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

(An Autonomous Institution affiliated to VTU, Belagavi)

Seventh Semester, B.E. - Automobile Engineering

Semester End Examination; Jan. / Feb. - 2021

Vehicle Dynamics

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Assume missing data if any. iii) Draw neat sketches wherever necessary.

UNIT - I

1 a. Sketch earth fixed coordinate system and tyre axis system (tyre force and moments). 6

b. Explain the factors affecting rolling resistance. 8

c. Explain the advantages of radial tyre. 6

2 a. How the power for propulsion and tractive force calculated? 6

b. The coefficient of rolling resistance for a truck weighing 62293.5 N is 0.018 and the coefficient of air resistance is 0.0276 in the formula $R = kW + k_aAV^2$ N, where A is m^2 of frontal area and V the speed in km/hr the transmission efficiency in the top gear 6.2:1 is 90% and that in the second gear of 15:1 is 80% the frontal area 5.574 m^2. If the truck has to have a maximum speed of 88 km/h in top gear calculate; 14

i) The engine BP required

ii) The engine speed, if the driving wheels have an effective diameter of 0.8125 m

iii) The maximum grade the truck can negotiate at the above engine speed in second gear

iv) The maximum draw bar pull available on level at the above engine speed in second gear

UNIT - II

3 a. Derive expression for axle loads for an ideal accelerating four wheel drive car on an inclined road. 10

b. A motor car with wheel base of 2.75 m with the centre of mass 0.85 m above the ground and 1.15 m behind the front axle has coefficient of adhesion 0.6 between the tyres and ground. Calculate the maximum possible acceleration when the vehicle is, 10

i) All wheel drive ii) Front wheel drive iii) Rear wheel drive

4 a. Derive a condition for limiting value of overturning velocity of an automobile taking turn on level ground. 10

b. Explain the method to find the C.G. of a vehicle. 10

UNIT - III

5 a. Explain various factors affecting the stopping distance. 4

b. Discuss the efficiency of the braking system when the brakes are applied when the vehicle is taking turn? 6

Contd…2

c. A vehicle weights 13341.5 N and has a wheel base of 2.65 m the C.G. is 1.27 m behind the front axle and 0.76 m above the ground level. Maximum braking on all four wheels on level ground will bring the vehicle uniformly to rest from a speed of 64 km/h in a distance of 25.9 m. Calculate the value of adhesion between the tyre and road. Under the same road condition, the vehicle descends a hill of gradient 1 in 20 and is braked on the front wheels only. Determine the stopping distance and load distribution. 10

6 a. Discuss how the vehicle behaves when;

i) Front wheels locked first 10

ii) Rear wheels locked first during braking

b. Discuss the difference between disc brake and drum brake. 10

UNIT - IV

7 a. Discuss steering geometry error. 6

b. The distance between the king-pins of a car is 1.3 m, the track arms are 0.1525 m long for a track of 1.42 m and wheel base of 2.85 m, find the radius of curvature of the path followed by the near-side front wheel at which correct steering is obtained when the car to the right. Length of the track rod is 1.2 m. 14

8 a. With the help of graph, explain relationship between steer angle and vehicle speed during neutral, under and over steer. 10

b. A passenger car has a weight of 20.105 kN and what base of 3.2 m the ratio of distance between the C.G. of the vehicle and the front axle to the wheel base is 0.465. The cornering stiffness of each of the tyre is 38.92 kN/rad and that of the rear tines is 38.25 kN/rad. The staring gear ration is 25. Determine the yaw velocity gain and the lateral acceleration gain of the vehicle with respect to steering wheel displacement. 10

UNIT - V

9 a. Explain the different sources of vibration in an automobile. 10

b. Determine the pitch and bounce of frequencies and the location of oscillation centres of an automobile with the following data:

Sprung mass m = 2120 kg

Radius of gyration r = 1.33 m

Distance between the front axle and centre of gravity I = 1.267 m 10

Distance between the rear axle and centre of gravity = 1.548

Front spring stiffness k_f = 35 kN/m

Rear spring stiffness k = 38 kN/m

10 a. Explain aerodynamics resistance, aerodynamic lift and aerodynamic pitching moment. 10

b. Explain different aerodynamic aids. 10

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