SUSPENSION SYSTEM.

(2 marks)

1. **What are the functions of a suspension system?**
   Ans:-
   1. To prevent road shocks from being transmitted to the vehicle component and the passengers.
   2. To safeguard the occupants from road shocks.
   3. To preserve stability of vehicle while in motion.
   4. To maintain the road wheels in contact with road surface.

2. **What are the types of leaf spring?**
   Ans: (i) Semi–elliptical leaf spring, (ii) Quarter elliptical leaf spring, (iii) Transverse leaf spring.

3. **What are the functions of shock absorber?**
   Ans: Function of shock absorber is to control the amplitude and frequency of spring vibration. It damp down the spring oscillations.

4. **List the various types of suspension springs.**
   Ans: (i) Leaf spring, (2) coil spring, (iii) Torsion bar, (iv) Rubber spring, (v) Air spring.

5. **What are the advantages of air suspension system?**
   Ans:  
   1. Give smooth, shock and vibration free ride.
   2. Provide preset constant frame height.
   3. Adjust load condition automatically.
   4. No interleaf friction.
   5. Improved ride comfort and reduced noise.
   6. Constant vehicle height is provided hence change in head lamp alignment due to varying loads are avoided.

6. **What is unsprung weight?**
   Ans: Unsprung weight is the weight of vehicle components between the suspension and the road surface. This includes rear axle assembly, steering knuckle, front axle, wheels, tyres and brakes.

7. **What are advantages of using McPherson strut type front suspension system?**
   Ans:  
   1. Simpler in construction.
   2. Lighter in weight.
   3. Less expensive.
   5. Small amount of camber change during bump travel.
8. Define
(i) **Rolling**: While cornering centrifugal force produces movement of the vehicle about longitudinal axis through C.G.
(ii) **Pitching**: Rotating action produced in the vehicle about transverse axis through C.G. parallel to ground is known as Pitching.
(iii) **Bouncing**: The complete body movement in vertical direction or rising up and down of vehicle body is known as bouncing.
(iv) **Yawing**: The motion of vehicle about vertical axis through C.G. is known as yawing. It is due to sudden braking.

(4 marks)

1. **What are advantages of front independent suspension?**
   Ans:
   1. Lighter springs can be used
   2. Unsprung weight is reduced, reducing tyre scrub and hence increases tyre life.
   3. Increased riding comfort due to use of softer spring.
   4. Improved steering and stability as steering geometry do not change with spring deflection
   5. Increased passenger accommodation as engine is positioned forward and lowered
   6. Lower bonnet line that improves visibility.

2. **What are drawbacks of front independent suspension?**
   Ans:
   1. More complicated system
   2. High initial cost
   3. Misalignment of steering geometry due to wear of components.
   4. More rigid sub-frame or chassis frame is required
   5. Forces due to unbalanced wheels are transmitted easily to the steering wheel.
   6. More parts and movable bushings hence more wear and tear of parts that increases possibility of misalignment of tyres
   7. Good road holding as wheels remains straight or vertical

3. **What are advantages of rear independent suspension?**
   Ans:
   1. Lighter springs can be used
   2. Unsprung weight is reduced, reducing tyre scrub and hence increases tyre life.
   3. Increased riding comfort due to use of softer spring.
   4. Good road holding as wheels remains straight or vertical

4. **What are drawbacks of rear independent suspension?**
   Ans:
   1. More complicated system
   2. High initial cost
   3. More rigid sub-frame or chassis frame is required
   4. More parts and movable bushings hence more wear and tear of parts that increases possibility of misalignment of tyres
5. **What are the advantages of air suspension system?**
   Ans:
   1. Give smooth, shock and vibration free ride.
   2. Provide preset constant frame height.
   3. Adjust load condition automatically.
   4. No interleaf friction
   5. Improved ride comfort and reduced noise
   6. Constant vehicle height is provided hence change in head lamp alignment due to varying loads are avoided.

6. **State the reasons for using coil spring in suspension systems.**
   Ans: it is mainly used in independent suspension. The main reasons of using it are as follows.
   1. There is no interleaf friction
   2. It has good ride qualities
   3. Energy stored per unit volume is almost double than that of leaf spring.
   4. These are available in variable rate hence different intensity of shocks are absorbed.
   5. These springs are softer hence provides good comfort to driver and passengers.

