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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; February - 2022

Vehicle Dynamics

Time: 3 hrs *Max. Marks: 100*

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

UNIT - I

1 a. Sketch and explain in brief SAE vehicle fixed and earth fixed coordinate system. 10

b. Explain the forces and moments of pneumatic tyre of an automobile. 10

2 a. A motor car weighs 17795 N including the four road wheels each of which has an effective diameter of 0.66 m, a radius of gyration of 0.28 m and a weight of 294 N has as an engine developing 66 kW at 2400 rpm. The parts which rotate at engine speed weight 1069 N, with a radius of gyration of 0.115 m. The transmission efficiency is 90% and the total road and air resistance at thus engine speed in top gear of 3.84:1 is 873 m on level road. Calculate the acceleration of m/s^2, under those conditions and assuming acceleration to be uniform the time required to increase the speed by 32 km/hr. 10

b. Explain static, non-rolling dynamic and rolling dynamic stiffness of pneumatic tire. 10

UNIT - II

3 a. Mention the assumptions and derive an equation for axial loads for a vehicle moving down the gradient. 10

b. A motor car with wheel base 2.75 m with C.G. 0.85 m above the ground the level and 1.15 m behind the front axle has coefficient of adhesion 0.6 between the tyre and ground. Calculate the maximum possible acceleration when the vehicle is? 6

i) Driven on four wheels, assuming that the slip occurs first at front wheels

ii) Driven on a front wheel only

iii) Driven on the rear wheels only

c. Derive an equation for load distribution on wheels on three wheeled vehicle. 4

4 a. Derive an equation for maximum achievable acceleration for front and rear wheel drive vehicle, when the vehicle moving on level road? 10

b. A passenger car having gross vehicle weight of 1000 kg. The wheel base of the vehicle is 2.5 m C.G. of the vehicle is 1.1 m from the rear axle and 0.7 m above the ground level. The vehicle is travelling up and gradient of 12°. Calculate the reaction of each wheel and what is the limiting value of inclination for overturning of the vehicle? 5

c. Write a note on effect of vertical C.G. position on maximum achievable acceleration and braking performance. 5

Contd... 2

UNIT - III

5 a. Write a note on;

i) Stopping distance ii) Work done braking 10

iii) Braking efficiency along iv) Brake torque with suitable mathematical equations

b. A motor car has a wheel base of 2.64 m, the height of C.G. above the ground level is 0.61 m, and it is 1.12 m in front of the rear axle. If the car is travelling at 40 km/hr on a level road, determine the minimum stooping distance, when?

i) The rear wheels are braked 10

ii) The front wheels are braked

iii) All the wheels are braked

Take $\mu = 0$.

6 a. With a neat sketch, explain the construction of drum and disk braking system. 10

b. A motor weighs 13341.5 N and has a wheelbase 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 an adhesion between the tyre and the road. Under the same road condition, vehicle descends a hill of gradient 1 in 20 and is braked on the front wheels only. Determine the load distributed between the front and rear wheels and the distance required to bring the car to rest. 10

UNIT - IV

7 a. The distance between the king-pins of car is 1.3 m, the track arms are 0.1525 m long and the length of the track rod is 1.2 m for a track. 1.42 m and wheel base of 2.85 m, find the radius of curvature of the path followed by the rear-side front wheel at which correct steering is obtained when the car is turning to the right. 10

b. Describe the cornering properties of pneumatic tyre of an automobile. 10

8 a. Explain the directional stability during under steer and over steer. 10

b. Explain the condition for true rolling and write equations for turning circle radius. 10

UNIT - V

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

b. Explain the model an automobile for two-degree freedom system considering sprung and un sprung mass and write the equation of motion for the same. 10

10 a. Explain with a suitable equations aerodynamic drag, lift and skin friction and write a note on effect of same on stability and performance of an automobile. 10

b. Show the aerodynamic pressure distribution on an automobile and explain different aerodynamics aids. 10

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