SUMMER– 18 EXAMINATION

Model Answer

Subject Name: Vehicle Layout and Transmission System **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. N.	Answers	Marking Scheme
01	**A**	**Attempt any SIX of the following:**	**12**
	(a)	**What are the materials used for chassis of vehicle?**	**02**
	Ans	Materials used for chassis of vehicle: (Any two material- two marks) Most frames used on light vehicles are made of low-carbon steel having a carbon content of 0.15-0.25%. i) Mild sheet steel ii) Carbon sheet steel iii) Nickel alloy sheet steel iv) Aluminum alloy (Alpax)	**02**
	(b)	**Enlist two applications of conventional frame.**	**02**
	Ans	Two applications of conventional frame: 1. Truck 2. Jeep 3. Auto-rickshaw	**02**
	(c)	**What is the frameless construction of vehicle?**	**02**
	Ans	In this type of vehicle heavy side members used in conventional construction are eliminated and the floor is strengthen by cross members and the body, all welded together,	**02**
	(d)	**State the necessity of Automobile clutch.**	**02**
	Ans	**Necessities of clutch:***(Any two)* 1. To engage and disengage the engine power from transmission as required when the vehicle is to stop by applying brakes. 2. To facilitate the easy gear shifting from 1st to 2nd or from top to 1st gear whenever required by disconnecting the engine from transmission. 3. To reduce the noise in transmission by providing suitable means. 4. To reduce the vibrations during high speed power transmission.	**02**
	(e)	**What is the need of gearbox for vehicle?**	**02**
	Ans	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	**02**

		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.	
	(f)	**State the need of propeller shaft in a truck**	**02**
	Ans	1. To transmit rotary motion and power to the differential. 2. To transmit power at varied angle. 3. To absorb the shocks coming on the transmission system when the vehicle starts from rest. 4. To accommodate change in length when the rear axle moves up and down.	**02(Any 02)**
	(g)	**State the function of differential**	**02**
	Ans	**Function of differential:** 1. To transmit the power from propeller shaft at right angle to the axle shafts for moving the wheel. 2. To differentiate the speed of two rear wheels when vehicle takes a turn, i.e. the outer wheel has to travel more distance than inner wheel or the outer wheel has to run faster than the inner wheel.	**02(Any 02)**
	h	**Describe the operation of rear axle**	**02**
	Ans	It is live axle of front engine rear wheel driven automobile. The drive from comes to pinion shaft which is supported in the bearing in the axle casing, the crown wheel in mesh with pinion and is mounted on shat on the ends of which are fixed the caps which serves to restricts the wheels in axial directions. The wheels are mounted on bearing on the ends of axle shafts and thus the drive to rear wheels is given.	**02**
	B)	**Attempt any two:**	**08**
	a)	**Classify the vehicle layout with respect to location of engine, No. of live axle, luggage section, application.**	**04**
	Ans	**Classification of vehicle layout with respect to:** **1. According to location of Engine** a) Front Engine Rear Wheel Drive b) Front Engine Front wheel Drive c) Mid Engine Rear wheel Drive d) Rear Engine Rear Wheel Drive **2. According to no. of live axles:** a) Two Wheel Drive vehicle - only one front or rear axle is live axle. b) Four Wheel Drive vehicle - both front and rear axle are live axle. **3. According to arrangement of Engine** a) Logitudinally placed engine b) Transversely placed engine **4. According to Application.** a) Light Motor Vehicle - e.g. Car Jeep, b) Heavy Motor Vehicle - e.g Truck, Bus, Commercial or Goods carrier vehicle	**04**

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	b)	**Differentiate between single plate clutch and multiplate clutch**	**04**
	Ans	Answer: **Difference between single plate clutch and multiplate clutch:** *(Any 4 points)*	**04**

Sr	Single Plate clutch	Multi-plate clutch
1	It consists of only one clutch plate.	It consists of two or more number of clutch plates.
2	Number of pairs of friction surfaces in contact are two.	Number of pairs of friction surfaces in contact are more than two.
3	It does not ensure smooth engagement.	It ensures smooth and gradual engagement.
4	It requires more space.	It requires less space.
5	For same power transmission, larger in size.	For same power transmission, smaller in size.
6	For same size, torque transmission capacity is less.	For same size, torque transmission capacity is more.
7	Frictional power loss is less.	Since it has number of friction plates instead of single, frictional power loss is more.
8	Application- Trucks, Jeeps, cars etc.	Application- Two wheelers, racing cars, some heavy duty trucks.

	c)	**What is fluid coupling? State its working principle.**	**04**
	Ans	When the crankshaft rotates, the driving member or impeller also rotates. The driving member is filled with oil and the centrifugal force causes the oil to be forced outward radially. As a result of this, the driven member or turbine is forced to rotate .Thus the engine power is transmitted from crankshaft to the transmission shaft. As the engine speed increases, the thrown out oil from the driving member strikes the driven member with greater force and tends the driven member to rotate at the same speed, becoming one unit by means of oil film which combines both the members. As the engine speed falls down, the oil film between the driving and driven members is broken away and the members are disengaged.	**02**

