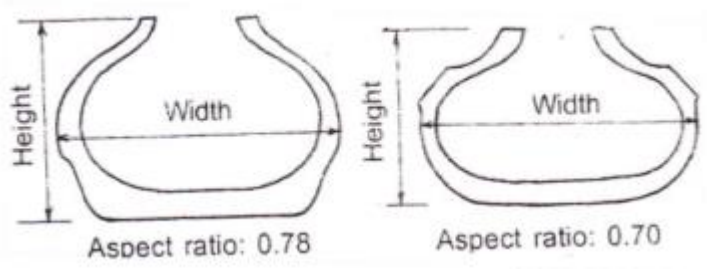
WINTER – 19 EXAMINATION

Subject Name: Automobile Transmission System **Model Answer** Subject Code: **22309**

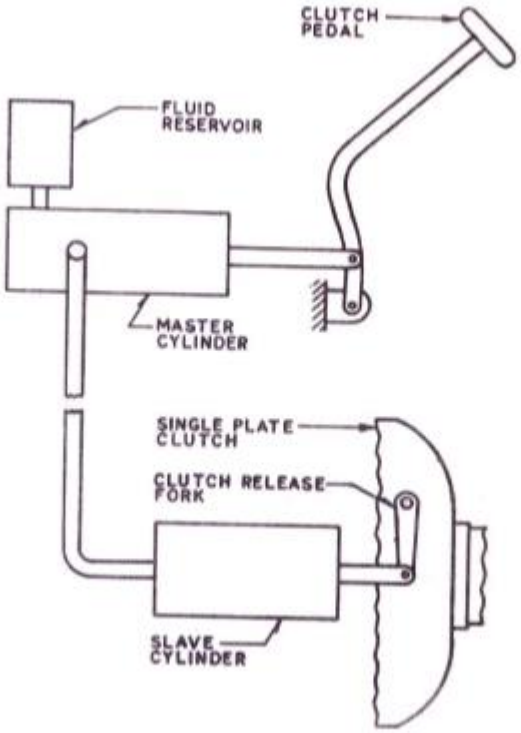
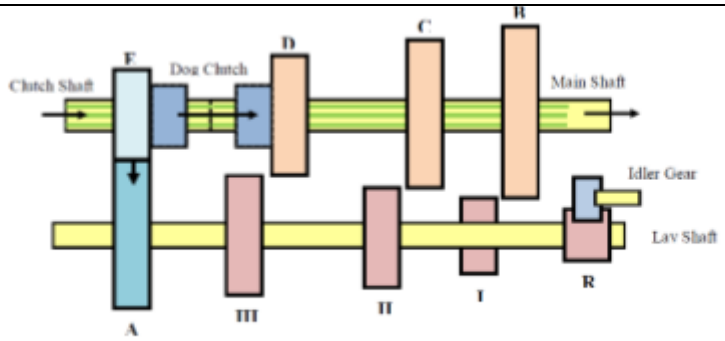
Important Instructions to examiners:

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
1.		**Attempt any FIVE of the following.**	10
	a)	**List any four functions of frame.**	02
		Function of the Frame 1. To support the body and chassis components such as engine, gear box, axles, suspension system, braking system etc. 2. To withstand different types of loads acting on it 3. To withstand torsional vibration caused by vehicle movement. 4. To withstand the centrifugal force caused by cornering of vehicle.	01 mark each
	b)	**State the types of cross members used in conventional type chassis frame.**	02
		1. Ladder type frame 2. X-type frame 3. Off set frame **4.** Perimeter frame	02
	c)	**State the necessity of clutch in automobile.**	02
		Necessity of clutch: Clutch is a device, which engage and disengage the engine power to the transmission system. It transmits the rotary motion of the engine to the transmission whenever required. It is located between engine flywheel and the gearbox and mounted on the clutch shaft i.e. transmission input shaft. Clutch provides a means for gradual engagement and disengagement to transmit power and torque smoothly and without jerk.	02
	d)	**State the principle of operation of the gear box in terms of Torque, speed and diameter of the gear.**	02

