft fits in the center of a large, steel, star-shaped "gear" those nests inside a circular cage. The cage is spherical but with ends open, and it typically has six openings around the perimeter. This cage and gear fit into a grooved cup that has a splined and threaded shaft attached to it. Six large steel balls sit inside the cup grooves and fit into the cage openings, nestled in the grooves of the star gear.

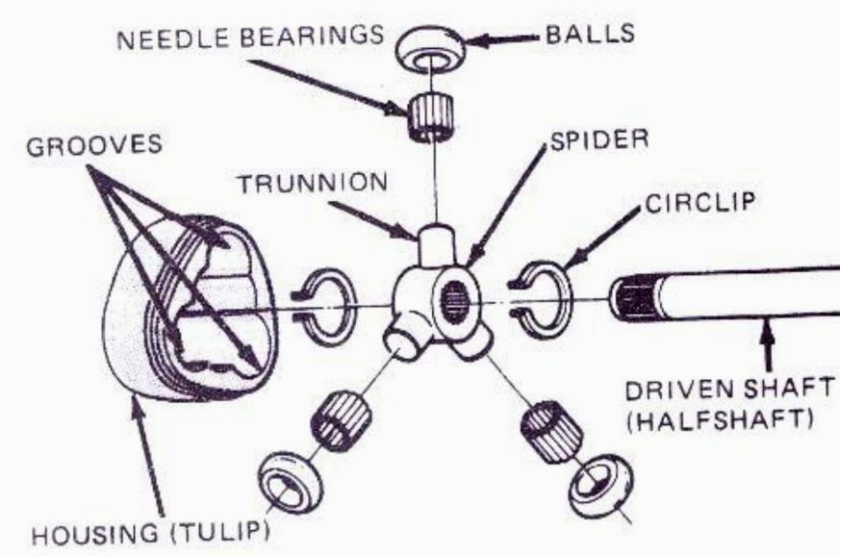


1. Half shaft (input shaft)
2. Spherical socket (inner)
3. Spherical socket (outer)
4. Circlip
5. Output shaft
6. Ball
7. Bearing cage

Application:-on Out board side

2. Tripod joint:

These joints are used at the inboard end of car drive shafts. This joint has a three-pointed yoke attached to the shaft, which has barrel-shaped roller bearings on the ends. These fit into a cup with three matching grooves, attached to the differential. Since there is only significant movement in one axis, this simple arrangement works well. These also allow an axial 'plunge' movement of the shaft, so that engine rocking and other effects do not preload the bearings. A typical Tripod joint has up to 50 mm of plunge travel, and 26 degrees of angular articulation.

		Application:- in Out board side  	
	d)	**Explain the need of lubrication for gearbox in automobile.**	**4**
		Answer:- **Need of gear box lubrication:** Proper lubrication of gear box is extremely important. The transmission gears operate in a bath of lubricant. It prevents metal-to-metal contact which would generate so much heat that the gear teeth would be burned away. The important objectives accomplished by gearbox lubrication include: 1. Reduction of friction and wear, 2. Corrosion prevention, 3. Reduction of operating noise, 4. Improvement in heat transfer 5. Removal of foreign or wear particles from the critical contact areas of the gear tooth surfaces.	4

e) Differentiate between Disc & alloy wheels — 4

Answer *(Any four)*

Sr.	Disc Wheels	Alloy Wheels
1	It is made by press steel where steel disc is welded to rim	It is made of Aluminum alloy &manufactured by casting & forging process
2	It is heavy in weight as compare to alloy wheels	It is Light in weight reduce inertia forces
3	Low Manufacturing cost	High Manufacturing cost.
4	In case of damage it can be repairable	In case of damage it need to replace
5	It is corrosible	It is non corrosible
6	It does not have good thermal conductivity	It has good thermal conductivity
7	Aesthetic appearance is not that much good	Aesthetic appearance is good
8	Application HMV, Truck, Jeep etc	Application:-Motor cycle, Car , SUV etc