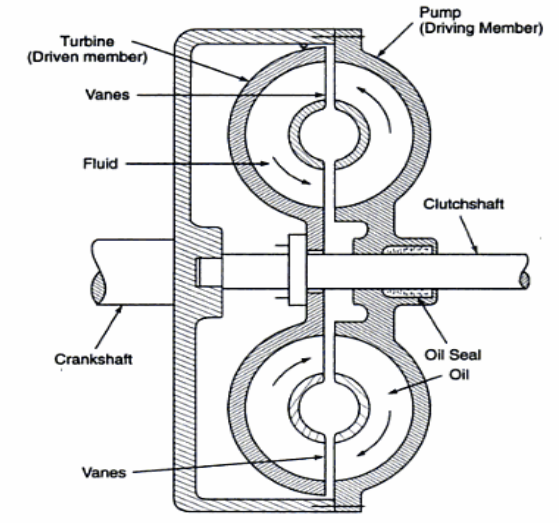

Fig. Fluid Coupling **02**

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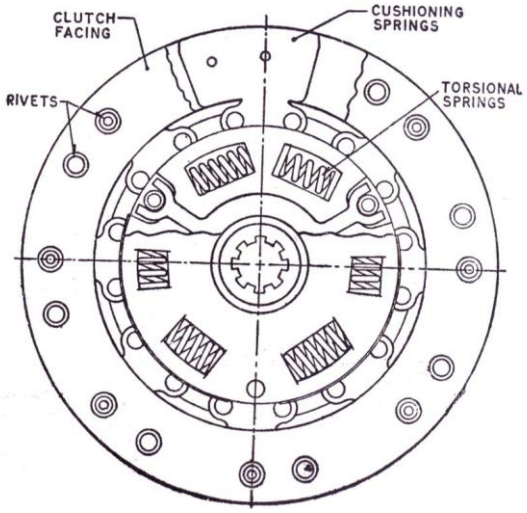
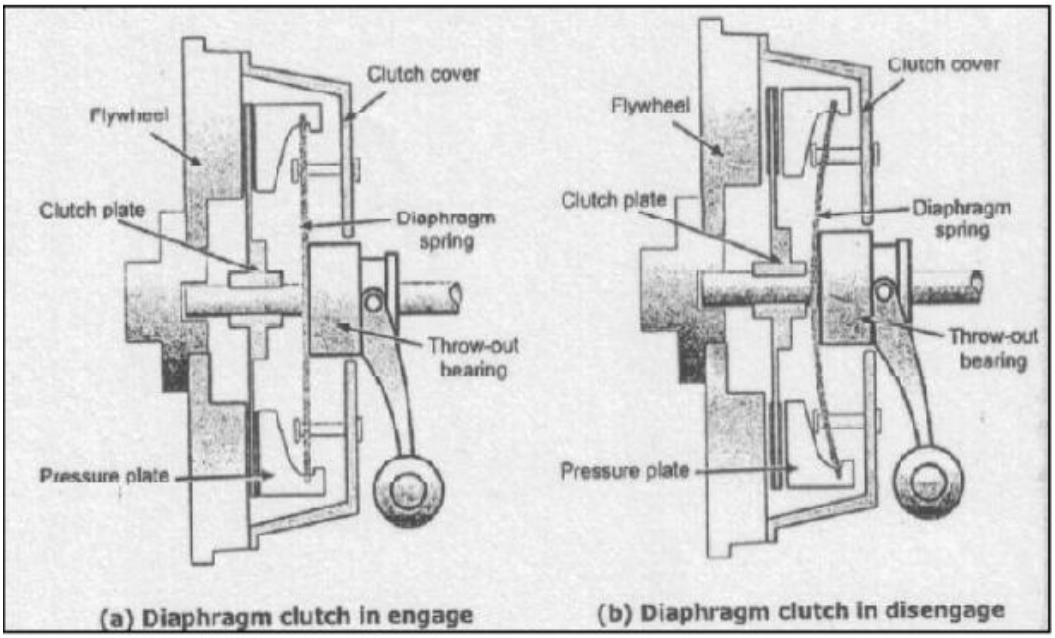
02		**Attempt any four:**	**16**
	a)	**Enlist main requirements of clutch**	**04**
	Ans	**Main requirements of clutch:** *(Any 04- 1 mark for each)* 1. It should be able to transmit maximum torque of the engine. 2. It should engage gradually to avoid sudden jerks. 3. It should be able to dissipate large amount of heat generated during clutch operation. 4. It should be dynamically balanced, particularly in the case of high speed engine clutches. 5. It should have suitable mechanism to damp vibrations and to eliminate noise produced during power transmission. 6. It should be as small as possible so that it will occupy minimum space. 7. It should be easy to operate requiring as little exertion as possible on the part of the driver. 8. It should be made as light as possible so that it will continue to rotate for any length of time after the clutch has been disengaged. 9. It must be trouble free and have longer life. 10. It must be easy to inspect, adjust and repair.	**04**
	b)	**Explain with neat sketch the construction of clutch plate**	**04**
	Ans	 **Fig: Clutch Plate** **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 is similar type of slots in each of the two plates situated on either side of the hub flange.	**02** **02**