		In a gear box, the counter shaft is mashed to the clutch with a use of a couple of gear. So the counter shaft is always in running condition. When the counter shaft is bring in contact with the main shaft by use of meshing gears, the main shaft start to rotate according to the gear ratio. When want to change the gear ratio, simply press the clutch pedal which disconnect the counter shaft with engine and change connect the main shaft with counter shaft by another gear ratio by use of gearshift lever. In a gear box, the gear teeth and other moving metal must not touch. They must be continuously separated by a thin film of lubricant. This prevents excessive wear and early failure. Therefore a gearbox runs partially filled with lubricant oil.	**02**
	e)	**State the functions of slip joint in propeller shaft.**	**02**
		Function of Slip Joint- It is provided at the gearbox end, this joint allows variation in length of the propeller shaft	**02**
	f)	**State the loads acting on the rear axle.**	**02**
		1. Shearing force due to vehicle weight 2. Bending moment due to offset of vehicle load and road reaction 3. Side thrust during cornering. 4. Bending moment due to Side thrust and support reaction. 5. Driving torque and torque reaction.	**02**
	g)	**Define aspect ratio for tyre.**	**02**
		 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. Low profile tyres have lower profile/aspect ratio numbers.	**02**
2.		**Attempt any THREE of the following:**	**12**
	a)	**Differentiate between conventional and integral type chassis frame. (Any four points)**	**04**
			Any four points 1 mark

Sr.No.	Conventional frame	Integral frame
1	There are two heavy side members and cross members welded, bolted or riveted to the superstructure.	Light side members are used.
2	Ground clearance is more.	Ground clearance is less

		3	Higher centre of gravity.	Low center of gravity	**each**
		4	Heavier in construction.	Lighter in construction.	
		5	When the vehicle is met with accident the frame cannot be taken easily to replace the damaged chassis frame.	In case of accident it becomes difficult to repair.	
		6	Used in heavy vehicles like trucks and buses.	Used for light vehicle and mostly for cars.	
	b)	**Draw a neat sketch of hydraulically operated clutch and label all parts.**			**04**
		 **Fig: Hydraulically operated clutch.**			**04**
	c)	**Draw the power flow diagram for a 3 forward and reverse speed of sliding mesh gear box and describe the power flow in second gear condition.**			**04**
		 **Figure: Fourth or Top or Direct Gear Position**			

