SUMMER – 19 EXAMINATION

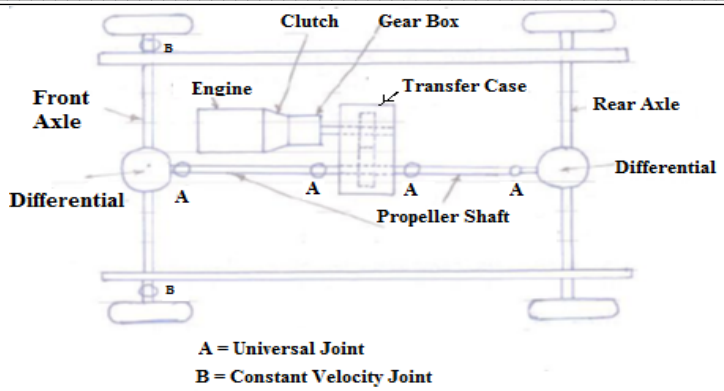
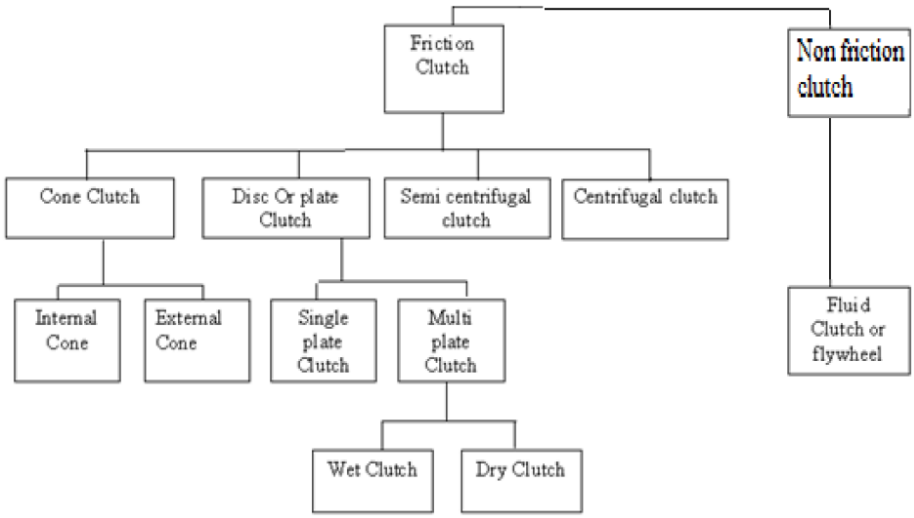
Subject Name: A T S **Model Answer** Subject Code: 22309

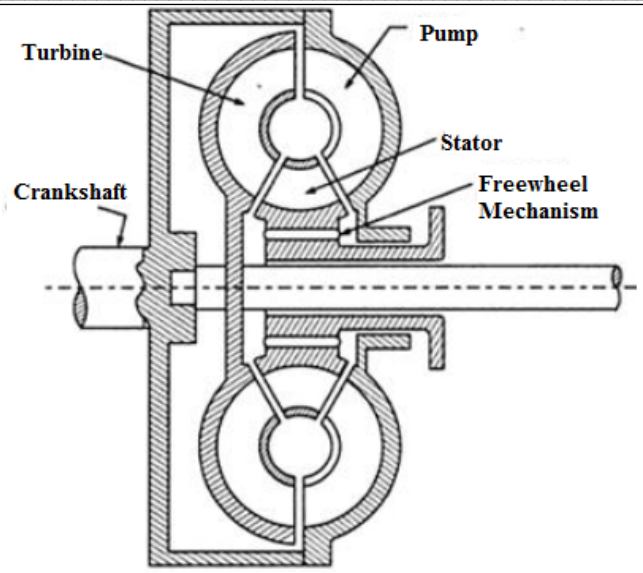
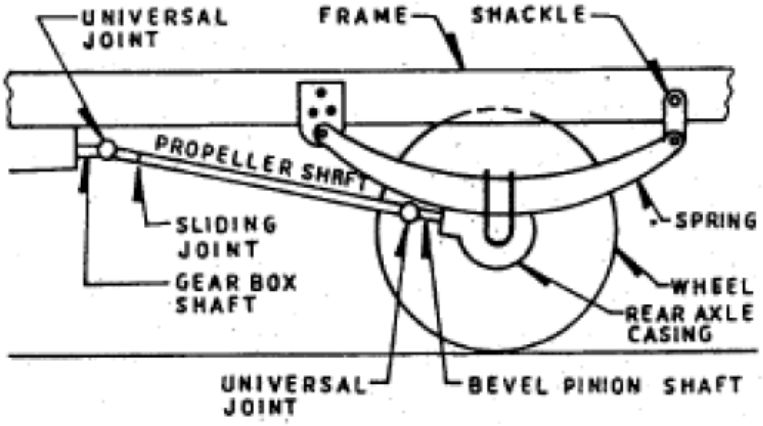
Important Instructions to examiners:

