MODEL ANSWER

Winter 2018 EXAMINATION

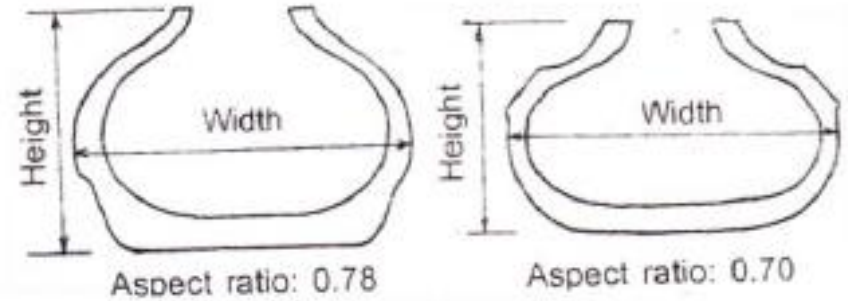
Subject Title: Automobile Transmission System Subject Code: 22309

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
1A		Attempt **any Five** of Following**(5X2)**	**10**
	a)	**State the necessity of Frame in Automobile.**	**02**
		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	**02**
	b)	**Enlist different material used in Frames**	**02**
		1) Mild steel 2) Carbon steel 3) Nickel alloy steel 4) Aluminum alloy.	**02**
	c)	**Write a function of Automobile Clutch**	**02**
		•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	
	d)	**State the purpose of Transfer case**	**02**
		1. Transfer case is used in four wheel drive vehicle along with main gearbox to transmit torque and power to the rear axle.	

		2. It enables the driver to drive the vehicle in two wheel drives on highways or shift to four Wheel drive for rough, muddy roads i.e. for cross country applications. 3. It also enables to drive the vehicle in high gear or low gear whenever required.	
	e)	**State the function of Slip joint & universal Joint**	**02**
		1)Slip joint Functions: 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) Universal Joint Function:-**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	**01** **01**
	f)	**State the load acting on rear Axle**	**02**
		Answer: The various loads acting on the rear axle are-(Any 02 points each carry 01 mark) 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.	
	g)	**Explain the concept of Aspect Ratio.**	**02**
		Aspect Ratio: The aspect ratio of a tyre is the height of the tyre sidewall expressed as a percentage of the tyre's width. For example, a tyre with a profile/aspect ratio of 65, is a tyre whose height is equal to 65% of its width.	**02**



