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## P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Sixth Semester, B.E. - Automobile Engineering

Make-up Examination; March/April - 2022

Automotive Chasis and Suspension

Time: 3 hrs

Max. Marks: 100

**Note:** Answer **FIVE** full questions, selecting **ONE** full question from each unit.

### UNIT - I

- 1 a. What are the requirements of an automobile? Discuss the merits and drawbacks of front engine-front wheel driven and Rear engine-rear wheel driven arrangements in automobile. 7
- b. With necessary diagram, derive expressions, to determine the vertical reactions at road wheels, for Distribution of Weight, in case of three wheeled vehicle and four wheeled vehicle resting on a level road. 8
- c. A car of weight  $W$ , has a wheel base,  $b$  and its c.g. is at distance,  $l$  in front of the rear axle and distance,  $h$  above the ground level. The wheels are of equal size. If  $R$  is the vertical reaction at the front wheels when the rear wheels are lifted up so that the longitudinal axis of the car makes an angle,  $\theta$  with the horizontal, show that  $R = (W/b) \times (l + h \times \tan \theta)$  5
- 2 a. With neat sketches, explain X-Member type and Box-Section type passenger car frames. 6
- b. How the stiffness and Rigidity tests being conducted on the frames serve to determine the linear deflection under bending loads and angular deflection under torsion? Explain the analysis arrangement and outcome diagrams. 10
- c. The bending moment diagram for channel section frame shows a maximum value of 1951 Nm. Ascertain the suitability of the following channel section; width = 77.5 mm, height = 227.5 mm, thickness = 6.5 mm. Permissible stress = 71.2 N/mm<sup>2</sup> 4

### UNIT - II

- 3 a. With necessary diagrams, explain the factors of steering geometry which influence stability and control of vehicle. 8
- b. List different types of steering gear. With neat sketch, explain the working of any one type of steering gear. 6
- c. The front wheel of a car has pivot centres 1.1 m apart. The length of each steering arm is 150 mm, while the track rod is 1m length. Calculate the wheel base for perfect rolling of the car wheels when the inner wheel stub axle is at 55° to the rear centre line. 6
- 4 a. Explain with necessary diagrams, the two steering mechanisms which shall satisfy the condition for perfect steering. Also derive expressions for the same steering mechanisms. 14

- b. A truck has pivot pins 1.37 m apart the length of each track arm is 0.18 m and the track rod is behind front axle and 1.27 m long. Determine the wheel base which will give the true rolling for all wheels when the car is running so that the inner wheel stub axle is  $60^\circ$  to the centre line of the car. A geometrical construction may be used.

6

**UNIT - III**

- 5 a. Along with sketch, Derive expressions for velocity ratio in a Hooke's joint. 10
- b. An automobile Engine develops a maximum torque of 162 N.m. the low gear ratio of transmission is 2.75, while the back axle ratio is 4.25. The effective wheel radius is 0.325m and coefficient of friction between the tyre and the road surface is 0.6. If the permissible stress is  $32373 \times 10^4$  Pa. Determine the maximum shaft diameter, assuming that the load is nearly torsional. What is the maximum load permissible on each wheel? 10
- 6 a. With neat sketches, describe the construction and operation of Hotchkiss and Torque tube rear axle drives. 10
- b. Explain, with neat sketch, the construction of the live rear axle of a front engine rear driven automobile. Explain various forces and torques experienced by the rear axle. 10

**UNIT - IV**

- 7 a. Derive expression for weight transfer in case of,  
 i) Brakes applied on front wheels only                      ii) Brakes applied on rear wheels only                      12  
 iii) Brakes applied on all wheels
- b. The brake drums of an automobile of 380 mm diameter. The shoes are anchored together 150 mm away from the brake drum centre. The free ends of the two shoes are pushed apart with a force of 320 N which may be considered acting at a distance of 320 mm from the anchor. Assume that the normal pressure on the brake shoes acts at a right angle to the line joining the anchor with the brake drum centre and the resultant frictional force acts at a distance of 200 mm from the brake drum centre. Take coefficient of friction between the shoes and the drum as 0.5. Calculate the braking torque provided by each shoe. 8
- 8 a. Along with necessary diagram, derive expressions to determine Braking Torques at leading and trailing shoes. 7
- b. How brakes for automobile use are classified? Explain, with neat sketch, the construction and working of any one type of braking arrangement in an automobile. 7
- c. A motor car has a wheel base of 2.64 m the height of its c.g. above the ground is 0.61 m and it is 1.12 m in front of the rear axle. If the car is travelling at 40 kmph on a level track, determine the maximum distance in which the car may be stopped, when;  
 i) The rear wheels are braked                      ii) The front wheels are braked                      6  
 iii) All wheels are braked
- The coefficient of the friction between tyre and the road may be taken as 0.6

## UNIT - V

- 9 a. What are the basic considerations of suspension system? 4
- b. Sketch and explain any one method to achieve the independent suspension in front and in rear axles of cars. 8
- c. A typical coil suspension spring has 10 effective coils of a mean diameter 125 mm and made out of wires of diameter 15 mm, the spring is designed to carry a maximum static load of 3531.6 N. Calculate the shear stress of 637650 kPa is allowable in the material, then what is the possible clearance in the spring? Take the value of  $G = 73573 \times 10^3$  kPa. 8
- 10 a. Sketch and briefly explain inset, zero set and outset automobile wheel. 6
- b. Sketch and explain three different carcass types of tyre. 9
- c. Discuss the advantages of tubeless over conventional tubed tyres. 5

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