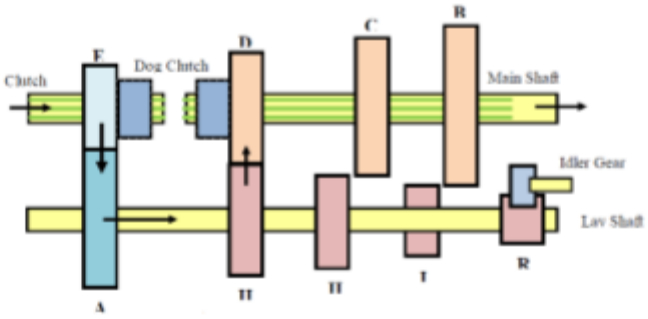


Figure: Third Gear Position

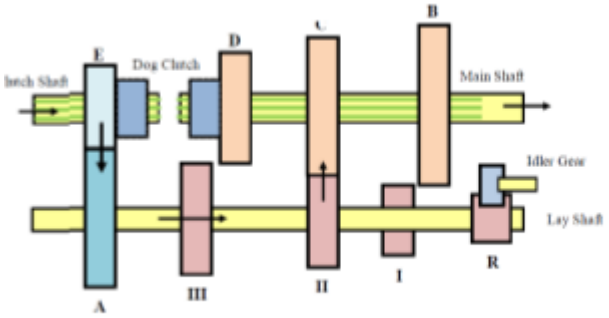


Figure: Second Gear Position

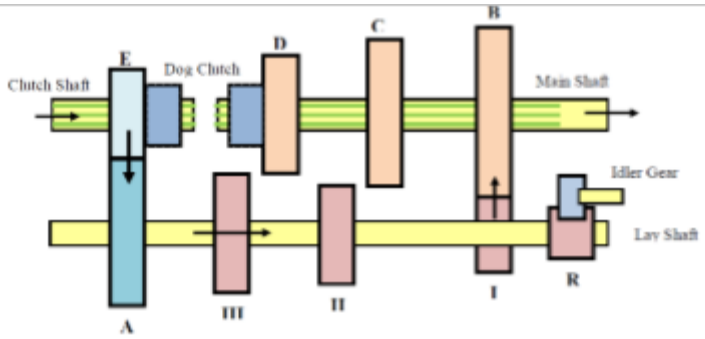


Figure: First Gear Position

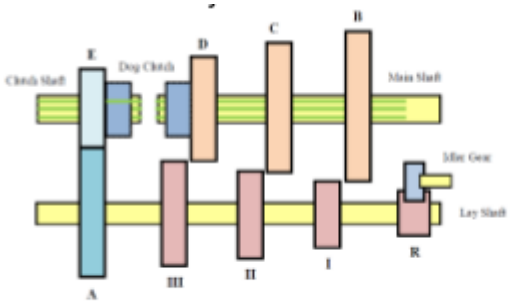


Figure: Neutral Gear Position

03 mark for diagram 1 mark for explanation

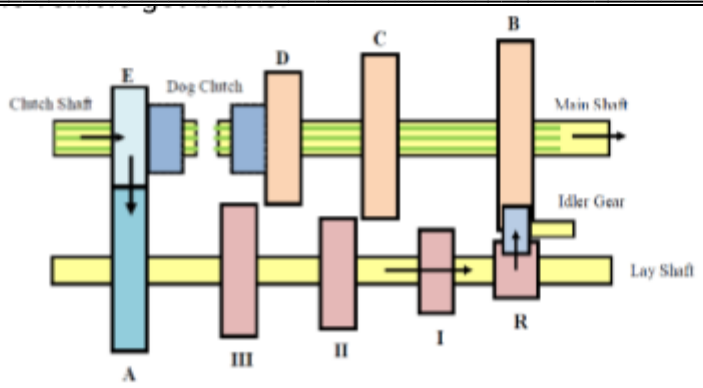


Figure: Reverse Gear Position

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

d) Differentiate between Hotchkiss drive and torque tube drive in automobile(Any 4 points) — **04**

Answer: **Comparison of Hotchkiss drive and Torque tube drive:** *(Any four points - 4 marks)*

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

01 mark each any 4 points

3 Attempt any THREE of the following: — **12**

a) State the loads acting on a frame. — **04**

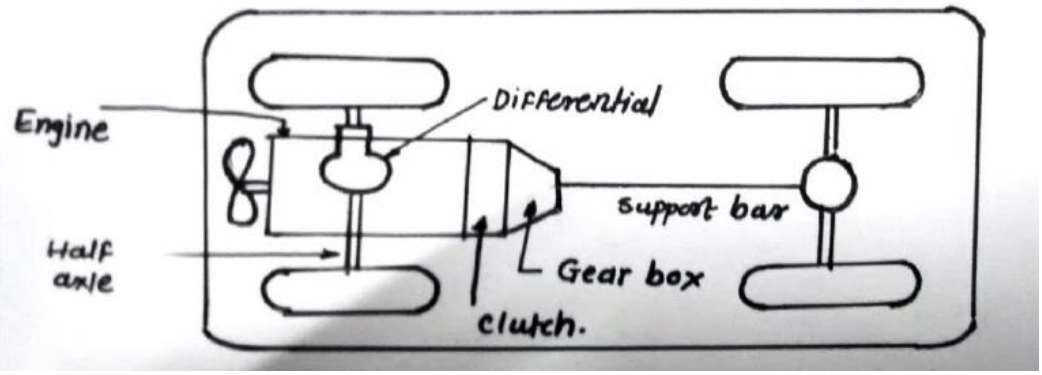
Answer:

Loads acting on a Frame: (Any four)

a) Static loads: The loads due to the chassis parts like engine, transmission, steering system, body, fuel tank etc. and passengers are acting on the frame which causes vertical bending of side members.

b) Inertia loads: Inertia loads of short duration are acting on the vehicle while application of braking torque and engine torque. This results into bending of side members in the vertical plane**.**

c) Impact loads: When a vehicle or wheel collides with any other object on the road or