4

f) State the necessity & requirements of a tyres used in four wheeler. — **4**

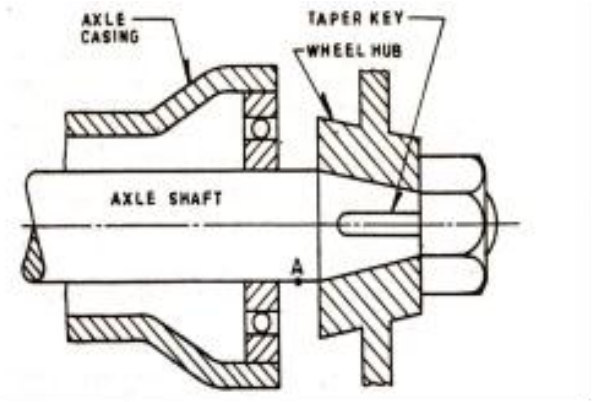
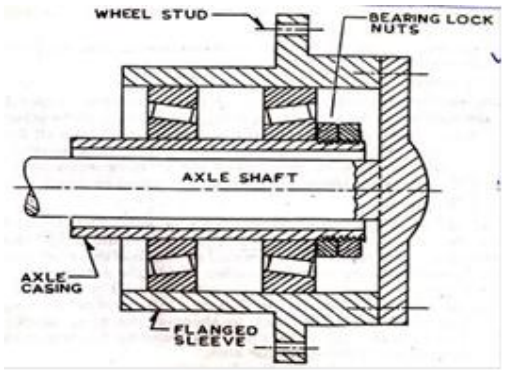
Necessity:- *(any Two)* — 2

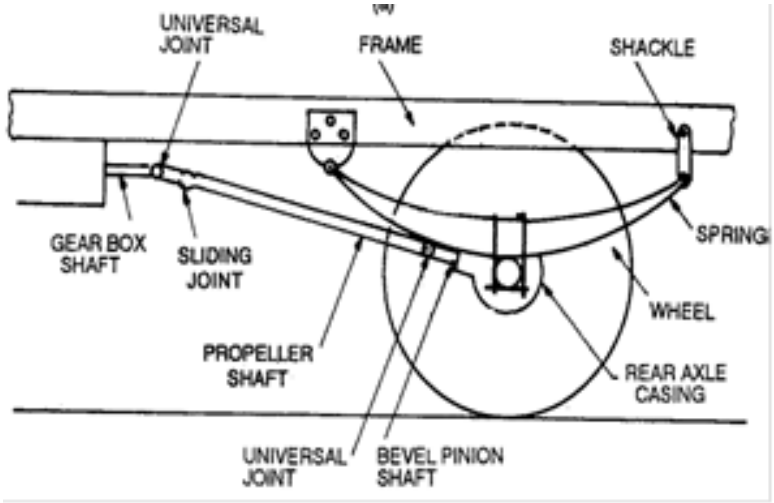
1. To carry the load of vehicle
2. To transmit driving thrust
3. To steer the vehicle
4. To apply brake
5. To with stand thrust & corning force
6. To provide cushioning effect(to absorb road shocks)