Fig;- Aspect ratio

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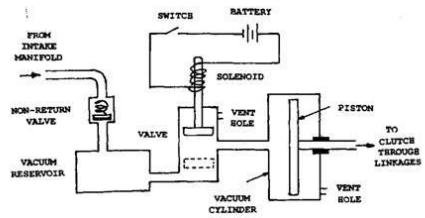
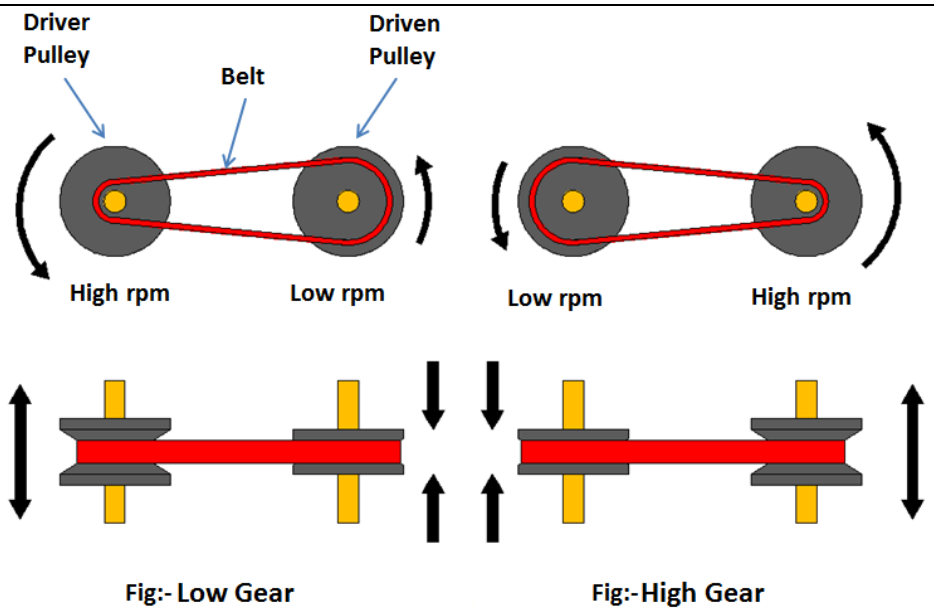
Q. No.	Sub Q. N.	Answer	Marking Scheme
2		Attempt **any Three** of Following.(3X4)	**12**
	a)	**Explain any one type of Frame section with neat sketch**	**04**
		Answer:- four section of chassis frame with their merits (any 1 type)  Channel Box Tubular I-section Figure: Frame sections **Channel Section:** The channel section is used for making the long members of the frame. It provides a good resistance to bending. It is poor in torsion. This type of section is used in conventional ladder like frames of LMV (e.g. Mahindra Jeep) and HMV (e.g. Truck, Bus etc). **Box section:** Box section is good for both bending and torsion. The cross member of conventional frame are made of box sections. This type of frame section is used in frames of motorcycles (e.g. Bajaj Pulsar, Boxer etc.) **Tubular sections**: Tubular sections provide good resistance to torsion but poor resistance to bending. Now a days, tubular section is used to make complete chassis frame of three wheeler, scooter, motorcycle, matador and pickup van etc **I-Section:** I- section is used for making cross members. I-Section has high moment of inertia and stiffness which makes it resistant to bending moments. The web provides resistance against shear forces. These sections are not resistant to torsional loading (twisting) and they shall not use in the cases where torsion is dominant.	**02** **02**
	b)	**Describe with schematic sketch working of Vacuum operating clutch mechanism**	**04**
			**02**

		Fig:- Vacuum Opearted Clutch linkage -Vacuum operated clutch linkage operated by engine Vacuum created during suction stroke -It consists of vacuum reservoir tank connected to engine inlet manifold through non return valve. -Reservoir connected to solenoid valve which operated by battery and switch in the gear lever. -Control valve attached to vacuum cylinder consist of piston & plunger which further connected to release fork & release bearing as shown in fig	**02**
	c)	**Describe working of continuously variable transmission with suitable sketch**	**04**
		 **Fig**:- Continuously Variable Transmission a) Low Gear b) High Gear A Vario-drive consists of two set of split pulleys - drive and driven pulley and drive belt between the pulleys. The drive pulley is fitted 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. As the speed of the engine increases, or load on the rear wheel decreases, centrifugal force on the weight rollers increases thus rollers are thrown radially outward. When rollers are forced outward, they press-in the movable face of the drive pulley closer to the drive face which results in increasing effective diameter of drive pulley at the same time effective diameter of driven pulley gets decreased thus a reduced drive ratio between the driven and drive pulleys is obtained.	**02** **02**
	d)	**Explain construction of Hotchkiss drive with suitable sketch**	**04**

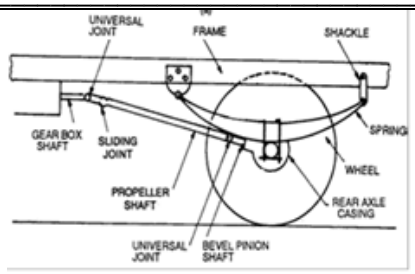


Fig:- Hotchkiss Drive

02

Hotchkiss drive: Explanation:

Construction:-

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.