		road obstacle, it is subjected to externally applied impact load. Impact load may distort the frame to parallelogram shape. **d) Short Duration load**: While crossing a broken patch of a road, a vehicle is acted upon by heavy and suddenly applied loads of short duration. **e) Momentary duration (combined) loads:** While negotiating curves, applying brakes and striking a pot hole, a vehicle is acted upon by combined loads of momentary duration. **f) Overloads**: Overloading a vehicle beyond its designed capacity.	**01 mark each**
	b)	**Draw a neat layout of front engine front wheel drive and label it.**	**04**
		 **Figure: Front Engine Front Wheel Drive**	**04**
	c)	**State the location and function of Torsion damper spring and pressure spring in a single plate dry disc clutch.**	
		Torsion damper spring: **Location:** They are small coil springs located between the clutch disc splined hub and the friction disc assembly. **Function:** These springs provides a flexible torsional connection between the centre hub flange and side plates which are riveted to main clutch plate. **Pressure Spring:** **Location:** These are helical springs located between clutch cover and pressure plate in clutch **assembly.** **Function:** When your foot is off the pedal, the springs push the pressure plate against the clutch disc, which in turn presses against the flywheel. This locks the engine to the transmission input shaft, causing them to spin at the same speed.	

	d)	**Describe the necessity of Gear box in Automobile.**	**04**
		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.	**04**
4.		**Attempt any THREE of the following:**	
	a)	**Distinguish between single plate and multiplate clutch. (Any 4 poins)**	**04**
		Distinguish between Single Plate clutch and Mult-plate clutch	**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.

	b)	**Describe working of centrifugal clutch with neat sketch.**	**04**
		Centrifugal clutch- (Sketch –02 marks, suitable explanation – 02 marks) **Working of Centrifugal Clutch:** Centrifugal clutch works on the principle of centrifugal force. When the engine is started, the speed of the driving shaft is less, so the centrifugal force is also less. Therefore, shoes (flyweights) do not move outwards and torque is not transmitted to the rear wheel. As the speed of engine increases, the centrifugal force also increases. At certain engine speed, the shoes fly off outwards due to increased centrifugal force and they come in contact with the driven member. Now both the driving and driven members rotate together and the clutch is said to be engaged. Thus the engine torque is transmitted to the rear wheel. When the engine speed decreases, the centrifugal force also decreases. Now the shoes return back to their original position due to spring force which results in a disengagement of the clutch and torque is not transmitted to rear wheel.	**02**

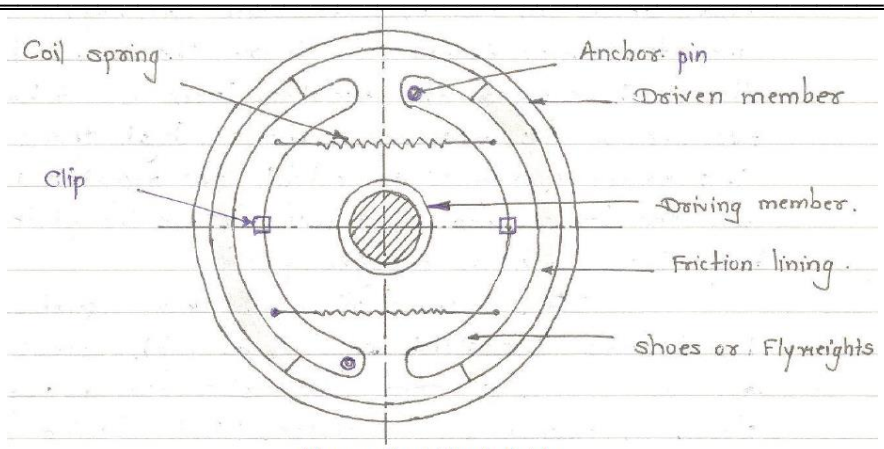


Figure- Centrifugal clutch

02

OR

Working of centrifugal clutch:-

Fig. Shows schematic arrangement of centrifugal clutch. As the speed increases the weight A flies, therefore operating the bell crank lever B which presses the plate C. This force is transmitted to the plate D by means of springs E. The plate D containing friction lining is thus pressed against the flywheel F therefore engaging the clutch. Spring G serves to keep the clutch disengaged at low speed. The stop H limits the amount of centrifugal force.