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)	**State any two advantages of FERWD vehicle.**	**02**
	Ans.	***(Any two 01 Mark each)*** **Advantages Of FERWD Vehicle:** 1. Even Weight distribution. 2. Improved Traction 3. Better Braking and handling characteristics. 4. Large luggage space is available behind rear seat. 5. Good accessibility to engine, gear box and rear axle. 6. Construction of accelerator, choke, and gear box are simple. 7. Reduces power losses from large fan.	*Any two 01 Mark each*
	(b)	**State any two functions of frame of vehicle.**	**02**
	Ans.	***(Any one 02 Marks)*** **Function of the Frame** 1. To support the body and chassis components such as engine, gear box, axles, suspension system, braking system etc. 2. To withstand different types of loads acting on it.	*Any one 02 Marks*
	(c)	**List the clutch lining materials.**	**02**
	Ans.	***(Any four materials- 1/2 mark each)*** **The materials for clutch lining are:** 1. Leather 2. Cork 3. Fabric 4. Asbestos 5. Reybestos and Ferodo 6. Non- asbestos clutch lining material.	*Any four materials 1/2 mark each*

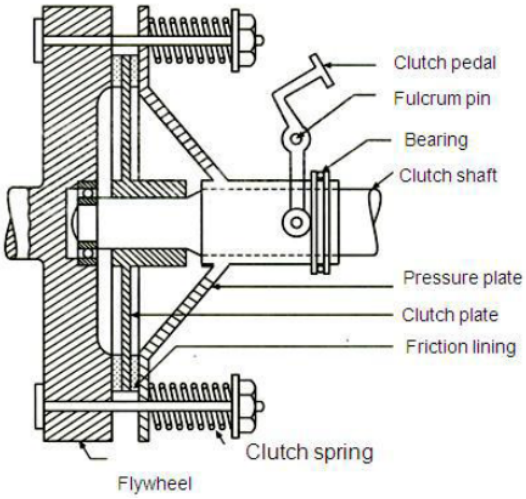
	(d)	**List the major components of automobiles gear box.**	**02**
	Ans.	***(Any four ½ Mark Each)*** 1 Clutch Shaft (Driving or I/P Shaft) 2 Counter or Lay Shaft 3 Main or Splined or Driven Shaft 4 Bigger Gear on Main Shaft 5 Medium Gear on Main Shaft 6 Smaller Gear on Main Shaft 7 Dog Clutches 8 Gear box casing or Housing 9 Filler Cap 10 Drain Plug	*Any four ½ Mark Each*
	(e)	**State the function and construction of slip joint.**	**02**
	Ans.	***(Function 01 Mark and Construction 01 Mark)*** **Function:** This serves to adjust the length of the propeller shaft when demanded by the rear axle movement. This joint allows variation in length of the propeller shaft. **Construction:** Depending upon the type of the drive, one slip joint may be there in shaft. Slip joint is formed by the internal splines on the sleeve attached to the left universal joint and external splines on the propeller shaft.	*Function 01 Mark and Construction 01 Mark*
	(f)	**State the function of differential.**	**02**
	Ans.	***(Any two 01 Mark each)*** **Function of Differential:** 1. To transmit the torque at right angle in equal proportion when vehicle moves straight ahead. 2. To differentiate the speed of road wheels while taking a turn. 3. Equal distribution of torque in all running situations.	*Any two 01 Mark Each*
	(g)	**State the effect of incorrect tyre inflation**	**02**
	Ans.	***(Any Four ½ Mark Each)*** **Effects of Under-inflation:** ***(Any Two 01 Marks)*** 1) Uneven tread wear, more wear at tyre sides. 2) Lack of directional stability. 3) Increased rolling resistance leading to increased fuel consumption. 4) Excessive flexing of sidewall causes build up. 5) Vehicle will roll on curves. **Effects of Over-inflation:** ***(Any Two 01 Marks)*** 1) Reduced tread contact area with road surface. 2) Reduced tyre grip. 3) Increased vibration resulting in uncomfortable ride. 4) Increased stresses may causes tread separation and crack in the side wall. 5) The centre of tyre will be worn rapidly.	*Any Four ½ Mark Each*
2		**Attempt any THREE of the Following**	**12**
	(a)	**Sketch the lay out of four wheel drive vehicle and label the major parts.**	**04**
	Ans.	***(Neat Labeled Sketch 04 Marks)***	*Neat Labeled Sketch 04 Marks*