02

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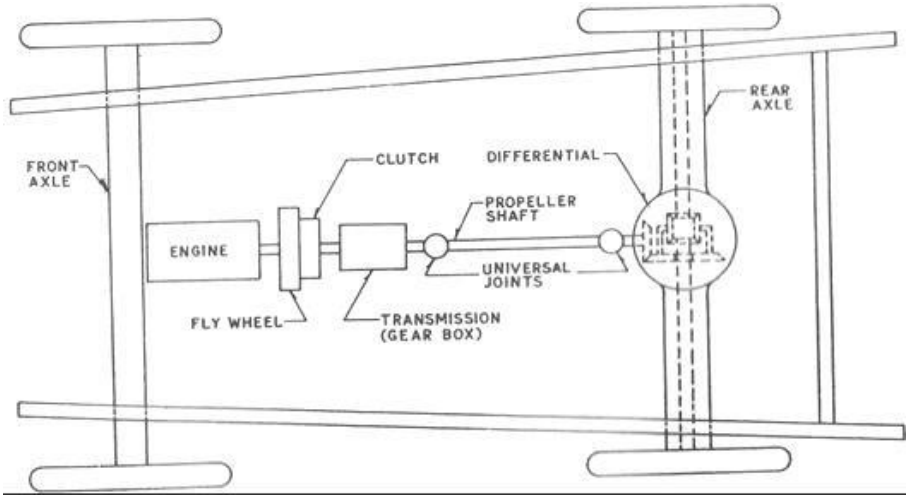
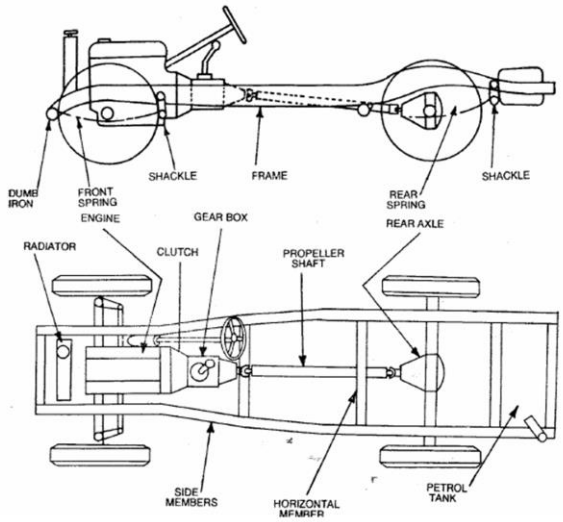
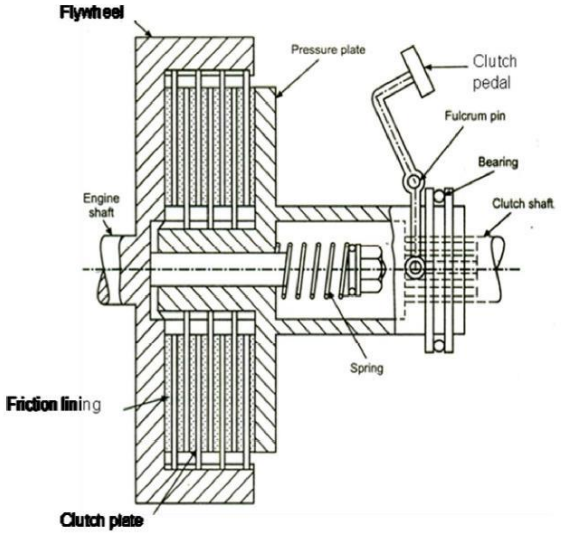
3		Attempt **any Three** of Following.(3X4)	**12**
	a)	**Sketch a layout of Front Engine Rear Wheel Drive vehicle & label the major parts**	**4**
		(Diagram 2 marks & neat labelling 2 marks)  **Fig**:- Front EngineRear Wheel Drive Vehicle Layout	**4**
	b)	**Illustrate with the sketch functional relationship of major components of power transmission system**	**4**
		 	**02**