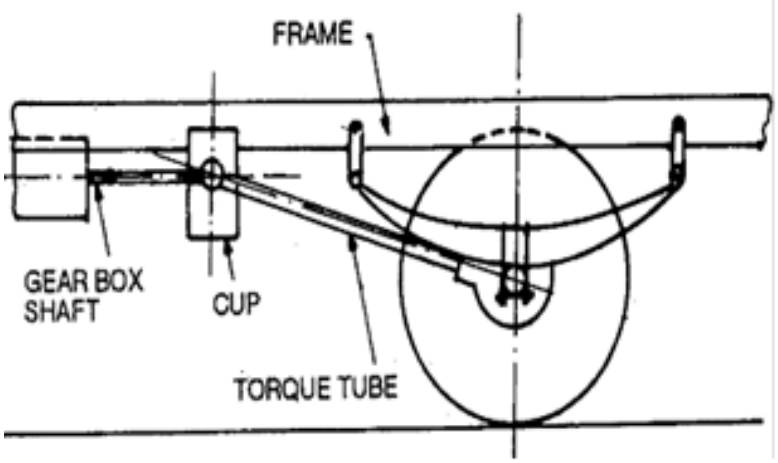
Requirement *(any two)* — 2

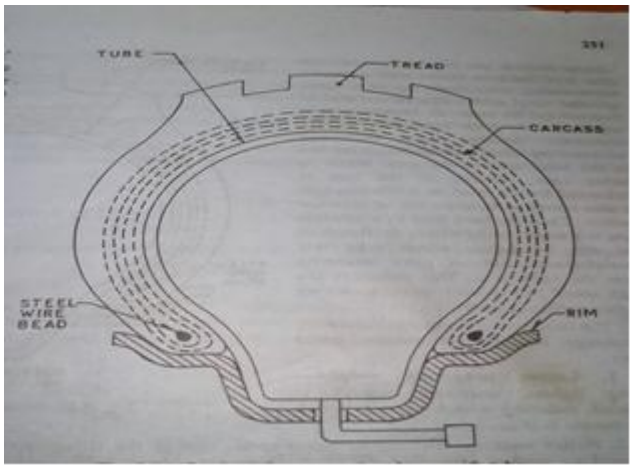
1. The tyre should be light in weight to reduce the inertia forces.
2. The material of tyre should have good wear resistance .
3. It must be strong enough than to perform above functions
4. It should be statically & dynamically balanced
5. The tyre should be easy to remove & refit on wheel & vehicle.

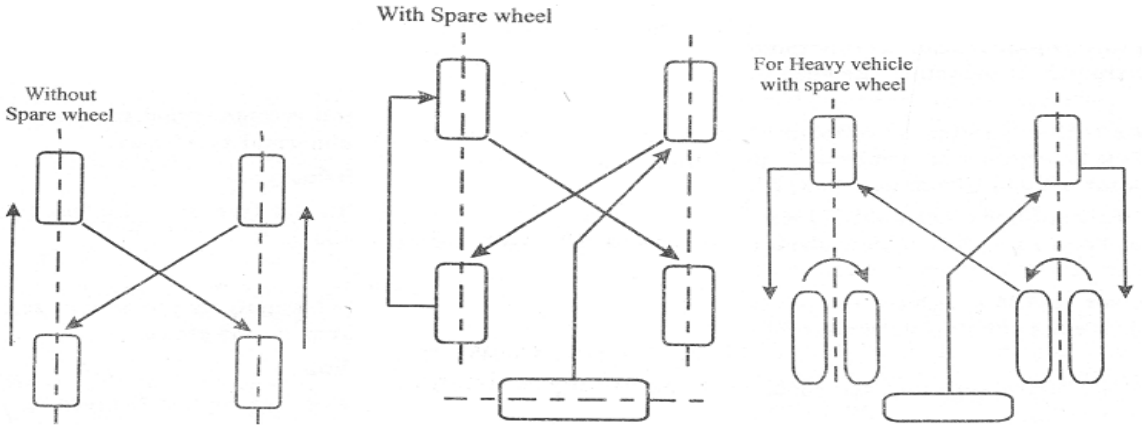
5		**Solve any Two**	**16**
	a)	**Describe the necessity of rear axle and explain the various loads acting on rear axle.**	**8**
		Answer: **Necessity of rear axle –** 1. It carries the rear road wheels. 2. It transmits power to the rear wheels. 3. The rear axle sustains a major fraction of vehicles 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. **Loads acting on the rear axle:** **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.	4 4

	b)	**Explain with neat labeled diagram semi-floating type rear axle and Full floating type rear axle**	**8**
		Answer: **Type of rear axles**: **a) Semi floating:**	
		 Fig.: Semi floating type rear axle	2
		Explanation: 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.	2
		b) Full floating:	
		 Fig: Fully-Floating rear axle.	2

		Explanation: The figure shows the full floating axle. The wheel is on the axle casing. Two roller 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. Fully floating rear axle is used in heavy commercial vehicles	2
	c)	**Explain with neat labeled diagram of Hotchkiss drive and Torque tube drive**	8
		Hotchkiss drive: Explanation: This drive is invented by Albert Hotchkiss. In the Hotchkiss drive two universal joints are used one at front and second at rear end of propeller shaft. Slip joint is used to accommodate change in length of propeller shaft. Leaf spring is shacked at the rear and bracketed at front end. Leaf spring takes Weight of body, driving thrust, side thrust, torque reaction and braking thrust. In the Hotchkiss drive, splines eliminate thrust transmitted back to the driveshaft from the wheels, allowing simple rear-axle positioning using parallel leaf springs. Due to torque reaction leaf spring deflects. It is used in heavy duty vehicles like bus and trucks.  Fig. Hotchkiss Drive	2 2 2