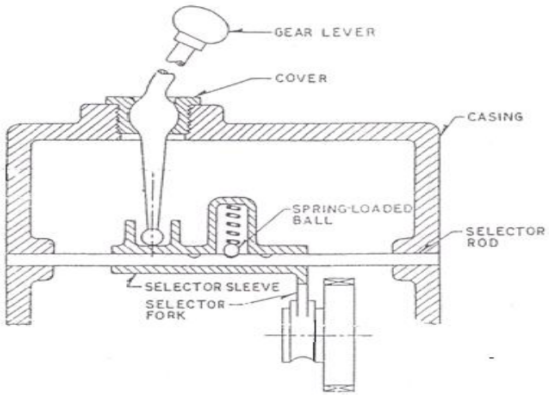
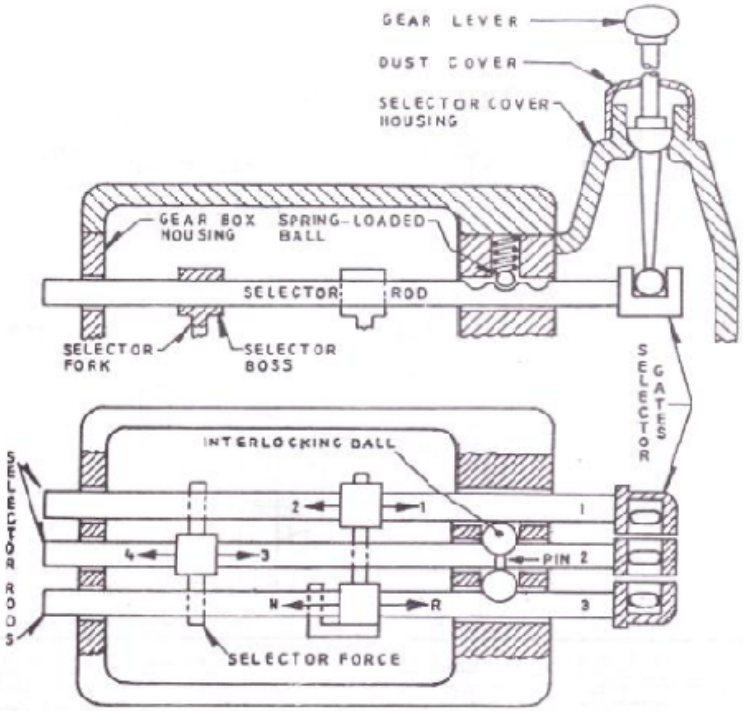
		 Figure: Layout of 4 Wheel Drive Vehicle.	
	(b)	**Classify the friction and non-friction type automotive clutches.**	**04**
	Ans.	*(Correct Answer 04 Marks)* 	*Correct Answer 04 Marks*
	(c)	**Describe the working of torque converter with sketch.**	**04**
	Ans.	*(Working 02 Marks and Labeled Sketch 02 Marks)* **Working:** Converter starts operating when the impeller starts rotating, with the engine providing the required input. The impeller creates a centrifugal pumping head or vortex flow. At the same time, the fluid must follow the rotational inertia or the effort of the impeller. These two fluid forces combine to produce a resultant force in the form of an accelerated jet stream against the turbine vanes. The impeller and turbine attempts to act as an effective fluid coupling. The turbine vanes reverse the fluid direction. The curved turbine vanes provide efficient energy transfer, but the reentry of the remaining fluid thrust back to the impeller, works against the impeller and crankshaft direction. Hence, it is necessary to introduce the stator element to make the converter work. The stator is employed between the turbine, outflow and impeller inflow to reverse the direction of the fluid and make it flow in the same direction as that of the impeller. Instead of the fluid opposing the impeller, the fluid energy now assists the impeller and crankshaft rotation. This results in boosting the rpm of the impeller. This allows the impeller to accelerate more and recycle the fluid with a greater thrust against the turbine vanes.	*Working 02 Marks and Labeled Sketch 02 Marks*