		Fig:- major assembly & There location on chassis frame 1. **Chassis Frame: -** it is backbone of vehicle. all sub systems mounted on chassis frame 2. **Engine:-**it is heart of vehicle. It is device which converts chemical energy into mechanical energy by the process of combustion which is than propulsion of vehicle. 3. **Clutch:-**It is device which engage & disengage engine power to gearbox while shifting gears 4. **Gearbox:-**It vary torque & speed as per requirement. 5. **Propeller Shaft:-**It transmits power of gearbox to differential. 6. **Final Drive:-**it turn power in 90^0 ,do some permanent speed reduction, increase & decrease speed of outer & inner wheel while taking turn. 7. **Wheels & Tyres:-**it carry weight of vehicle , transmit driving thrust, absorb road shocks	**02**
	c)	**Describe the working of motorcycle clutch with neat sketch.**	**04**
		Working While the flywheel is rotating the pressure plates rotate and press against the friction plate.This causes the friction plates and thus the clutch shaft to rotate as well. When the pedal is pressed , the flywheel continues to rotate but the friction plates are released. This happens because they are not fully pressed by pressure plates. Thus the shaft also stops rotation.  **Fig:- Multi plate Clutch**	**02** **02**
	d)	**Describe advantages of torque converter over manual transmission system (any 4)**	**4**
		Advantages of torque converter (1 mark to each) 1. Torque converter varies gear ratio in the range of 3:1 to 1:1 in infinite no. of stages which gives uniform acceleration	

		2. No need of operating clutch & gear manually 3. It provides driving comfort to driver by avoiding manual interference of gear changing. 4. It allows starting & stopping vehicle without any difficulty.	

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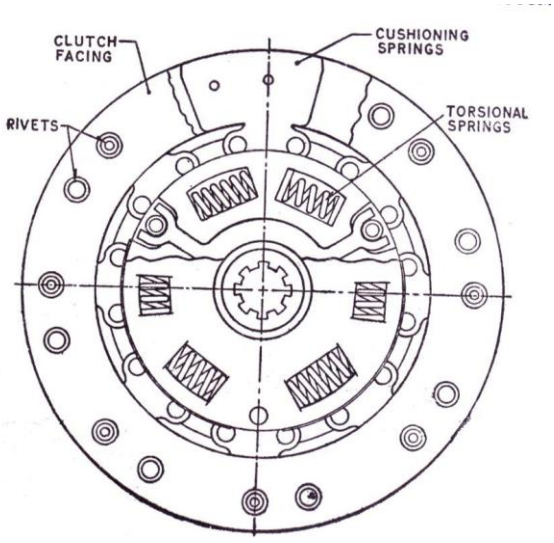
4		Attempt **any Three** of Following.(3X4)	**12**
	a)	**Describe with neat sketch construction details of clutch plate.**	**04**
		 Fig:- Single Plate Clutch	**02**

Constructional details

It consist 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 flang — **02**

b) Compare dry clutch & wet clutch on basis of — **04**

(Each point 1 mark)

Parameter	Dry Clutch	Wet Clutch
Construction	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 circula
Torque	Torque transmission capacity is higher.	Torque transmission capacity is lower (35-50% of dry clutch), since the clutch plates are wetted by oil
Heat Transmission Or heat dissipation	due to metal and air contact heat dissipation is fair	Due to metal and oil contact heat dissipation is much better.
Application	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.

c) What are the different materials used for clutch lining? State its necessity. — **04**

Material:-
1. Leather
2. Cork
3. Fabric
4. Asbestos
5. Reybestos and Ferodo
6. Non- asbestos clutch lining material

— **02**

Necessity:-
1. It should have good anti fading characteristic
2. It should have longer life.
3. It should be nonpolluting.
4. It should have lesser cost

— **02**

d) In modern car synchromesh gearbox is preferred over constant mesh gearbox. Justify its application with suitable illustration — **04**

Reason of synchromesh gear box preferred over constant mesh gearbox

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.