02

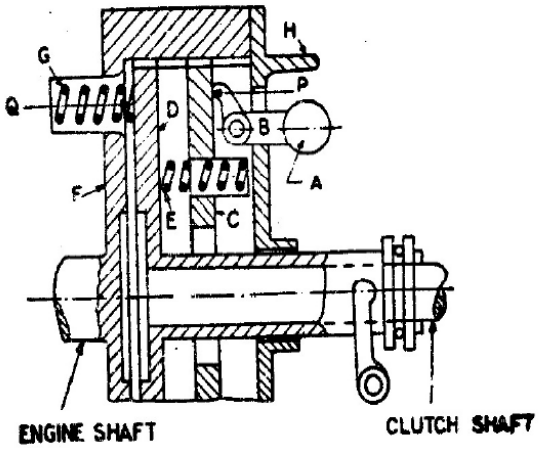
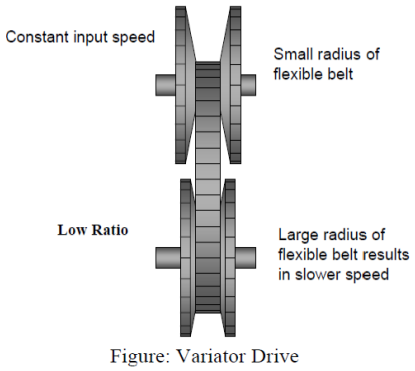


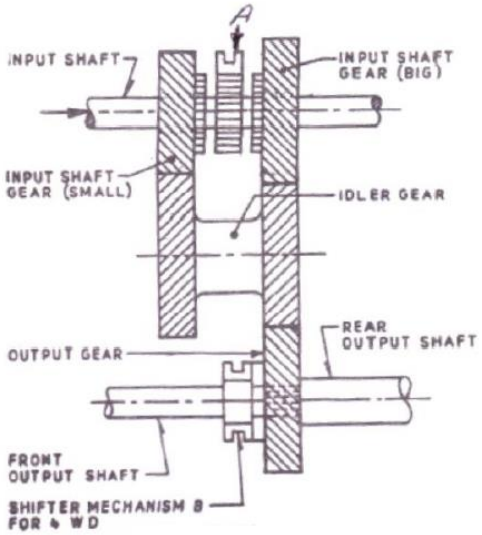
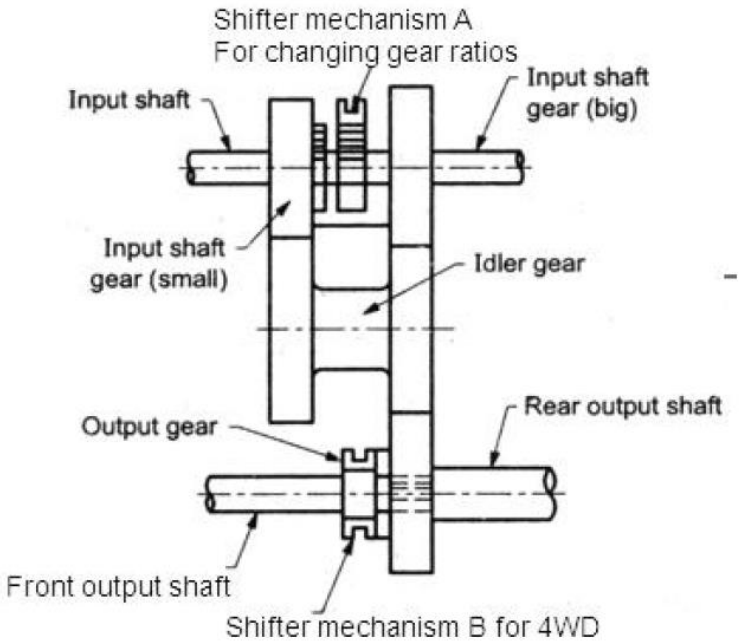
Figure-Centrifugal Clutch

A-Weight, B- Bell crank lever, C &D – Plates, E-Springs, F-Flywheel, G-Spring, H-Stop

02

	c)	**State wherein the following clutch is used in Automobiles:** **1. Multiplate wet Clutch** **2. Diaphragm Clutch** **3. Centrifugal Clutch** **4. Fluid Coupling**	**04**
		1. Multi plate Clutch: i) Multi plate wet clutch used in Two-Wheeler where space is limited. ii) It is also used in racing cars where torque transmission criteria is maximum. iii) It is used in Heavy Transport vehicles and special purpose vehicles.	**01**