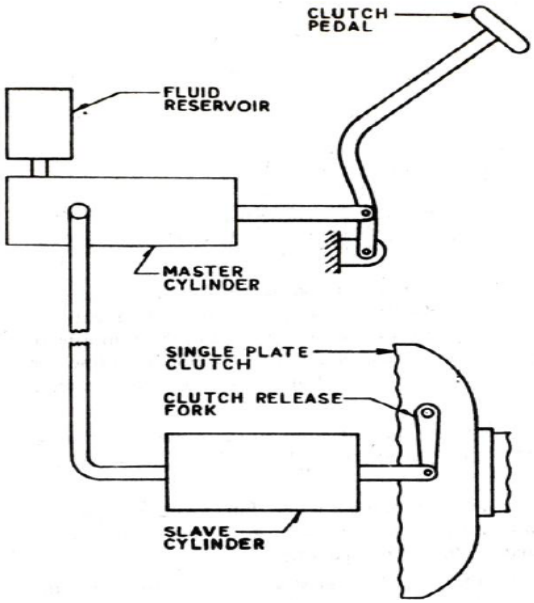
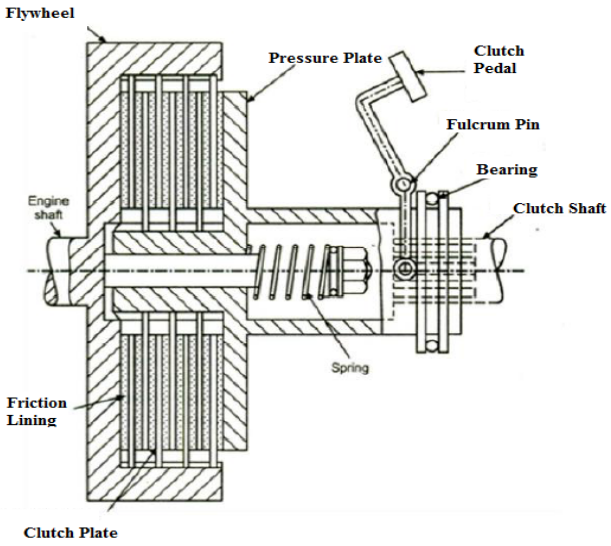
		 Figure: Torque Converter	
	(d)	Draw the neat labeled sketch of Hotchkiss drive.	04
	Ans.	*(Neat Labeled Sketch 04 Marks)*  Figure : Hotchkiss Drive	*Neat Labeled Sketch 04 Marks*
3		Attempt any THREE of the Following	12
	(a)	Classify the vehicle layout with respect to: (i) Arrangement of Engine. (ii) Application.	04
	Ans.	*(Classification w.r.to each criteria 02 Mark each)* **(i)According to Arrangement 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 **(ii) According to Application.** a) Light Motor Vehicle - e.g. Car Jeep, b) Heavy Motor Vehicle - e.g Truck, Bus, Commercial or Goods carrier vehicle c) Passenger transport vehicle - e.g. Car Jeep, Bus d) Goods transport vehicle - e.g. Truck, Commercial or Goods carrier vehicle e) Special purpose vehicles- e.g. Bulldozer, Dumper, Mobile crane, Ambulance, Milk van.	*Classification w.r.to each criteria 02 Mark each*
	(b)	Differentiate between 2WD and 4WD on the basis of the following:	04

		(i) Torque and Power Transmission. **(ii) Engine Location and Drive.** **(iii) Performance and Efficiency.** **(iv) Merits.**	
	Ans .	***(Any four pointe 01 Mark each)***	*Any four pointe 01 Mark each*

Parameter	2WD	4WD
(i)Torque and Power Transmission.	Low Torque and Power Transmission	High Torque and Power Transmission
(ii)Engine Location and Drive.	Engine Located at the centre and 2WD out of 4wheels.	Engine Located at the side and all the 4 wheels are drive wheels
(iii)Performance and Efficiency.	Low performance, High efficiency.	High performance, Low efficiency.
(iv)Merits.	1. Simple in construction. 2. Better fuel efficiency.	1. Robust & rigid in construction. 2. Provide good grip and road adhesion.

