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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

Semester End Examination; June - 2017

Automotive Chassis and Suspension

Time: 3 hrs

Max. Marks: 100

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

ii) Missing data, if any, shall be assumed suitably and stated properly.

iii) Sketches should be drawn using pencil only. Use of Design data hand book is permitted.

UNIT - I

- 1 a. Explain briefly, classification of automobile chassis. 4
- b. For stability of a vehicle on a slope, derive expressions for : 10
 (i) The reactions at the wheels (ii) The limiting angles for overturning and sliding down the slope.
 Sketch the necessary diagram.
- c. A vehicle of total weight 49050 N is held at rest on slope of 10° . It has a wheel base of 2.25 m and its centre of gravity is 1.0 m in front of the rear axle and 1.5 m above the ground level, 6
 (i) What are the normal reactions at the wheels?
 (ii) Assume that sliding does not occur first, what will be the angle of slope so that the vehicle will overturn?
 (iii) Assuming all the wheels are to be braked, what will be the angle of the slope so that the vehicle will begin to slide, if the coefficient of adhesion between the tyre and the ground is 0.35?
- 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 with 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^2 . 4

UNIT - II

- 3 a. Sketch and explain the function of front axle assembled with stub axle. Explain, how the stresses on the front axle are dealt with? 8
- b. The load distribution between the front and rear axle of a motor vehicle weighing 13244 N such that 48% of the total load is taken by the front axle. The width of the track is 1.4 m and the distance between the centres of the spring pads is 0.66 m. 12
 Design a suitable I section for the front axle assuming that the width of the flange and its thickness are 0.6 and 0.2 of the overall depth of the section respectively and the thickness of the web 0.25 of the width of the flange. Assume a working stress of 90 N/mm^2 .
- 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° 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 Nm. The low gear ratio of transmission is 2.75, while the back axle ratio is 4.25. The effective wheel radius is 0.325 m and coefficient of friction between the tyre and the road surface is 0.6. If the permissible shear stress is 32373×10^4 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 the various forces and torques experienced by the rear axle. 10

UNIT - IV

- 7 a. Derive expressions for weight transfer in case of;
- (i) Brakes applied on front wheels only (ii) Brakes applied on rear wheels only 14
- (iii) Brakes applied on all wheels.
- b. The brake drums of an automobile are 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 right angles 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. 6
8. Explain with neat sketch, the construction and working of,
- (i) Leading and Trailing brake shoes (ii) Brake compensation (iii) Vacuum servo brakes. 20

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 and the deflection under the above loading. If a maximum 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. With neat sketch, explain the constructional difference between conventional Tubed and Tubeless tyre. 8
- b. Explain the desirable tyre properties. 4
- c. With neat and simple sketch, compare radial and bias ply tyres with respect to,
- (i) Road Contact (ii) Rolling Resistance 8
- (iii) Cornering force and Self Righting torque (iv) Tyre distortion.