		2. Diaphgram Clutch: i) It is used typically on all later model equipped manual transmission. ii) Heavy duty type requires diaphragm pressure plate to provide greater torque to minimize slippage between the clutch disc and engine flywheel. iii) The Diaphragm Clutch used in Maruti-800 car (by M/s. Maruti Udyog Limited). **3. Centrifugal clutch:** i) Used in Automatic transmission vehicles like mopeds. ii) Used in semi-automatic transmission vehicles like Cars. **4.Fluid Coupling:** i) A fluid coupling is used to transmit rotating mechanical power, providing variable speed and controlled soft start-up in machine drives, avoiding shock loading.	**01** **01** **01**
	d)	**Describe working of variator drive with neat sketch.**	**04**
		Working of Variator Drive: Vario-drive provides various drive ratios between the engine and rear wheel according to the engine speed and load. It consists of two set of split pulleys – drive and driven pulley and drive belt between the pulleys. The drive pulley is attach to the crankshaft and driven to rear wheel. The variator (drive pully) 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, centrifugal force on the weight roller is also increased. This pushes the movable drive face inward. The unit then acts with a reduced drive ratio by allowing the drive belt to run on a pulley of greater diameter. The driven pulley and clutch weights are attached over the drive shaft. The force of the driven face spring is increased, the driven pulley turns and the clutch connects automatically. The effective diameter of the drive pulley is increased. The movable face is forced outward by means of the belt until equilibrium is reached between the torque tension of the belt and force of the spring. When this occurs, the drive ratio decreases and less torque is delivered to the final reduction.  Figure: Variator Drive (Note: Equivalent credit should be given to any other suitable diagram)	**02** **02**

	e)	**Draw a neat sketch of Transfer case arrangement. Label all the parts and state the application of transfer case in Automobiles.**	**04**
		Working of transfer case: 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.	**01**
			**02**
		OR	
			

Application of Transfer case: Transfer case is used in four wheel drive vehicle along with main gearbox to transmit torque and power to the rear axle. **01**

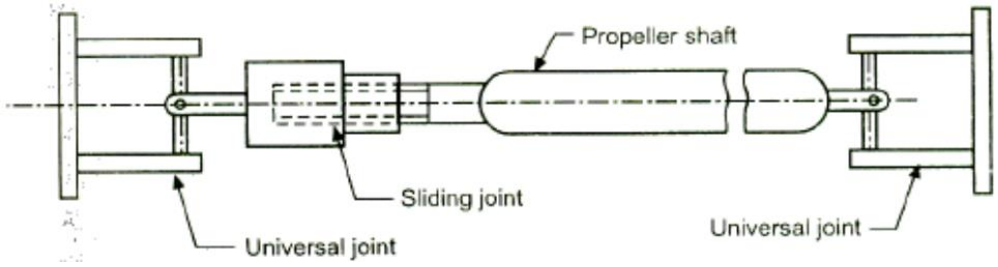
5. Attempt any TWO of the following:

a) Compare constant mesh gear box with synchromesh gear box.(Any 4) **06**

Sr No.	constant mesh gear box	synchromesh gear box
1.	It has need of double declutching .	No need of double declutching as in case of constant mesh gearbox.
2.	Problem in engagement of higher gears due to constant mesh device	Smooth engagement of higher gears due to synchromesh device.
3.	It is more noisy.	It is less noisy as helical gears are used.
4.	It has more vibration.	It has less vibration.

06

b) Draw a neat sketch of a hollow propeller shaft. Label all the parts. State the necessity of Universal joint. **06**



04

Necessity of universal joint:

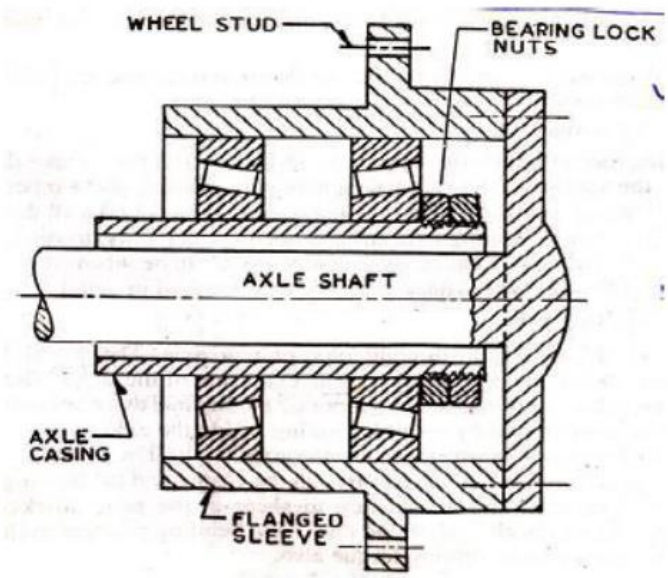
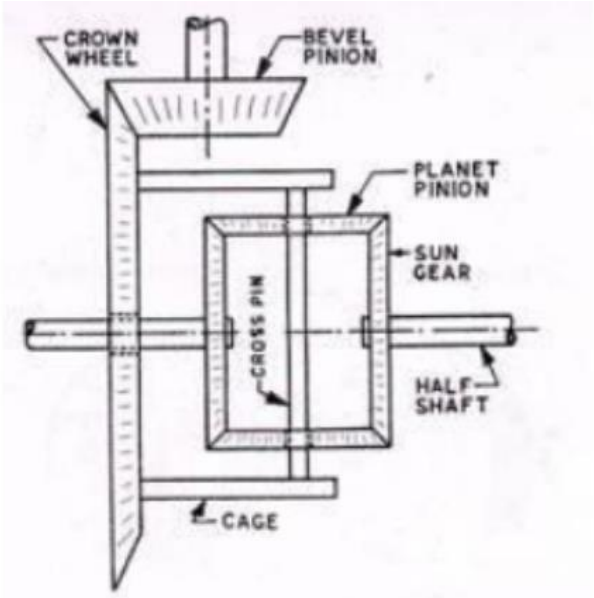
- A universal joint is used where two shafts are connected at an angle to transmit the torque.
- Universal joint is used to transmit motion at varying angles.

02

c) Draw a neat of full floating rear axle. Label all the parts. State an application of Semi floating, three quarter floating and full floating rear axle. **06**

application of
Semi floating: light motor vehicle
three quarter floating:light motor vehicle
full floating rear axle: heavy commercial vehicles

03

		 Fig: Full floating rear axle	
6.		**Attempt any TWO of the following:**	**12**
.	**a)**	**State the necessity of Differential on a vehicle. Draw a neat sketch of the Differential unit and label all the parts.**	**06**
		Need of Differential in automobile: 1) When vehicle is taking turn outer wheel will have to travel greater distance as compared to inner wheel. 2). If the vehicle has a solid rear axle only and no other device, there will be tendency to skid. 3. Hence wheel skidding is avoided by incorporating the mechanism i.e. differential. 4) Differential reduces the speed of inner wheel and increases the speed of outer wheel when vehicle is taking turn, at the same time keep the speed of rear wheel same when going straight ahead. 	**02** **04**

	b)	**State the effect of Inflation pressure on the life of the tyre. With a sketch explain tyre rotation procedure and its necessity.**	**06**
		Effects of Under-inflation: *(Any two)* 1. Uneven tread wear, more wear at tyre sides. 2. Lack of directional stability. 3. Increased rolling resistance leading to increased fuel consumption. 4. Excessive flexing of sidewall causes build up. 5. Vehicle will roll on curves. **Effects of Over-inflation:** *(Any two)* 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	**02**
		Necessity of tyre rotation: ● Tire rotation is important for tread wear and long tire life. ● Tire rotation can also result in performance advantages. ● Rotation is important because in most cases, the tires on the front axle need to accomplish very different things than the tires on the rear axle	**01**
		Tyre rotation procedure for a four wheeler: Tyre rotation is the practice of moving the wheels and tires 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, 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).	**03**

	c)	Differentiate between cross ply and radial-ply tyre. (Any 6 points)	06

Answer: (any Six, 1 mark for each)

Sr.No	Radial ply tyre	Cross ply tyre
1	Plies are running radially straight from bead to bead	Plies are running diagonally opposite from bead to bead
2	Stiffness of tyre is less	Stiffness of tyre is more
3	It gives ultimate comfort for speed more than 55 Km/hr.	Because of more stiffness tyre is less comfortable.
4	Steering is harder	Steering is easy
5	Tyre has firm grip with road	Tyre has lesser grip with road.
6	Radial ply tyre has more breaking grip	Cross ply tyre has less breaking grip
7	Parking of vehicle is difficult	Parking of vehicle is easy
8	It is costlier	It is cheaper than radial
9	Tread life is more	Tread life is less