7. **Write a short note on, independent suspension.**
   Ans: when vehicle with rigid axle suspension comes across the bump the axle tilts and the wheels no longer remains vertical. This causes the vehicle to tilt to one side decreasing road adhesion. It also causes rough ride and wheel wobble. To avoid this the wheels are sprung independent of each other, so that tilting of one wheel does not affect the other.
   **Advantages:**
   1. Lighter springs can be used
   2. Unsprung weight is reduced, reducing tyre scrub and hence increases tyre life.
   3. Increased riding comfort due to use of softer spring.
   4. Improved steering and stability as steering geometry do not change with spring deflection
   5. Increased passenger accommodation as engine is positioned forward and lowered
   6. Lower bonnet line that improves visibility.
   7. Good road holding as wheels remains straight or vertical
   **Disadvantages:**
   1. More complicated system
   2. High initial cost
   3. Misalignment of steering geometry due to wear of components.
   4. More rigid sub-frame or chassis frame is required
   5. Forces due to unbalanced wheels are transmitted easily to the steering wheel.
   6. More parts and movable bushings hence more wear and tear of parts that increases possibility of misalignment of tyres

8. **State the objectives of suspension system.**
   Ans: The objectives of a suspension system are as follows,
   1. To prevent road shocks from being transmitted to the vehicle component and the passengers.
   2. To safeguard the occupants form road shocks.
   3. To preserve stability of vehicle while in motion.
   4. To maintain the road wheels in contact with road surface.
1. What are the types of leaf spring? Describe construction of semi-elliptical leaf spring.

   Or Explain leaf spring with neat sketch

Ans:- it is made of series of flat steel plates of graduated length placed one on top of another. The plates or leaves are held together at the center by a center U-bolt which passes through holes in the leaves. U-bolts also fix the leaf spring to axle. Clips are placed at intervals along the spring keep the leaves in alignment. The longest leaf called as master leaf is rolled at both ends to form a spring eyes. One end of spring is mounted on the frame with a simple pin, while on the other end connections is made with a shackle.

   When vehicle comes across bump on the road surface, the wheel moves up, deflecting the spring. This changes the length between the spring eyes therefore to accommodate this change in length shackle is provided at one end.

   Generally rear springs are kept longer than that of front; this causes them to vibrate at different frequencies which prevent excessive bouncing of vehicle. When leaf spring deflects, the upper side of each leaf tips slides or rubs against the lower side of the leaf above it. This interleaf friction produces some damping which reduces spring vibration. But it is not preferred as damping changes with time hence shock absorber is provided.

![Fig. 3.8: Leaf Spring](image)

2. What is torsion bar? Where it is used? Explain it’s working with a neat sketch.

Ans:

Torsion bar is bar of steel that is held stationary at one end and forced to twist at the other end. It works on principle of resistance to twist. It takes shear stress only. Torsion bar is often used with independent suspension system. A torsion bar is shown in figure.

   It consists of a steel bar fixed at one end to the frame, while the other end is fixed to wheel arm and is supported in the bearing. The other end of wheel arm is connected to the wheel hub. When wheel strikes a bump, it starts vibrating up and down, thus exerting torque on the torsion bar, which acts as a spring.
Advantages:
   1. Lighter in weight as compare to leaf spring.
   2. Occupy less space
   3. Large portion of spring load is transmitted to the fixed end of the bar.
   4. Last up to the life of car
Disadvantages:
   1. Does not take driving or braking thrust.
   2. Damping is necessary to control the vibrations produced due to road shocks
Example: Honda city 1.5 on rear wheel.

3. **write two advantages and two disadvantages of front independent suspension system**

Ans: **Advantages of independent suspension:**
   1. Lighter springs can be used
   2. Unsprung weight is reduced, reducing tyre scrub and hence increases tyre life.
   3. Increased riding comfort due to use of softer spring.
   4. Improved steering and stability as steering geometry do not change with spring deflection
   5. Increased passenger accommodation as engine is positioned forward and lowered
   6. Lower bonnet line that improves visibility.
   7. Good road holding as wheels remains straight or vertical

**Disadvantages of independent suspension:-**
   1. More complicated system
   2. High initial cost
   3. Misalignment of steering geometry due to wear of components.
   4. More rigid sub-frame or chassis frame is required
   5. Forces due to unbalanced wheels are transmitted easily to the steering wheel.
   6. More parts and movable bushings hence more wear and tear of parts that increases possibility of misalignment of tyres

These are used on MARUTI 800, Alto,

4. **Explain the working of anti – roll device for front axle independent suspension.**

Ans: Stabilizer or anti-roll or sway bar is normally fitted with independent suspension. It helps to reduce body roll as vehicle corners. It is simply a bar of alloy steel with arms at each end connected to the lower wishbone and supported in bush bearings fixed to the frame and is parallel to the cross member.

