TRANSMISSION SYSTEMS

1. WHAT IS THE NECESSITY OF TRANSMISSION SYSTEM IN AUTOMOBILE?
   - Variation of resistance to the vehicle motion at various speeds.
   - Variation of tractive effort of the vehicle motion at various speeds.

2. WHAT IS THE FUNCTION OF A CLUTCH?
   A mechanism which enables the rotary motion of one shaft to be transmitted, when desired, to a second shaft, the axis of which is coincident with that of the first.

3. WHAT IS “CLUTCH FREE PEDAL PLAY”? 
   When the clutch pedal is pressed, the trust bearing is not pressed immediately. Rather a part of the pedal movement is purposely kept idle. This is done to avoid a rapid wear of the thrust bearing and the clutch plates and is called clutch free pedal play.

4. WHY ARE CONE CLUTCHES BETTER THAN DISC CLUTCHES?
   Since the cone discs are having large frictional areas and wedging action, they can transmit a larger torque than disc clutches with the same outside diameter and actuating force and hence cone clutches are preferred to disc clutches. But usually cone clutches are mainly used in low peripheral speed applications.

5. DEFINE SLIP IN THE CLUTCH. WRITE DOWN THE CAUSES FOR IT.
   A large amount of heat is generated due to which clutch facings wear out rapidly and even burn out. This is called as slip in the clutch. This may be caused by the following reasons.
   - Incorrect linkage adjustment
   - Weak or broken clutch springs.
   - Worn out facings

6. WHAT ARE THE MAIN COMPONENTS IN FRICTION CLUTCH?
   - Clutch plate
   - Clutch facing
   - Pressure plate
   - Springs
   - Bearing

7. WHAT DO YOU MEAN BY FLUID FLYWHEEL?
   It is an alternative to clutch, uses fluid for transmitting the torque. It is also called hydraulic coupling.
8. WHAT IS THE FUNCTION OF A SYNCHRONIZER IN A GEARBOX?

It is used for avoids the double declutching. It fitted only on the high gears and on the low and reverse gears ordinary dog clutches are only provided. This is done to reduce the cost.

9. LIST OUT SOME AUTOMATIC TRANSMISSION DEVICE.

- Epicyclic gear box
- Multi plate clutches
- Torque convertor

10. DIFFERENCE BETWEEN TORQUE CONVERTOR AND FLUID FLYWHEEL

FLUID FLYWHEEL

- The fluid flywheel transmits the same torque given to it by the engine shaft.
- Stator is not there.
- Efficiency is low.

TORQUE CONVERTOR

- The torque convertor increases the torque in a ratio of about 2:1 to 3:1.
- Stator is there.
- Efficiency is high.

11. DEFINE PROPELLER SHAFT AND LIST OUT VARIOUS PARTS OF PROPELLER SHAFT

This is the shaft which transmits the drive from the transmission to the bevel pinion or worm of final drive in front engine rear drive vehicles. It is also called as drive shaft. It consists mainly of three parts

- Shaft
- One or Two universal joints
- Slip joint

12. WHAT IS THE FUNCTION OF UNIVERSAL JOINT?

It is a special type of joint between two shafts whose axes are inclined to each other. Most common example is the Hook’s joint.

13. LIST OUT THREE TYPES OF FINAL DRIVES

- Straight bevel gears
- Spiral bevel gears
14. WHAT IS THE NEED FOR A DIFFERENTIAL MECHANISM IN AN AUTOMOBILE?

When the vehicle is taking a turn, the outer wheels will have to travel greater distance as compared to the inner wheels in the same time. If therefore, the vehicle has a solid rear axle only and no other device; there will be tendency for the wheels to skid. Hence the wheel skidding is to be avoided, some mechanism must be incorporated in the rear axle, which should reduce the speed of the inner wheels and increase the speed of the outer wheels when taking turn ; it should at the same time keep the speeds of all the wheels same when going straight ahead.

15. LIST OUT VARIOUS FORCES ACTING ON REAR AXLE.

- Weight of the body
- Driving thrust
- Torque reaction
- Side thrust

16. LIST OUT TWO TYPE OF REAR AXLE DRIVE.

- Hotchkiss drive
- Torque tube drive

17. LIST OUT REAR AXLE CASTING

- Split type
- Banjo or separate carrier type
- Salisbury or integral carrier type

Unit - III

Part – B

5. Explain the construction and working principle of diaphragm clutch with neat diagrams.

https://ourmechanicalengg.wordpress.com/
Figure 3.5 shows the construction of the diaphragm clutch. The construction is almost similar to the single plate clutch, but for the diaphragm springs. As a separate piece, the diaphragm spring is conical. When pressure is applied, it gets flattened.