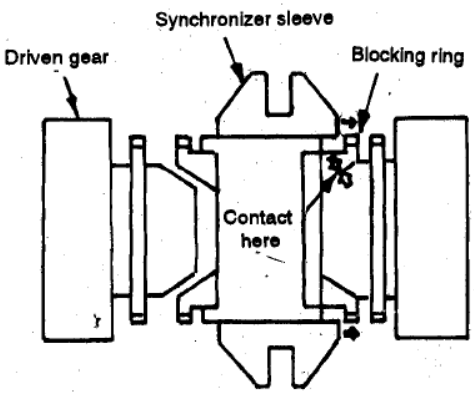
01

Application of synchromesh gearbox **01**

Modern cars, Sport utility vehicles, for Higher gears in gearbox

Application Synchronizer to avoid double declutching

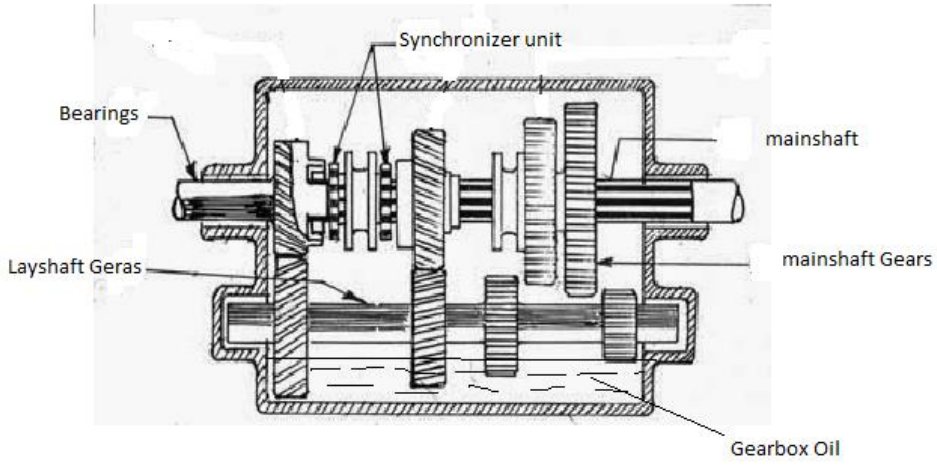
The main purpose of this unit is to synchronize the speed of the two gears before they are engaged. We know that in running vehicle, when we press the clutch & put the gear in neutral position, till the gear are revoling. All the gear do not revolve at the same speeds & when we have to engage two gears running at different speeds by shift lever there will be some sound due to clashes of gears and very hard to engage and disengage the gears. To avoid said problems the synchromesh devices are used. Synchromesh devices are not fitted to all the gears. They are fitted only on the higher gears. During synchronization the synchronizer sleeve is moved towards selected gear pushing the block ring to the right, the ring contacts the shoulder of the driven gear and begins to synchronize the speed of the two parts. In this way the drive from lay shaft gears to main shaft gear and then to the main shaft through synchronizer device **01**



01

Fig:- Working of Synchronizer

e) Describe with sketch the method of lubrication of synchromesh gearbox **04**



02

Fig:- Splash Lubrication of Synchromesh Gear box

		Splash lubrication system The splash lubricating system is simple to manufacture and implement in synchromesh gearbox. Lay shaft gear revolutions splash up lubricant from the sump to provide adequate lubrication to main shaft gears, Synchronizer , selector fork &,main shaft, lay shaft & clutch shaft Bearings components. The lubricant is thrown against the gravity inside the gearbox casing as droplets or fine mist. **Different lubrication points of synchromesh gear box:** 1. The gear box should always remain filled with lubricant. The gears are partially dipped in lubricating oil 2. It lubricates bearing of the gear box 3. Selector mechanism is lubricated by thin machine oil/engine oil	**01** **01**