		Torque Tube Drive:  **Fig. Torque Tube Drive** **Explanation:** In this type of drive Open type propeller shaft is used. Two universal joints are used one at front & second at rear end of the propeller shaft. Slip joint is used to accommodate change in length. Torque reaction, driving thrust, side thrust, weight of the body & braking torque all are taken by leaf spring. Leaf spring is shackled at the rear and bracketed at front end. The centre axis of propeller shaft and bevel pinion shaft is not coinciding when axle moves up and down. It is used in heavy vehicles like bus, truck.	2 2
6		**Solve any Two**	**16**
	a)	**Explain conventional, semi integral and integral type frame. List various materials used for chassis frame.**	**8**
		Answer: **Conventional frame**: There are two heavy side members and cross members welded, bolted or riveted to the superstructure. It has more ground clearance, higher centre of gravity and heavier in construction. When the vehicle is met with accident the frame cannot be taken easily to replace the damaged chassis frame. Used in heavy vehicles like trucks and buses. **Semi-integral frame:** In this, heavy cross and side members are eliminated. In some vehicles half frame is fixed in the front end on which engine, gear box and front suspension is mounted. It has less Ground clearance, lower centre of gravity and light in weight. When the vehicle is met with accident the front frame can be taken easily to replace the damaged chassis frame.	2 2

		Used in FIAT car and some of the European & American cars. **Integral frame:** In this type no frame is used and all the assembly units are attached to the body. all the functions of frame are carried by body itself. It has less weight, saving in fuel consumption, increased stability and provides safety to the passengers. Due to elimination of long frame it is cheaper. Only disadvantage is repairing is difficult. Now a daysit is used in most of the cars. **Materials used for chassis frame-** 1) Mild steel 2) Carbon steel 3) Nickel alloy steel 4) Aluminum alloy.	2 2
	b)	**Draw a neat sketch of tyre tube construction. Explain tyre rotation procedure for a four wheeler with neat sketch.**	**8**
		Answer:- **Tyre tube construction:**  Fig. Tyre tube construction: **Tyre rotation procedure for a four wheeler:** Tyre rotation is the practice of moving the wheels and tyres of an automobile from one position to another, to ensure even tire wear. Even tyre wear is desirable to extend the useful life of a set of tyres. The weight on the front and rear axles differ which causes uneven wear.The pattern of tyre rotation differs for the front wheel drive vehicles and rear wheel drive vehicles. A good example is Front Wheel Drive vehicles which places braking,	4 2

		steering and driving forces on the front axle tyres. Rear axle tyres only receive braking forces resulting in a much faster wear rate for the front axle tyres. Tyre rotation for these vehicles therefore becomes very important for optimum tyre life. Tyre rotation should be undertaken every 5,000 to 8,000 kilometers, even if there is no sign of uneven wear. The "Cross Pattern" provides the best results and can be performed on any Front or Rear Wheel Drive vehicle equipped with 4 non-unidirectional tyres. (Unidirectional tyres must be rotated front to rear only). Free rolling axle tyres are crossed and installed to the drive axle, while the drive axle tyres are brought straight to the free rolling axle (without crossing). The rotation patterns of tyres for different vehicles are shown in figure.  Figure 1 OR Figure2 OR Figure3 Fig:- Tyre Rotation Procedure	2
	c)	State the different types of Tread patterns and explain the effect of inflation pressure on the tyre life	8
		Answer: Types of Tread patterns: Symmetric Tread Pattern, Asymmetric Tread Pattern, Directional Tread Pattern, Snow/Mud Tread. **OR** Fine Tread Pattern: Used in LMV Course TTyre inflation: **Effects of Under-inflation:** 1) Uneven tread wear, more wear at tyre sides. 2) Lack of directional stability.	2

		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:** 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. read Pattern: Used in HMV	3 3