	c)	**What are the different materials used for clutch lining? State its necessity**	**04**
	Ans	The materials for clutch lining are: *(any two materials- 1/2 mark each)* 1. Leather 2. Cork 3. Fabric 4. Asbestos 5. Reybestos and Ferodo 6. Non- asbestos clutch lining material. **Necessity of clutch lining:** *(Any 02- 1 mark each)* 1. To transmit maximum power from engine flywheel transmission without jerk 2. To dissipate the heat and able to withstand higher heat generated 3. It should have higher coefficient of friction 4. It should be cheap and easy to manufacture.	
	d)	**Explain with neat sketch the working of ' diaphragm clutch'**	**04**
	Ans	*(Any suitable figure and explanation shall be given due credit)*  **Working**: Clutch remains usually in engaged condition. It is required to depress clutch pedal to disengage the clutch. When a driver or an operator drives a vehicle he is required to engage clutch by depressing clutch pedal. As driver depresses the clutch pedal, effort applied gets transmitted either through level or cable to clutch release fork. The fork pushes clutch release bearing towards engine side due to which clutch release levels shown in figure get displaced getting pressure plate in backward direction. This action creates clearance between drive and driven members resulting disengagement of clutch. As the driver leaves clutch pedal it returns to its original position due to which pressure plate put thrust on clutch plate from one side and flywheel on the another. This is how clutch gets engaged.	**02** **02**

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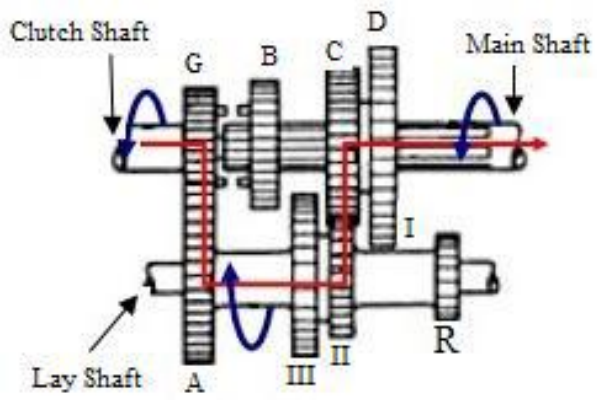
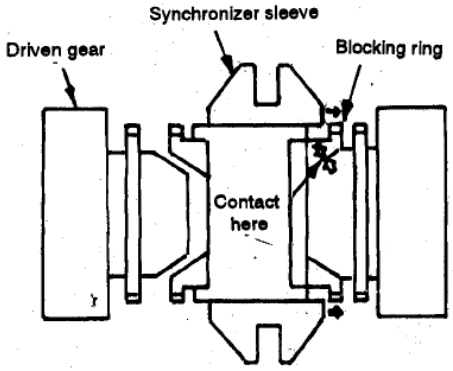
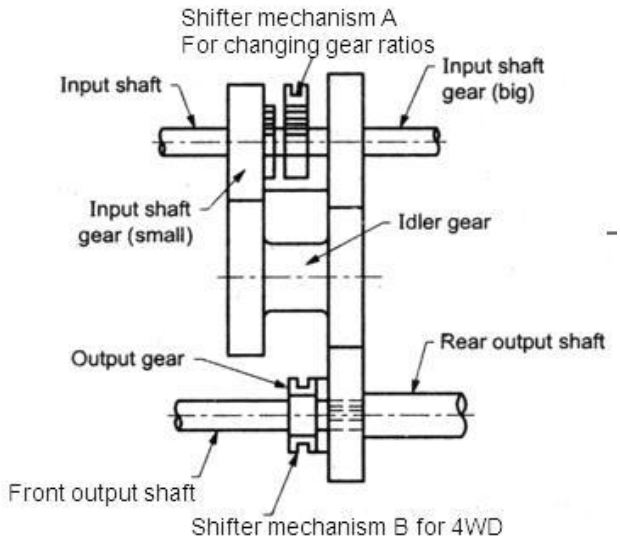
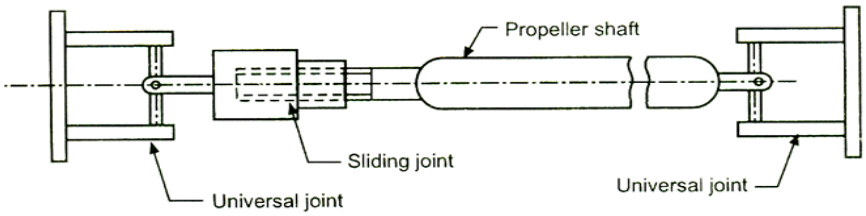
	e)	**What is 'variator drive'? State its two applications in which variator drive is used.**	**04**
	Ans	It is an automatic transmission that can change seamlessly through a continuous range of effective gear ratios. This contrasts with other mechanical transmissions that offer a fixed number of gear ratios. When the two cones of the pulley are far apart (when the diameter increases), the belt rides lower in the groove, and the radius of the belt loop going around the pulley gets smaller. When the cones are close together (when the diameter decreases), the belt rides higher in the groove, and the radius of the belt loop going around the pulley gets larger. CVTs may use hydraulic pressure, centrifugal force or spring tension to create the force necessary to adjust the pulley halves. **Applications in which variator drive is used** *(Any 02):* All mopeds like Honda Activa, Hero pleasure, TVS scooty, all snowmobiles, utility vehicles, golf carts, small tractor etc	**02** **02**
	f)	**State the classification of Automobile gear box**	**04**
	Ans	*(Any suitable classification shall be given due credit)* **Type of Gear Boxes:** 1. Sliding mesh gear box 2. Constant mesh gear box 3. Synchromesh gear box. 4. Epicyclic / automatic gear box.	**04**
03		**Attempt any four:**	**16**
	a)	**Explain with power flow diagram of sliding mesh gearbox.**	**04**
	Ans	 G: Clutch gear, A: Countershaft Gear, B: Top gear/third gear, C: Second gear, D: First gear, I, II, III, R: - counter shaft First, Second, Third, and Reverse gear. **Figure:** Power flow when sliding mesh gear box 1. 1st gear: - When gear 'C' on main shaft slide towards left side & mesh with 'II' gear on lay shaft then 1st gear ratio 3:1 obtain. 2. 2nd Gear:-When gear 'B' on main shaft slide towards right side & mesh with 'III' gear on lay shaft then 2nd gear ratio 2:1 obtain. 3. 3rd Gear: - When gear 'B' on main shaft slide towards left side & mesh with 'G' clutch shaft then 3rd gear ratio 1:1 obtain. 4. Reverse Gear: - When gear 'D' on main shaft slide towards right side & mesh with 'R' reverse gear on lay shaft then reverse gear ratio 3:1 obtain.	**02** **02**