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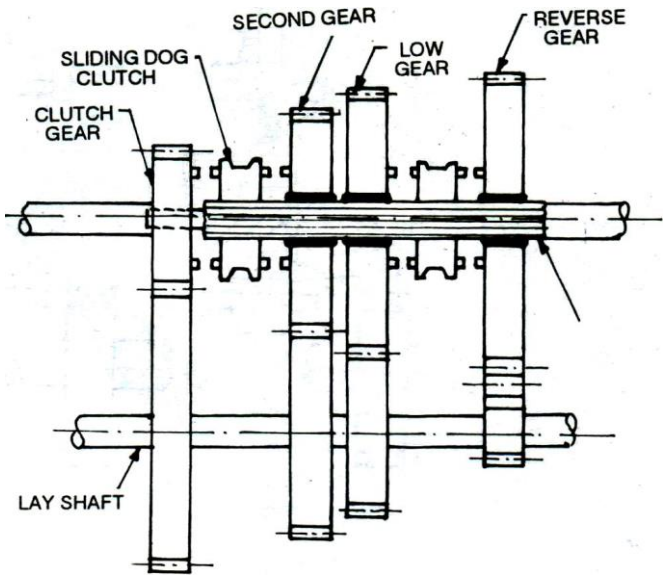
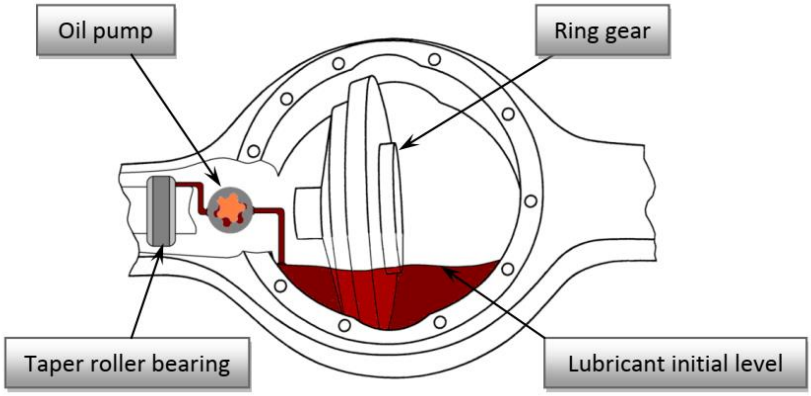
Q. No.	Sub Q. N.	Answer	Marking Scheme
5		Attempt **any TWO** of Following.(2X6)	**12**
	a)	**Describe with schematic diagram working of constant mesh gearbox**	**06**
		 Fig:- Constantmesh Gearbox -In constantmesh gearbox all the gears on the mainshaft are constantly mesh with layshaft gear & freely rotate on mainshaft. -When the clutch is in engaed position & gears are netral position & engine is running an additional part called "Dog clutch"is provide between mainshaft gears slide on splined shftb with help of selector mechanism. -a whole assembly enclosed in the gearbox hausing and filled with specific grade oil in specific quantity **Working:-** **Neutral Gear:-**in neutral stage all dog clutches remains at centre position and no power transmit throgh gearbox.	**02** **02**

		1st Gear:-As the right side dog clutch slide towards left and its teeth mesh with teeth of first gear on mainshft than first gear ratio obtained which is near about 3:1 **2nd Gear:-** When left side dog clutch slide towards right side and its teeth mesh with teeth of second gear on mainshft than second gear ratio obtained which is near about 2.5:1 **3rd Gear or Top gear:- :-** When left side dog clutch slide towards left side and its teeth mesh with teeth of clutch shaft gear than third gear ratio obtained which is near about 1:1 **Reverse Gear:-** As the right side dog clutch slide towards right side and its teeth mesh with teeth of reverse gear on mainshft than direction of mainshaft becomes reverse & reverse gear ratio obtained which is near about 3:1	**02**
	b)	**Compare Hotch kiss drive with torque tube drive & justify their use in relevant transmission systems**	**06**
		Any 6 points	**06**