The diaphragm spring produces sufficient pressure on the pressure plate to engage the clutch. The diaphragm is held between two pivot rings. The rear pivot ring is in the clutch cover. In the engaged position, the spring is made to pivot or rest on the rear pivot ring as shown. At this stage, the outer ring comes in contact with the pressure plate. The spring in the conical shape as shown in Figure 3.5 exerts sufficient pressure and makes the pressure plate be in firm contact with the clutch plates and the fly wheel.

To disengage the clutch, the pedal is pressed. This causes the linkage to move the throw-out bearing towards the fly wheel. Throw-out bearing presses the centre portion of the conical spring to move, thereby removing the pressure on the pressure plate. The clutch disc is released from contact with the driving members. Thus, the pressure plate is removed and the clutch is said to be engaged.
Advantages:

1. Lesser operating effort is required.
2. Constant and uniform loading on the driven plate is made available.
3. Accurate balancing is made available always and heavy vibration is avoided.
4. Design is compact, no need of release levers.
5. Comparatively less affected by the centrifugal force; it can withstand higher rotational speeds.

6. Explain the centrifugal and semi centrifugal clutchers with neat sketches.

CENTRIFUGAL CLUTCH

In this arrangement, the centrifugal action of fly-weights is made use of for engaging and disengaging the pressure plate. A simple arrangement is shown in Figure 3.6; in which the clutch pedal and the springs are eliminated. The functioning of the clutch is automatic and depends upon the engine speed. In this arrangement, there is no need for specific operation to disengage the clutch. The vehicle can also be stopped with the gear load, without stalling the engine. The vehicle is controlled by the accelerator pressure and gear transmission at the starting only. This arrangement makes the driving operation very easy and convenient.
As the speed increases, the fly-weights move outwards due to centrifugal force. This movement operates a bell rank lever and presses the floating plate. As shown in the figure, there are helical springs between the floating plate and pressure plate. The force is transmitted to the pressure plate through the springs. The pressure plate containing the friction lining pressure the clutch. There is one more set of springs on the back side of the pressure plate as shown in the figure to keep the clutch in disengaged position at low speed. A projection or a strip called stop is also provided to limit the movement of the fly-weights and the amount of the centrifugal force. Even if the speed is increased beyond this limit, the pressure on the plates will remain constant.

**SEMI-CENTRIFUGAL CLUTCH**

In this arrangement the motion is transmitted partly by the springs and partly by the centrifugal force. The spring action is effective at normal speeds like the conventional clutch.

For higher speeds the centrifugal action of fly weights is made use of. The constructional details are simplified in the figure. In this arrangement, three hinged levers and three clutch springs are arranged alternatively at equal intervals.
The lever is provided with a fulcrum at the bottom, hinged to the pressure plate at the top as shown in Figure 3.7. They fly weights are placed at the upper end of the lever with an adjusting screw provided at the bottom end of the lever. Centrifugal force on the pressure plate can be slightly varied by adjusting this screw.

As stated earlier, the pressure of the springs is enough for torque transmission at normal speeds. When the speed increases, the fly weights move out due to the centrifugal force and operate the fulcrum to press the pressure plates.

7. Explain the over running clutch with the sketch. Give some advantages of free wheel?

Free Wheel Unit

This is called free wheel clutch and is plated next to the gear box. The construction is shown in Figure 3.8. The driving member is connected to the gear box shaft while the driven member is connected to the propeller shaft, as shown in the figure. There are three slots or recesses provided with spring actuate rollers through wedges provided in between the two members. In these wedge portions springs and rollers are placed as shown in the figure 3.8. When the driving members is rotating in the direction as shown in figure, the balls or rollers are jammed and the driven member is also rotating in the same direction. But, if the vehicle comes down a hill, then the condition is reversed as the outer one becomes the driving member, and the
inner member the driven one. Thus, connection is automatically disconnected from this unit. So, when the direction of the inner member is opposite, the gear box and engine are isolated from the wheels. In the reverse drive, free wheel is to be locked. When the direction is changed, the wedge recess is reduced and the balls are free. This makes the outer member to rotate freely.

Fig: Free wheel unit

Advantages of free wheel

1. The engine can idle without disengagement of gears.
2. Without changing gears to neutral often, fuel economy is obtained.
3. There is less wear on transmission.
4. A Positive clutch is possible so that the unit can be put off action when required.

However, it is difficult, as brakes must be applied more effectively to stop the wheel while moving down a slop.
11. With the help of a neat diagram describe the construction and working of an over drive?