	b)	**How lubrication of gearboxes is carried out? Explain any one method in brief.**	**04**
	Ans	*(Any suitable answer shall be given due credit)* **lubrication points of gear box carried out as below:-** 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. **Splash Lubrication**: (*any suitable type of method is applicable)* Splash lubrication is the normal method for lubricating spur, helical, bevel and worm gears. The gears simply dip into a bath of oil as the rotate. Splash lubrication needs at least 3 m/s tangential speed gear speed to be effective. It is important that provisions are made to ensure the teeth are not immersed in the bath such that excessive losses result from the oil being churned up. The oil level should be monitored under static and dynamic conditions to ensure it is correct for the application.	**02** **02**
	c)	**Explain with sketch the construction of 'Synchronizer' used in synchromesh gearbox.**	**04**
	Ans	**Construction of synchronizer-** 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 gears are revolving. 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.  **Fig. Synchronizer**	**02** **02**
	d)	**What is 'transfer case'? Explain its working with neat sketch.**	**04**
	Ans	**Transfer case:** Transfer case also called as a transfer box or an auxiliary gear box is used in four wheel drive Vehicle. 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. It also enables to drive the vehicle in high gear or low gear whenever required. **Working:**	**01**

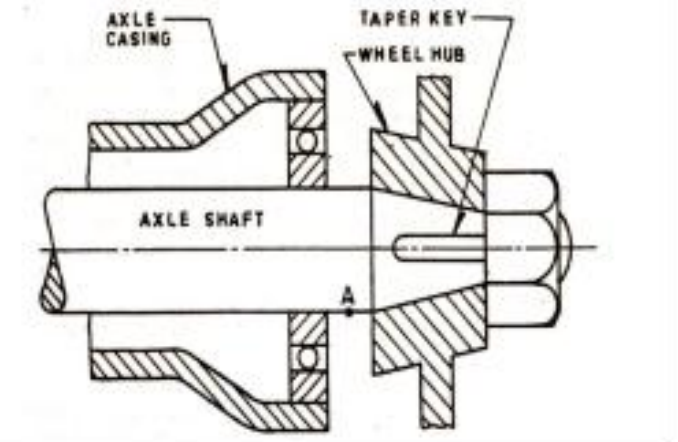
		When the shifter-A is at the central position as shown in fig. here neither the gear G1and nor the gear G2 is connected to the input shaft, it is known as neutral position. When the shifter-A connects the input shaft with big input gear G2, and the shifter-B disconnects the front output shaft from the 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  **Fig: Transfer case**	**01** **02**
	e)	**State the advantages & disadvantages of 'torque converter'**	**04**
	Ans	**Advantages:** *(Any 2)* **1.** It multiplies the torque of the engine by two or three times **2.** It serves the purpose of gear box in better way by providing torque variation in infinite number of ways **3.** Torque output variation is continuous **Disadvantages:** *(Any 2)* **1.** Efficiency of torque convertor is high only within narrow limits of sped **2.** There is chances of cavitation	
	f)	**Explain the construction features of propeller shaft with sketch.**	**04**
	Ans	**Construction Propeller shaft**:	**02**