   When both the wheels deflect up or down by the same amount, the stabilizer bat simply turns in the bearings. Whereas when one wheel deflects, then only one end of stabilizer moves, thus twisting the stabilizer bar. The resistance of bar to twisting reduces tendency of vehicle to roll.
5. Explain the McPherson strut type front independent suspension system with a neat sketch.

Ans:

It consists of only a lower wishbone. A strut containing shock absorber and the springs carries stub axle on which wheel is mounted. The wishbone is hinged to the cross-member and position the wheel as well as resists accelerating, braking and side forces. This suspension is lighter keeping the lower unsprung weight. This type gives maximum room in the engine compartment and is therefore commonly used on front wheel drive cars.

**Advantages of McPherson strut type suspension:**

1. Simpler in construction.
2. Lighter in weight
3. Less expensive
4. More engine room for transverse engine mounting
5. Small amount of camber change during bump travel

**Disadvantages of McPherson strut type suspension:**

1. Do not have provision for castor and camber adjustments.
2. If shock absorber wears out, the strut need to be replace.
3. These are affected by spring sag and bush wear.

**Applications:** These are used on MARUTI 800, Alto.

6. Explain the working of telescopic shock absorber with a neat sketch.

Ans:

Shock absorber is used to damp the vibrations that are produced by the spring. The principle of operation of hydraulic shock absorber is that when a piston forces a fluid in a cylinder to pass through small hole a high resistance to the movement of piston is developed which provides a damp effect. The advantage of hydraulic shock absorber is that the damping is proportional to the square of speed. So for small shock/vibration the damping is small whereas for large shock/vibration the damping automatically becomes more.

As the wheel comes across the bump, the tube moves up compressing the fluid between valve A and valve B. The increase in pressure causes valve A to open allowing fluid to flow from lower chamber to the upper chamber, as volume of upper chamber is less the pressurized fluid after filling the upper chamber will flow through valve B in a space between cylinder and tube. This causes the piston to move slowly.

During return stroke the fluid from the outer space will come first in lower chamber and there after from upper chamber. The fluid used is generally mixture of 60% transformer oil and 40% turbine oil.
7. Explain the wishbone type front independent suspension system with a neat sketch.

Ans: It consists of upper and lower wishbone arm pivoted to the frame member. The spring and damper is placed between the lower wishbone and the underside of the cross-member. The weight of the vehicle is transmitted from body to wheel through cross-member, coil spring and lower wishbone arm.

Because of V shape, the wishbone not only positions the wheels and transmits the vehicle load to the springs but also it resists acceleration, braking and side forces. The upper arm is shorter in length than the lower arm. This helps to keep the wheel track constant thus avoiding tyre scrub reducing the tyre wear.

**Advantages:**
1. Every wheel have separate suspension hence movement of one tyre will not affect the other

**Disadvantages:**
1. Scrubbing of tyres occurs on the bump.
2. Camber change is more.
3. Less room for engine compartment.

It is used on Ambassador, Fiat.

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8. Draw a layout of air suspension system.
9. Explain the Gas filled shock absorber with a neat sketch.

Ans:

The gas filled shock absorber is used to reduce the aeration or foaming of hydraulic oil. On rough roads the passing of fluid from one chamber to another becomes so rapid that foaming can occur. Foaming is simply the mixing of the fluid with any available air. The foaming reduces the effectiveness of the shock absorber. So as to reduce the tendency of foaming the gas filled shock absorber are used.

It works on same principle as that of conventional shock absorber. It consist of a single tube in which the piston with the valves is attach to the rod which is mounted to the frame where as the tube is attached to the wheel. The tube consists of the dividing piston that separates the oil chamber from the gas chamber. The oil chamber contains special hydraulic oil and a gas chamber contains a nitrogen gas under pressure equal to 25 times the atmosphere.

As the wheel comes across the shock the tube moves up causing the fluid from oil chamber to force through the valve in the piston on the top chamber. As the top chamber is filled fully the pressurized oil force the dividing piston down causing the gas to kept compressed. During return stroke the pressure of nitrogen gas is higher, that will cause the dividing piston to return to its original position. Thus in this case the hydraulic oil does not come in contact with the air hence no foaming will form and the effectiveness will remain good on rough roads.

Advantages:
1. Large damping is possible.
2. It can mount in any position.
3. Large volume of fluid is available for damping as full diameter of tube can be used as working chamber.