**Over Drive:**

This device is used to rotate the propeller shaft faster than the engine shaft. Over drive is used to drive at a higher speed. With the help of this drive, engine life can be increased, fuel consumption can be improved, vibration and noise can be reduced. Moreover, additional gear ratios are made available. This unit is mounted just after the gear box. This is fitted to the top gear only. These are suitable especially for high power cars and can be operated manually and automatically. This consists of an epicyclic gear train. The principle of over drive is explained in the figure.

**Fig: Principle of over drive**

The main shaft of the gear box is connected to the planet carrier. A ring gear is attached to the outer race of the free wheel and then to the output shaft. The output shaft is cast integral with this free wheel. Suppose, the sun gear is locked to the gear box output shaft, the planet carrier driven by the gear box shaft, rotates around the sun gear. This carries the
pinion gears. So the pinion gears walk around and drive the annulus gear, from where the drive to the output shaft is obtained. In this case, the ring gear rotates slower than the planet carrier. This arrangement gives a lower ratio than the direct drive.

In case, a direct drive is needed, sun gear is directly connected to the planet carrier. Now, the drive is taken from the gear box shaft the epicyclic gear train which is locked. Then, the train is transmitted through the free wheel to the over drive shaft. So, in the case of the drive, the output shaft can rotate faster than the gear box shaft.

Advantages

1. engine life is increased.
2. Fuel economy is improved.
3. vibration and noise are reduced.
4. increased gear ratio is available.
5. Higher to gear ratio with greater fuel economy is provided.
6. Engine wear and loss of power reduces as the engine speed is lower.
7. Engagement and disengagement are easy.

12. Describe the working of a torque converter? How does it work as a fluid coupling?

Refer study material pg: 181 (13th Question)

13. What is the function of propeller shaft in the transmission system of a vehicle?

Propeller Shaft:
This is an important shaft in the transmission system, by means of which drive is transmitted to the driving axle. The shaft power is to be transmitted to the rear wheels at different lengths and different angels. This shaft connects the transmission with the driving axle by means of Universal joints. This shaft also contains a slip joint which enables the shaft to vary its length. Thus the propeller shaft has to transmit the power from the engine end to the driven end in different vertical and horizontal planes. The propeller shaft is to withstand torisonal stresses, therefore, it must be well balanced. It should not whip when rotating at high speeds. This is made of a strong steel tube or shaft, with the main parts are shown in figure:

Fig: Propeller shaft

There are two types of propeller shaft.

1. Solid shaft and
2. Hollow tube

They are also called as Open type and Enclosed type.

**Open type:**

The open type is mostly used in commercial vehicles. This is simply a long shaft provided with the universal joint at each end. If the shaft is very long then it is made up of portions with an additional universal joint in between.

**Enclosed type:**

This is a solid shaft enclosed by a tubular structure which is called as torque tube. This torque tube is rigidly connected to the gear box casing by a ball joint. The torque tube is a rigid extension of the axle housing and prevents the twisting of the axle. Roller bearings are used to support the shaft inside the tube. Comparatively, the diameter of this shaft is smaller than the open type. Rivets are provided at both ends to prevent longitudinal movement.

**Sliding joint:**

When the rear axle moves up and down, it movement will be in a circle, with the front spring support at the frame as the centre. But due to propeller shaft motion, this centre is at the front universal joint, and these two centre joints go inside. Hence, the propeller shaft needs some arrangement to vary its length. This is accommodated by providing a sliding joint in the propeller shaft. This slip joint takes care of the difference in the length of the propeller shaft, due to its inclination when the axle moves up and down along with spring.

14. Explain the Hotch kiss drive and torque tube drive with neat diagrams

**Hotch Kiss Drive:**

This is the simplest one available for rear axle drive. The arrangement is shown in figure. Apart from taking the weight of the body, aprings also bears the torque reaction, driving
thrust and side thrust. There are two universal joints at the ends of the propeller shaft, which also carries a sliding joint as shown in the figure. The springs are rigidly supported in the rear axle. At the front end, the spring is fixed rigidly on the frame and a socket is used to support at the rear end. The spring deflection due to the torque reaction is shown in figure. So the torque reaction is taken up by the springs and the driving thrust is transmitted by the front half of the spring to the frame.

Fig: Hotch kiss drive
Advantages of hotch kiss drive:

1. The torque reaction, driving thrust, side thrust are all well supported by the leaf spring and universal joints.
2. Varying propeller shaft length can be accommodated without any inclination.
3. Provides comfortable ride.