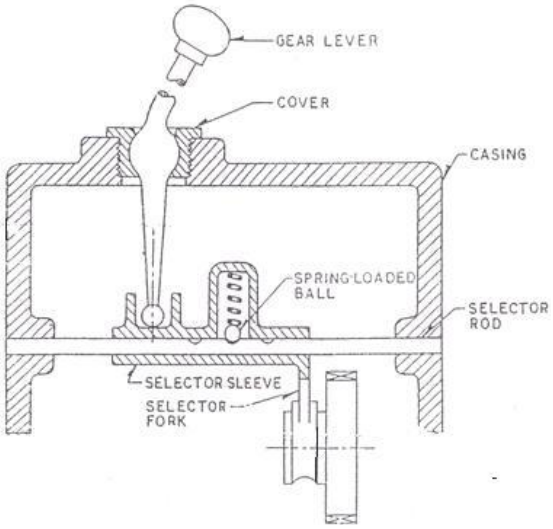


It consists mainly of three parts:

1. **Shaft:** - As the shaft has to withstand mainly torsional loads, it is usually made of tubular cross-section. The shaft has to be well balanced to avoid whirling at high speeds. Shaft is made of steel, aluminum or composite materials
2. **Universal joints**: Depending upon the type of the rear axle one or two universal joints is used. The universal joints account for the up and down movements of the rear axle when the vehicle is running.
3. **Slip joint**: - Depending upon the type of the drive, one slip joint may be there in shaft. This serves to adjust the length of the propeller shaft when demanded by the rear axle movement. Slip joint is formed by the internal splines on the sleeve attached to the left universal joint and external splines on the propeller shaft as shown in figure

02

04		**Attempt any four:**	**16**
	a)	**Explain with neat sketch semi floating rear axle.**	**04**
	Ans	 Fig:- **Semi floating type**	**02**
		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	**02**

		support below the axle casing	
	b)	**Enlist loads acting on the rear axle**	**04**
	Ans	**Loads acting on the rear axle (any 4)** 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	
	c)	**Enlist with neat sketch the construction of gear shifting mechanism.**	**04**
	Ans	 **Fig. Gear selector mechanism with gear lever on the top of gear box** **OR**	**02**

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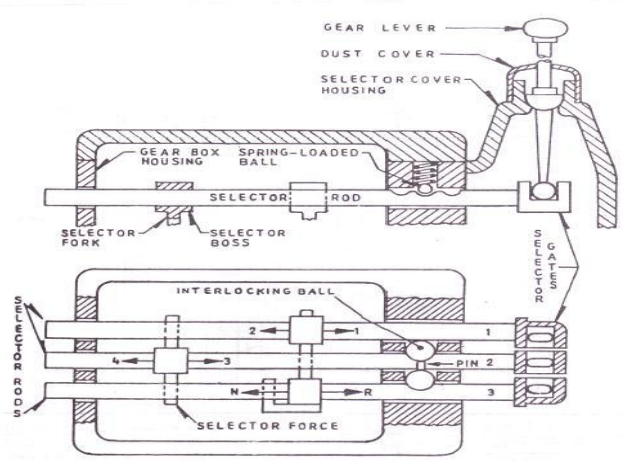
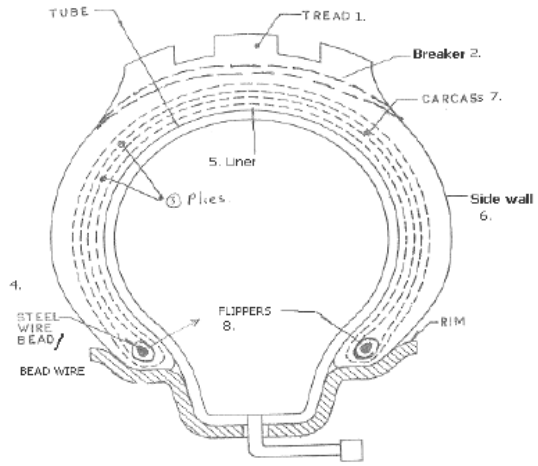
		 **Fig. Gear selector mechanism with gear lever on the top of gear box** **Construction: -** A typical mechanism for a 4-forward speeds and reverse gear box where the gear lever is ball mounted in the gear box cover. This facilitates its movement in any direction. The lower end of gear lever fits into 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.	**02**
	d)	**State the function of universal joint & slip Joint.**	**04**
	Ans	Answer: **1)Function of universal joint:** 1. 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. 2. 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 joint** 1. 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. 2. If there is no slip joint, the propeller shaft will buckle or brake.	**02** **02**
	e)	**What are the advantages & disadvantages of 'spoke wheel'?**	**04**
	Ans	**Advantages:-** *(Any 2)*	