	©	**Describe with neat sketch working of single plate dry clutch.**	**04**
	Ans .	***(Sketch 03 Marks and Working 01 Mark)*** **Working:** When the clutch pedal is pressed, the pressure plate moves back against the force of springs and the clutch plate becomes free between the flywheel and the pressure plate. Thus the flywheel remains rotating as long as the engine is running and clutch shaft speed reduces slowly and finally it stops rotating, i.e. clutch is disengaged  **Figure: Single Plate Dry Clutch**	*Sketch 03 Marks and Working 01 Mark*
	(d)	**Describe with neat sketch working of gear selector mechanism mounted on the top of the gear box.**	**04**
	Ans .	***(Description 02 Marks and Labeled Sketch 02 Marks)*** **Gear Selector Mechanism Mounted on the Top of Gear Box-** A typical mechanism for a 4-forward speeds and reverse gear box where the gear lever is ball mounted in the gear box cover. This facilitates its movement in	*Description 02 Marks and Labeled*

		any direction. The lower end of gear lever fits into a slot in the selector sleeve. There are forks on the sleeves on three separate selector rods which are supported in the gear box casing. Each selector sleeve can slide on its rod, but just to avoid unwanted engagement of the gears, slots are made on the selector rods and the sleeves are provided with spring –loaded balls. These balls resist the movement of the forks until some force is applied to gear lever to overcome their resistance. In some cases the forks are fixed on the selector rods by means of pins and the assembly can slide. Grooves are provided on the gear bosses where the selector forks can fit in. Transverse motion of the gear lever selects the forks which are to be engaged and the longitudinal movements then slides the fork and its gear to engage the selected gear.  **Figure: Gear Selector Mechanism.** **OR**  **Figure: Gear Selector Mechanism.**	*Sketch 02 Marks*
4		**Attempt any THREE of the Following**	**12**
	(a)	**Describe with neat sketch working of hydraulic type clutch operating mechanism.**	**04**
	Ans	***(Description 02 Marks and Sketch 02 Marks)***	*Description*

	.	**Working of hydraulically operated clutch:** A hydraulically operated clutch mechanism is shown in the figure. The mechanism consists of master and slave cylinders. The cylinders are connected by hydraulic lines. When the clutch pedal is pressed the fluid under pressure from the master cylinder reaches the slave cylinder which is mounted on the clutch itself. The fluid under pressure actuates the slave cylinder push rod which further operates the clutch release fork to disengage the clutch. In India, this type of clutch has been used in Standard 20, Swaraj Mazda and Eicher Mitsubishi's vehicles etc.  **Figure: Hydraulic Type Clutch Operating Mechanism**	*02 Marks and Sketch 02 Marks*
	(b)	**In motorcycle which type of clutch is used and draw neat labeled sketch.**	**04**
	Ans .	***(For Answer of Question ½ Mark and its neat labeled sketch 3 ½ Marks)*** In Motorcycle Multi-plate Clutch is Used  Figure: Multi-plate Clutch	*For Answer of Question ½ Mark and its neat labeled sketch 3 ½ Marks*
	©	**Compare dry type clutch with wet type clutch on the basis of:** **(i) Construction.** **(ii) Torque Transmission.**	**04**

(iii) Size.
(iv) Application.

Ans.

(Four Points 01 Mark Each)

Parameters	Dry Type	Wet Type
Construction.	Clutch plate is non-perforated type	Clutch plate has perforations.
Torque Transmission	Higher	Lower (35 – 50 % of Dry Clutch)
Size	Bigger	Smaller
Application.	Generally Single Plate Clutch.	Generally in Multi-Plate Clutch.

Four Points 01 Mark Each

(d) Differentiate between sliding mesh and constant mesh gear box. **04**

Ans.