TORQUE TUBE DRIVE:

In this case, the propeller shaft in enclosed in a hollow tube. The tube portion is rigid with the final drive housing at one end and fastened at the other end by means of a flexible joint. Bearings are provide in the tube to support the propeller shaft. Only one universal joint is placed between the transmission and the propeller shaft. There is no sliding joint in this arrangement. The springs apart from supporting the body weight, take only the side thrust. The arrangement is shown in figure. Both ends of the springs are fitted by bolts and shackles. The axle casing is bolted at the centre of the springs. The front end of the propeller shaft is fitted in a cup with spherical fitting. The torque reaction and driving thrust are transmitted from
the axle to the frame through the torque tube. It is to be noted that both the pinion shaft and propeller shaft move about the same centre of the spherical cup. Hence, there is no need for a sliding joint.

Fig: Torque tube drive

Radius rods:
The side-way forces are transmitted to the axle from the frame normally by the springs. The coil springs or torsion springs cannot be used with flexibility. In such cases, a transverse radius rod is provided parallel to the wheel axis. This is pivoted at one end to the axle and at the other end to the frame. This arrangement is shown in figure. The Rod “A” is placed above the axle and pivoted at the middle. The ball and socket joints are used at the end of the rods to allow for relative motion.

16. Describe the construction and working of a differential?

When the Car is moving on a straight road both the rear wheels will be turning at the same speed. Suppose, the car takes a turn and both the wheels are rotating at same speed, it will be difficult for the return of the wheels to take place and the vehicle may get toppled if it is with solid rear axle. So, there will be a tendency for the wheels to skid. To avoid this difficulty, the outer wheels must be made to turn at a large radius. In the case of a solid rear axle, the inner wheel will slip causing rapid type wear, steering difficulty and poor road holding.

So, in order to avoid the above difficulties, some mechanism is needed to reduce the speed of the inner wheel, and increase the speed of the outer wheel during turning and bring back the wheels to rotate at the same speed. Thus, there must be a relative movement between the rear wheel, while taking a turn, with the torque transmitted being equal. Such an arrangement which provides the above requirements is known as ‘Differential’.

Type of Differentials
Normally the different is of any one of the type.

1. Conventional
2. Non slip
3. Double reduction type

**Principle of differential**

The figure explains the functioning of differential. In figure a) when the shaft is moved in a straight ahead position, the bevel gears along with the shaft shall revolve at the same speed in the same direction, irrespective of the speed of the shaft. If as shown in the figure b), S-2, is held, stationary, then the right side bevel gear will not rotate. In this case, if the main shaft is assumed to move forward, the pinion rotates about its own axis and the left side bevel gear rotates faster, then in the previous case. Because in this case the left side bevel gear receives two different motions due to

1. forward pulling of the shaft as before.
2. rotation of the pinion about its own which is in constant mesh with the bevel gear.

Suppose the right side bevel is allowed to slip on pinion wheel, then the left side bevel gear shall rotate at a lower speed than in the previous case.
Conventional type

Construction:

A differential consist of a casing in which the differential gears are assembled, as shown in the figure. The crown wheel or ring gear is attached to the rear axle shaft on bearings. The drive pinion is attached to the propeller shaft; two gears are attached to the end of the rear axle. Star pinions mesh with the sun gears. Two or four star pinions are provided. The star pinions are carried on pins. The pinions are free to rotate above their axes. The pin is held between the two parts of the cage. The sun gears and pinion are always in mesh and the sun gears are free to move inside the cage. The sun gears are positioned parallel to the ring gear, inside the differential cage. The assembly is supported on taper roller bearings.
The entire arrangement may be made to rotate as a single unit, so that the axle shafts rotate at the same speed, when the vehicle is moving straight.

**Working of the differential:**

When the vehicle is moving straight, there is no relative movement among the differential gears. The cage and the gears rotate as a single unit. If we assume the cage to be stationary during turn, one sun gear will cause the other to rotate in the opposite direction.

That is to sys, when the vehicle takes a turn, a binding force acts on the inner wheel. In that particular side the sung gear is held to rotate slowly with respect o the movement of the cage. This results in the star pinion rotating the outer side sun gear with a loss in the inner wheel speed and gain on the outer wheel speed. so the outer wheel moves faster. This rotation is super-imposed on the normal speed. suppose, the vehicle is tuning towards the right, a that time, there will be a resistance to motion on the right wheel.

Due to the result of differential action, if the right wheel rotates at 'N' rpm, the left wheel rotates in the opposite direction with 'n' rpm. This arrangement makes the resultant speed of the left wheel as (N+n) rpm and speed of the right wheel as (N-n) rpm. But, the torque transmitted is equal to both the rear wheels.