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

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, M. Tech - Mechanical Engineering (MMDN)

Semester End Examination; Dec - 2017/Jan - 2018

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

1 a. With the help of a block diagram, explain Driver-Vehicle-Ground System. 6

b. Discuss tyre forces and moments. 6

c. Explain the difference between Bias-ply tyre and Radial-ply tyre. 8

2 a. Briefly explain various resistances comes on vehicle. 6

b. A motor vehicle weights 7975.5 N and its engine develops 14.7 kW at 2500 rpm. At this engine speed the road speed of the car on the top gear is 64.37 km/h. Bottom gear reduction is 3.5:1 and the efficiency of the transmission is 88% on top and 80% on bottom gear. The diameter of the tyre is 0.762 m and frontal area of the vehicle is 1.116 m^2. The coefficient of air resistance is 0.0314. Road resistance coefficient is 0.023. Calculate;

i) Speed of car on bottom gear 14

ii) Tractive effort available at the wheel's on top and bottom gear

iii) Gradient which car can climb on bottom gear

iv) The tractive force at the wheels required to start up the car on the level and attain a speed of 48.28 km/hr in 10 sec. (Average Air speed resistance may be taken has half the maximum).

UNIT - II

3 a. Obtain the expression of skidding and overturning velocity of the vehicle, when taking left turn on level Road. 10

b. A car travelling on a laterally inclined road. The angle of inclination is 10º. Gross vehicle weight of the car is 1200 kg having wheel base 2.5 m, C.G. of the vehicle is 1.1 m from rear axle and 0.65 m above ground level. Track length of the car is 1 m. Coefficient of friction between tyre and road is 0.35. Calculate over turning speed of the car when vehicle is taking left turn. Also estimate lateral acceleration. Assume radius of curvature of the path is 75 m. 10

4 a. Derive load distribution equation and maximum allowable acceleration for a vehicle moving down the gradient for the following cases : 12

i) Rear wheel drive

ii) Four wheel drive.

Contd…2

b. A motor car having gross vehicle weight of 1000 kg with the wheel base 2.75 m and C.G. of the vehicle is at 0.85 m above the ground level and 1.6 m behind the front axle. The coefficient of friction between road and tyre is 0.6. Calculate the maximum possible acceleration when the vehicle is, 8

i) Driven by front wheels only ii) Driven by rear wheels only iii) Driven by four wheels.

UNIT - III

5 a. Explain the difference between disc brake and drum brake. 10

b. Derive relations for load distribution and deceleration when the brakes are applied to front wheels only and the vehicle is moving down the gradient. 10

6 a. What is brake proportionating? 2

b. Derive relations for condition for wheel lockup. 8

c. A motor cycle has a wheel base 1.44 m apart. The C.G. of the cycle and rider 0.76 m above ground level and 0.61 m in front of the rear axle. The coefficient of friction between the tyres and the road is 0.75. If the rear wheel is balanced, find the greatest retardation that can be obtained; 10

i) If the cycle is moving in a straight path

ii) If it is going round a curve of 45.7 m radius at 48 km/hr.

UNIT - IV

7 a. Derive fundamental equation governing the steady state handling behavior of road vehicles. 10

b. With the help of graph, discuss Yaw Velocity response and Lateral acceleration response to steering input. 10

8 a. Demonstrate how the steering error curve can be plotted graphically? 10

b. The distance between the kingpins of a car is 1.3 m. The track arms are 0.1525 m long and the length of the track road is 1.2 m. For a track of 1.42 m and a wheel base of 2.85 m, find the radius of curvature of the path followed by the near-side front wheel at which correct steeling is obtained when the car is turning to the right. 10

UNIT - V

9 a. Explain the various vehicle models. 8

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

Spining mass = 1500 kg; Radius of gyration = 1.2 m; Wheel base = 3.1 m; 12

Distance between rear axle and C.G. = 1.7 m; Front spring stiffness = 35 kN/m;

Rear spring stiffness = 38 kN/m.

10 a. Explain various factors that affect the aerodynamic drag. 12

b. Explain various aero dynamic aids. 8

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