(Four Points 01 Mark Each)

Parameter	Sliding Mesh Gear Box	Constant Mesh Gear Box
Construction.	It consists of spur gear.	It consists of helical gear.
	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.
	Selector fork unit is used in this gear box for engaging the gears.	Dog clutch unit is used in this gear box for engaging the gears.
Torque Transmission	Low	High
Size	The size of gearbox is very large.	The size of gearbox is small as compare to sliding mesh gearbox.
Application	It is the oldest type of gearbox used in motor vehicles.	Constant mesh gear box has been used in 2 & 3-wheelers.

Four Points 01 Mark Each

(e) In modern automobiles synchromesh gear box is preferred over the constant mesh gear box. Justify its applications with suitable illustration. **04**

Ans.

(Any four Merits 03 Marks and Illustration 01Mark)

Merits of Synchromesh Gear Box over Constant Mesh Gear Box:

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.
5) No skill required to operate it.
6) Life and accuracy is more.

Justification:

Illustration of Double Declutching used in Constant Mesh Gear Box, which is not used in Synchromesh Gear box;

Any four Merits 03 Marks and Illustration 01Mark

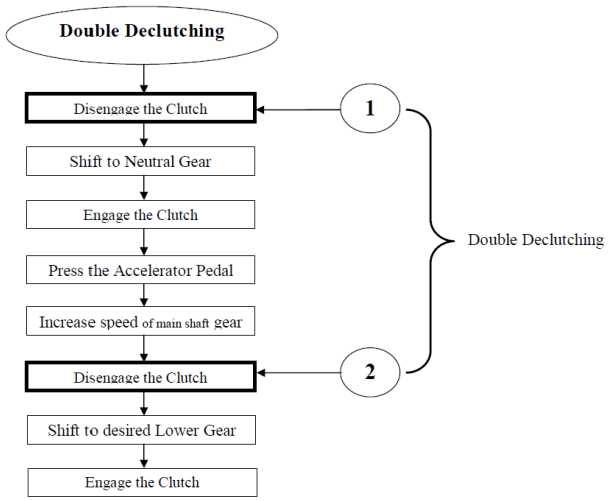


Figure: Double Declutching.

In this type, there is a provision of synchromesh device which avoids the necessity of double declutching, which a major drawback is observed in constant mesh gear box.

5		**Attempt any TWO of the Following**	**12**
	(a)	**Draw neat labeled sketch of synchromesh gear box.**	**06**
	Ans.	***(Neat Labeled Sketch 04 Marks)***	*Neat Labeled Sketch 04 Marks*