		1. Wire wheels are light in weight. 2. Wire wheel provide better cooling of brake drum. 3. They have high strength 4. They have better changeability as one nut is required to mounting & dismounting of wheels **Disadvantages:-** *(Any 2)* 1. Tubeless tyre cannot fit on spoke wheel 2. Load caring capacity is less 3. Balancing is difficult.	
	f)	**Enlist different types of tyres .how they are designed**	**04**
	Ans	*(Any suitable answer shall be given due credit) types 01 mark & any one design aspects 03 marks* **Types of tyres: A) Tube tyre b) Tubeless tyre** **A) tube type tyre construction**  Fig:- tube type tyre **Design Aspect of tube type tyre:-** This type of tyre need separate tube, the air under pressure is filled in the tube enclosed inside tyre & rim . 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 **B)Tubeless Tyre**	

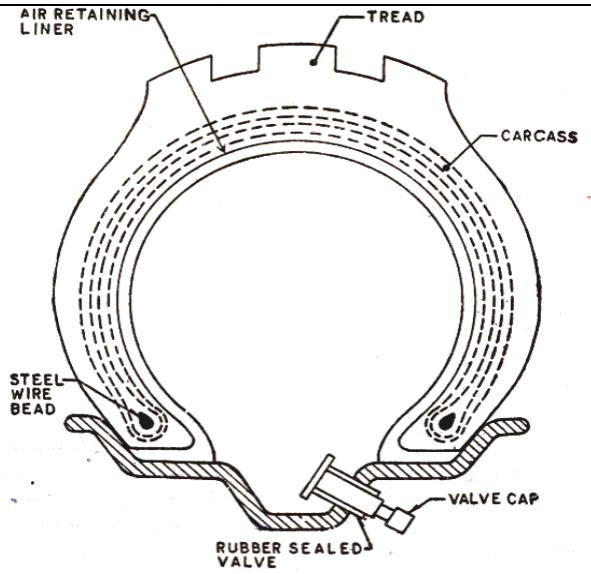
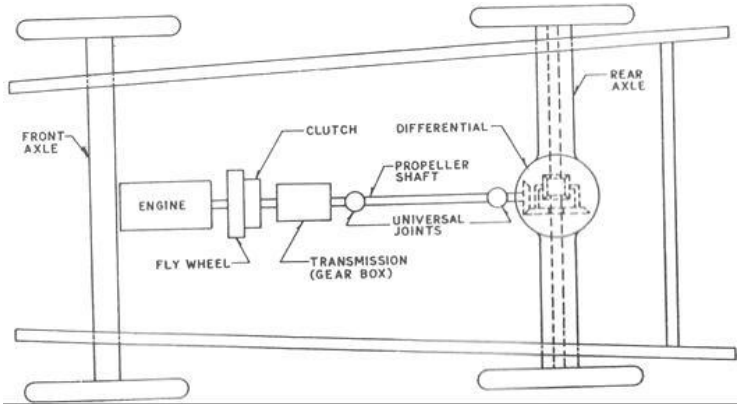


Fig:- tubeless tyre

Design Aspect of tubeless tyre:-

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. 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.

05		**Attempt any two:**	**16**
	a)	**Explain with the sketch the layout of chassis frame indicating the functions of main components with their locations.**	**08**
	Ans	**The main components are:** (Function ½, location ½) (Any 04- 04 marks) *(Note: Location may change due to type of layout considered, due credit shall be given to suitable answer)* 1. **The engine:** **Function:** It provides the motive power for all various functions which the vehicle or any part of it, may be required to perform. **Location**: at the front 2. **The Transmission system:** It consists of a clutch, a gearbox, a propeller shaft and differential. **Function:** To engaged or disengaged the power from engine to transmission system, to transmit the torque and to distribute the final torque equally between the driving wheels. **Location:** after engine	