Sr No	Hotchkiss Drive	Torque Tube Drive
1	Open type Propeller shaft is used	Propeller shaft is enclosed inside tube called torque tube.
2	Two universal joints are used one at front end & other is at rear end of Propeller shaft.	Only one universal joint is used at front end of Propeller shaft.
3	Slip joint is used to accommodate change in length of Propeller shaft.	No slip joint is used.
4	Torque reaction, driving thrust ,side thrust, weight of body & braking torque are taken by leaf spring	Weight of body & side thrust are taken by leaf spring. Torque reaction, driving thrust & braking torque are taken by torque tube.
5	Bracket is providing at front end of leaf spring.	Shackle is provided at both end of leaf spring.
6	Centre axis of Propellershaft & bevel pinion shaft is not coinciding when axle moves up & down.	Axis of Propellershaft & bevel pinion shaft coincides always.
7	**Application:-Heavy Vehicles truck, Jeep & buses**	**Application:-In light motor vehicle, SUV, cars, Military vehicles**
8	Propellershaft can be easily remove	Whole assembly of torque tube member should be remove for removing propeller shaft.

	c)	D**escribe a method of lubrication for rear axle assembly of the truck.**	**6**

		 **Fig;- Combined (Splash & Pressurized)Lubrication System** The combined lubrication system is very important in the final drive axle, where load and or speed transferred are high, the combination of splash and force feed of lubricant is delivered to different components, like in case of heavy duty tandem drive axles . The lubricant is distributed to some parts by the revolution of the ring gear producing splash and to other more critical parts by using the oil pump through oil galleries under pressure as shown in Figure. Lubricant is splashed and pumped from the sump and provides adequate lubrication to gears, seals and bearings in the axle. Lubricant trickles down due to gravity into the sump, where it is collected again and the cycle repeats	**3** **3**

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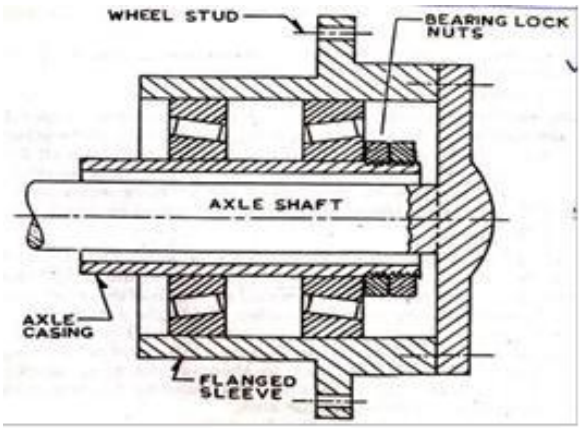
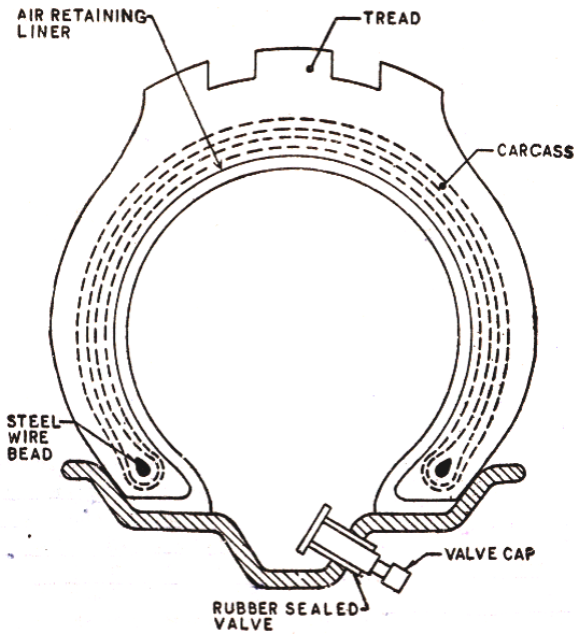
Q. No.	Sub Q. N.	Answer	Marking Scheme
6		Attempt **any TWO** of Following.(2X6)	**12**
	a)	**Describe with neat sketch working of full floating type.**	**6**
			**3**