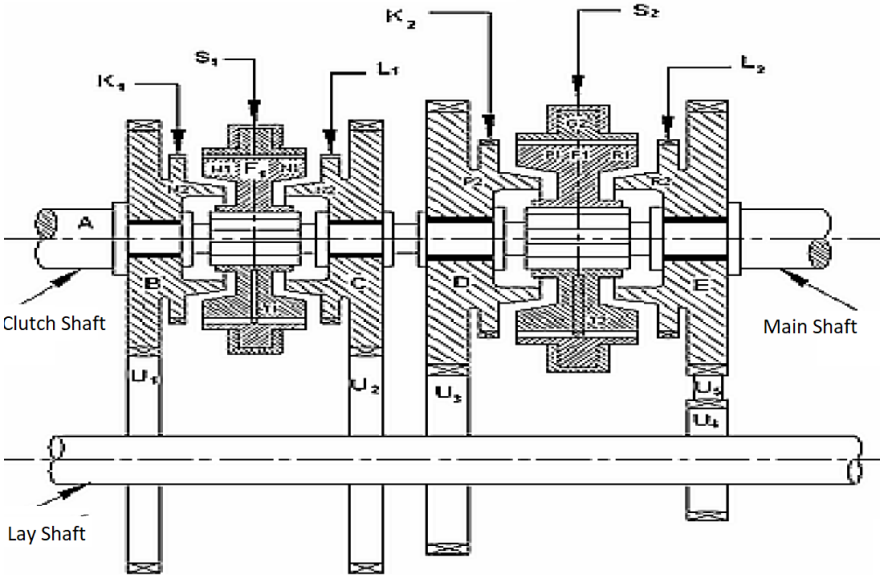
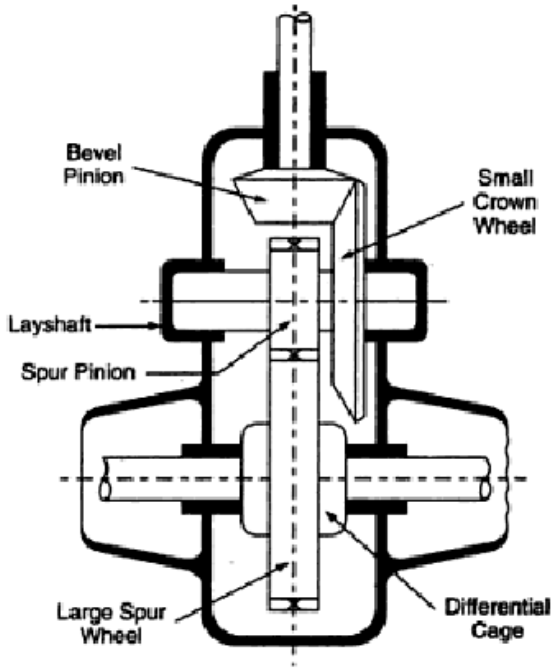
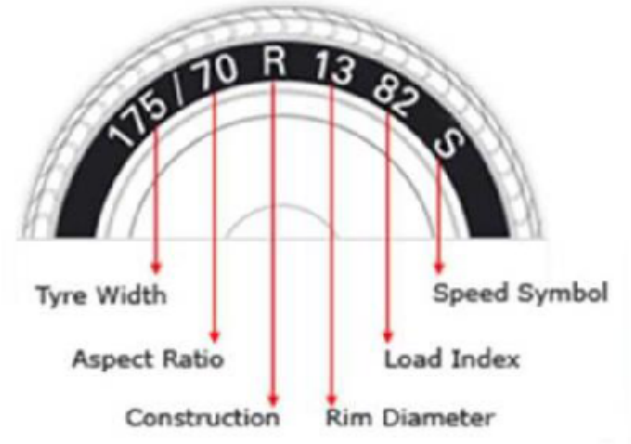


Figure: Layout of Synchromesh Gear Box

S.No.	Notation used for Component	Name of Component
1	**A**	Clutch (Engine Shaft)
2	**B,C,D,E**	Gears on Main (Splined) Shaft
3	**F1, F2**	Free Members
4	**G1, G2**	Ring Shaped Member
5	**K1, K2**	Dog Teeth on Gear B & Gear D
6	**S1, S2**	Forks
7	**T1, T2**	Spring Loaded Balls
8	**M1, M2, N1, N2, P1, P2, R1, R2**	Frictional Surfaces
9	**U1,U2, U3, U4**	Gears on Counter Shaft
10	**U5**	Reverse Gear on Reverse Shaft