		3. **The auxiliaries:** It consists of electrical systems. **Function:** To provide spark for ignition of charge, to start the engine by providing initial motive force, to provide electrical energy for lighting system. **Location:** charging system mounted on engine and lightening system on body 4. **The controls:** It consist of steering system and brakes **Function:** to control direction of moving vehicle, to steer the vehicle according to drivers will. **Location:** Steering on front wheel and brakes on all wheels. 5. **The body:** **Function:** To provide space for passenger and luggage. **Location:** on frame  **Figure: vehicle layout of front engine rear wheel drive**	***04 marks***
	b)	**Distinguish between torque tube drive and Hotchkiss drive.**	**08**

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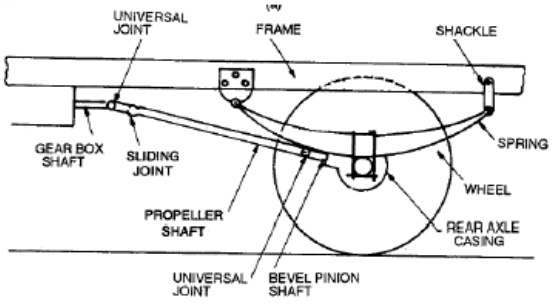
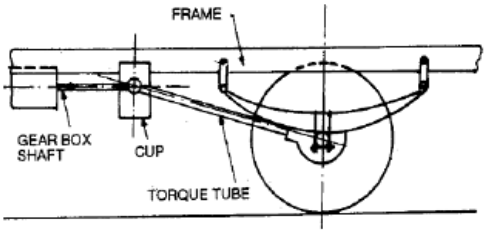
Ans

Hotchkiss Drive	Torque Tube Drive
1) 	1) 
2) Open type propeller shaft is used.	2) Propeller shaft is housed in a tube called torque tube.
3) Two universal joints is used one at front & second at rear end of the propeller shaft.	3) Only one universal joint is used at the front end of the propeller shaft.
4) Slip joint is used to accommodate change in length.	4) No slip joint is used.
5) Torque reaction, driving thrust, side thrust, weight of the body & braking torque all are taken by leaf spring.	5) Weight of the body & side thrust are taken by leaf spring. Torque reaction, driving thrust, braking torque are taken by the torque tube.
6) Leaf spring is shackled at the rear and bracketed at front end.	6) Both end of the leaf spring are shackled.
7) The centre axis of propeller shaft and bevel pinion shaft is not coinciding when axle moves up and down.	7) Axis of propeller shaft and bevel pinion shaft coincide always.
8) It is used in heavy vehicles like bus, truck.	8) It is used in light vehicles like cars.

08(Any 08)

c) Enlist different types of rear axle casing? Explain the construction of any one with sketch. **08**

Ans

Types of rear axle casing: ***(Types-2 mark, Explanation of any one-02 marks and sketch- 04marks)***

1. Banjo or separate carrier type (or one piece) casing
2. Split (or two piece) casing
3. Salisbury or Integral Carrier type casing

1) **Banjo type (or one piece) casing**: It is named so, because its shape likes 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.

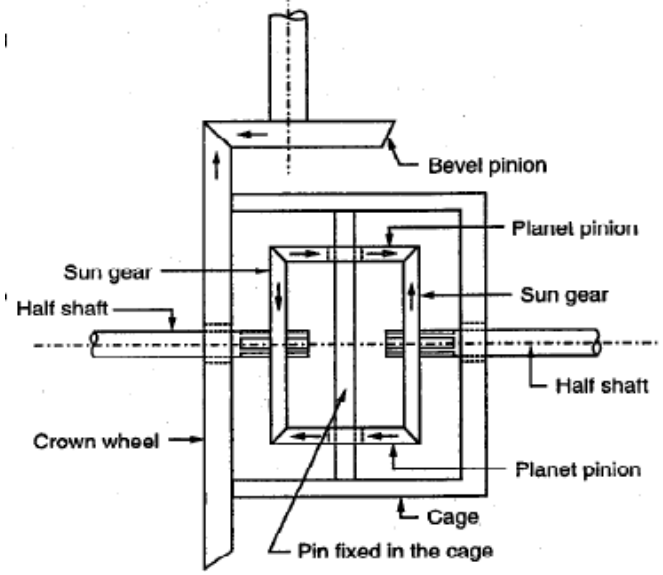
Figure: Banjo type Casing

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.