		Fig:- **full floating Rear axle** **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	**3**
	b)	**Describe with sketch construction of tubeless tyre & state its two advantages over Tube type**	**6**
		This type of tyre does not need separate tube, instead the air under pressure is filled in the tyre for which purpose a non return valve is fitted to the rim. The tyre is directly mounted on the rim and retains the air. The inner construction of tyre is almost the same as that of tubed tyre, except that it is lined on inside with a special air-retaining liner. It consist of two main parts i.e. carcass and tread. The carcass is basic structure taking mainly the various loads and consists of a number of piles wounded in a particular fashion from the cards of rayon or any other suitable material. The tread is a part of tyre, which comes in contact with the road surface when the wheel rotates. It is generally made of synthetic rubber.	**2**
		The design of tyre treads depends on various tyre properties like grip, noise and the wear. Between the bead and the tread, outer rubber covering and the carcass is called the sidewall. At the inner edges, beads are formed by reinforcing with steel wires. All piles are tied to the beads, which prevent any change of shape.  Fig:- tubeless Tyre	**2**
		Advantages:- (Any 2) 1) Lesser unsprung weight-due to lack of tube weight reduce & increase fuel efficiency .	**2**

2) Better cooling:-hence there is no tube heat directly transferred to rim which provide better cooling.

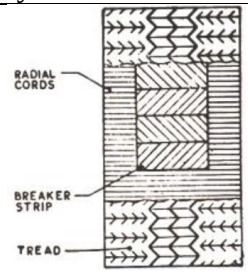
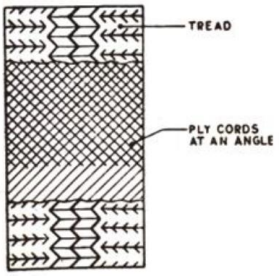
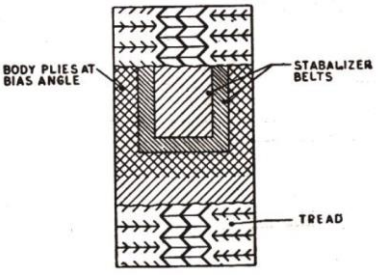
3) Comfortable ride:-in tubeless tyre shocks & vibration absorbed effectively which increase driving comfort.

4) Slower Leakage of air:- in case of puncture air retaining liner hold nail in position & prevent sudden air diffusion.

5) Simple assembly:-Only the tyre has be fitted on rim

6) Improve road safety:- in case of puncture air defuses slowly which provide safety to driver as well as other.

c) Distinguish among radial ply, cross ply & belted bias types tyres (any6) — 6

Sr. No.	Radial ply tyre	Cross ply tyre	Belted bias Type
1	Plies are running radially straight from bead to bead	Piles are running diagonally opposite from bead to bead.	The basic construction is like the bias-ply but for strengthening belt plies are added in the tread area the cord in belt run at an angle of 20^o to 35^o to the centre line of tire tread
2.	Stiffness of tyre is less, so it gives ultimate comfort at high speed.	Stiffness of tyre is more, so less comfortable.	Stiffness of tyre is moderate
3	Steering is harder.	Steering is easy.	Steering is moderate
4	Tyre has firm grip with road.	Tyre has lesser grip with road.	holds the tyre flatter thus provides good grip and safety
5	Radial ply tyre has more tread life.	Cross ply tyre has less tread life.	Belted bias tyre has more life than radial & cross ply tyres
6	More braking grip.	Less braking grip.	More braking grip
7	Costlier than cross ply tyre	Cheaper than radial ply tyre.	Costlier than radial ply & cross ply tyre
8	 Fig:- Radial ply Tyre	 Fig:- Cross ply tyre	 Fig:- Belted bias tyre