<table>
<tr><td></td><td>(b)</td><td>Compare Hotchkiss drive and Torque tube Drive.</td><td>06</td></tr>
<tr><td></td><td>Ans.</td><td>(Any Four Points 01 Mark Each)
<table>
<tr><th>S. N.</th><th>Hotchkiss Drive</th><th>Torque Tube Drive</th></tr>
<tr><td>1</td><td>Open type propeller shaft is used.</td><td>Propeller shaft is housed in a tube called torque tube.</td></tr>
<tr><td>2</td><td>Two universal joints is used one at front & second at rear end of the propeller shaft.</td><td>Only one universal joint is used at the front end of the propeller shaft.</td></tr>
<tr><td>3</td><td>Slip joint is used to accommodate change in length.</td><td>No slip joint is used.</td></tr>
<tr><td>4</td><td>Torque reaction, driving thrust, side thrust, weight of the body & braking torque all are taken by leaf spring.</td><td>Weight of the body & side thrust are taken by leaf spring. Torque reaction, driving thrust, braking torque are taken by the torque tube.</td></tr>
<tr><td>5</td><td>Leaf spring is shackled at the rear and bracketed at front end.</td><td>Both end of the leaf spring are shackled.</td></tr>
<tr><td>6</td><td>The centre axis of propeller shaft and bevel pinion shaft is not coinciding when axle moves up and down.</td><td>Axis of propeller shaft and bevel pinion shaft coincide always.</td></tr>
<tr><td>7</td><td>It is used in heavy vehicles like bus, truck.</td><td>It is used in light vehicles like cars.</td></tr>
</table></td><td>Any Four Points 01 Mark Each</td></tr>
<tr><td></td><td>©</td><td>Enlist the types of loads acting on rear axle and explain any two in details.</td><td>06</td></tr>
<tr><td></td><td>Ans.</td><td>(List of Loads 02 Marks and explanation of any two 02 marks each)
The various loads acting on the rear axle are
(1) Driving Thrust-
Driving torque produced in the engine causes the thrust to be produced in the road
wheels, which has to be transmitted from the axle casing to the chassis frame and the body of the vehicle.
(2) Torque Reaction-
If the rear axle is held rigidly when the road wheels are prevented from rotation, (due to driving needs or road conditions) the bevel pinion of the final drive tends to rotate around the crown wheel. It produces a tendency in the whole vehicle to rotate about the rear axle, or to lift off the front of the vehicle. This effect is known as torque –reaction.
(3) Braking torque or thrust-
The axle casing experiences the brake torque when the brakes are applied to the vehicle.
(4) Side thrust-
When the vehicle is taking the turn, the rear axle subjected to the side thrust or pulls due to any side load on the wheel.
(5) Weight of the body-
The rear axle may be considered a beam supported at ends loaded. This weight causes bending and shears force in the axle shaft.</td><td>List of Loads 02 Marks and explanation of any two 02 marks each</td></tr>
<tr><td>6</td><td></td><td>Attempt any TWO of the Following</td><td>12</td></tr>
<tr><td></td><td>(a)</td><td>Describe with neat diagram the construction and working of Double Reduction Axle.</td><td>06</td></tr>
<tr><td></td><td>Ans</td><td>(Construction 01 Mark, Working 02 Marks and neat diagram 03 Marks)</td><td>Construction</td></tr>
</table>

	.	**Construction:** In this type of axle the drive speed is reduced in two separate steps. The bevel pinion is driven by the propeller shaft and then drive is passed to the small crown wheel which is fixed to a lay shaft, on which is also fixed a spur pinion. **Working:** The spur pinion meshes with a large spur wheel which is attached to the differential casing just at the crown wheel of a single reduction axle. Thus the final drive is transmitted to the axle shaft.  **Figure: Double Reduction Axle**	*01 Mark, Working 02 Marks And neat diagram 03 Marks*
	(b)	**Give the tyre designation with one example and interpret the meaning of terms involved in it.**	**06**
	Ans .	***(Credit of 06 Marks should be given to Any Suitable Example)***  **OR**	*Credit of 06 Marks should be given to Any Suitable Example*

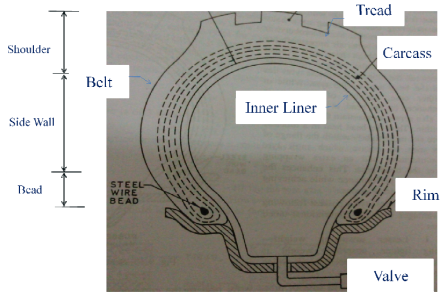
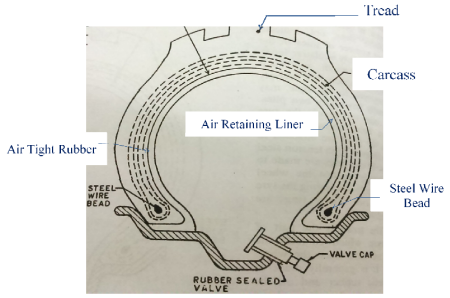


OR

E.g. - 175/70 R 13 82 S
Where,
175 = Tyre Width in mm
70 = Aspect Ratio of Tyre in Percentage
R = Radial Tyre
13 = Rim Diameter in inches
82 = Load Index
S = Speed Rating

(c) Compare with sketches Tube Tyre with Tubeless Tyre on the basis of Specifications, Construction and Performance — **06**

Ans. *(Sketch 03 Marks Three Points 01 Mark each)*

Parameters	Tube Tyre	Tubeless Tyre
Sketches		
Specifications	Used with spoke wheel	Used with Alloy Wheel
Construction	It encloses a tube in which air is forced to a high pressure as a Cushioning medium.	Tubeless tyre does not enclose tube. The air under pressure is filled in the tyre itself.
Performance	Poor	Better

Sketch 03 Marks Three Points 01 Mark each