Figure: Split type casing

OR

3) Salisbury or Integral carrier type: This is similar in construction to the banjo type except that in this the carrier i.e. differential housing has permanent housing tubes pressed and welded in its sides. According SAE nomenclature, it is called the unitized carrier housing

06		**Attempt any two:**	**16**
	a)	**Explain the working of 'differential' with neat sketch**	**08**
	Ans	**Working of differential:** 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. Both the road wheels turn at the same speed. 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 other 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.	**04**
			**04**
		Fig:- Construction of differential	
	b)	**What is 'Tyre terminology'? Explain with sketch indicating all components of tyre.**	**08**
	Ans	**Tyre Terminology: (Any four terms- 04 marks, Sketch -04 marks)**	

1. Tread: That portion of a tire that comes into contact with the road. It is
Distinguished by the design of its ribs and grooves. Provides traction in a variety of conditions, withstands high forces, and resists wear, abrasion, and heat.
2. Tread Depth: The depth of usable tread rubber, the distance from the top of the tread to the grooves in a tire. The measurement is taken at the center line of a tire.
3. Tire Size: The combination of tire width, construction type, aspect ratio, and rim size used in differentiating tires.
4. Sidewall: That portion of a tire between the tread and the bead. Protects the tire against impacts with curbs, etc. This is also where the sidewall markings can be found which tell you important information regarding the tire
5. Section height: The height of a tire, measured from its rim to its outer tread.
6. Section width: The distance between the outside of a tire's sidewalls, not including any lettering or designs.
7. Ribs: A pattern of tread features aligned around the circumference of a tire. There are usually multiple ribs across the tread area of a tire.
8. Carcass: The supporting structure of the tire consisting of plies anchored to the bead on one side and running in a radius to the other side and anchoring to the bead.
9. Bead: The part of the tire that sits on the wheel made of steel wires, reinforced by body ply cords, shaped to hold firmly the tire against the wheel rim.
10. Aspect Ratio: The relationship of a tire's sidewall height to its section width. In a tire size designation, it is 65 in "195/65R15". It is also referred to as the tire's profile or the series.
11. Load Index: Is a number that corresponds to the maximum load in kilograms that a tyre can support when properly inflated.

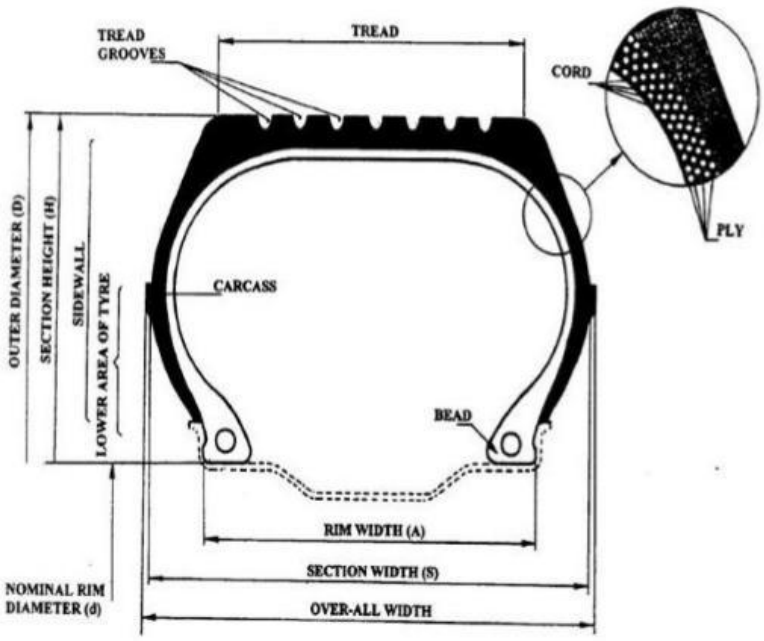
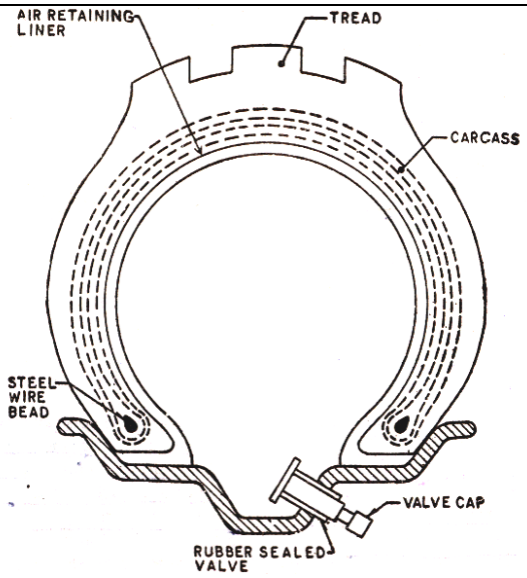


Figure: Tyre Terminology

	c)	**Explain with neat sketch the construction of tubeless tyre? State the advantages of tubeless tyre.**	**08**

	Ans	 **Figure-Construction of tubeless tyre** 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. 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. **Advantages of tubeless tyre:** **1.** Better Safety - less chances of accidents due to sudden air leakage **2.** Better fuel efficiency **3.** Less chance of damage in case of flat running **4.** Better heat dissipation **5.** Cost saving on tube **6.** No tube related problems **7.** Less balance weight required due to tube	**04** **02** **02 (Any 02)**