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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; Dec. - 2019

Vehicle Dynamics

Time: 3 hrs *Max. Marks: 100*

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

ii) Missing data, if any may be suitably assumed

UNIT - I

1a. With the help of block diagram, explain driver-vehicle-ground system. 6

b. Explain Hydro planning phenomenon. 6

c. Discuss various factors affecting tyre life. 8

2a. How the power for propulsion and required 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 of 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 Explain a method to find C.G of a vehicle. 12

b. A vehicle having gross weight 2500 kg, wheel base 3.5 m, C.G of the vehicle is 1.5 m above ground level and 1.65 m from rear axle. Track length of the vehicle is 1.5 m. the vehicle is travelling on a curved path having radius of curvature of which is 500 m. calculate the skidding and over turning speed of the vehicle if coefficient of friction between road and wheel is 0.4. 8

4.a Derive a relationship for maximum acceleration and load distribution for a vehicle moving up the gradient. 10

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

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

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

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c. A vehicle weighs 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. 10

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

6.a Discuss how the vehicle behaves when? 10

i) Front wheels locked first

ii) Rear wheels locked first during braking

b. A vehicle weighs 21.24 kN and has a wheelbase of 2.87 m. The C.G is 1.27 m behind the front axle and 0.508 m above ground level. The braking effort distribution on the front wheel is 60%. The coefficient of rolling resistance is 0.02. Determine which set of the wheels will first on two road surfaces; one with $\mu = 0.8$ and other with $\mu = 0.2$ 10

UNIT - IV

7.a Prove a condition for True Rolling. 6

b. What is cornering force and slip angle? What are the factors influence the amount of cornering force developed between road and tyre? 6

c. A track has pivot pins 1.37 m apart, the length of each track arm is 0.17 m and the track rod is behind front axle and 1.17 m long. Determine the wheel base which will give true rolling for all wheels when the car is turning so that the inner wheel stub axle is 60° to the center line of the car. 8

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

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

UNIT - V

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9.a Explain various mathematical model used to analyse the ride charectiristics of vehicle. 10

b. An automobile has following data: 10

Mass of vehicle = 1500 kg

Distance between front axle and C.G. = 1.4 m

Distance between rear axle and C.G. = 1.6 m

Front spring stiffness = 30 kN/m

Rear spring stiffness = 35 kN/m

Radius of gyration = 1.2 m.

Determine the pitch and bounce frequencies and location of the oscillating centres.

10.a. Sketch and explain various Aerodynamic force and moments acts on vehiele. 10

b. Explain effect of shape, angle of attack and operation parameters on drag and lift. 10

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