

GUJARAT TECHNOLOGICAL UNIVERSITY**B. E. VIIth Semester–Examination – Nov- 2011****Subject code: 170203****Subject Name: Vehicle Dynamics****Date: 24/11/2011****Time: 10:30 am – 01:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a) (i) What is Vehicle Axis System and Earth Fixed Axis System? 02**
(ii) A 4-door Sedan with 3.0 L engine is accelerate from a standing startup to 6% grade at an acceleration of 2 m/sec^2 . Calculate the load distribution on front and rear axles at this condition. **05**
The curb weight on front axle = 8673 N and the curb weight on rear axle = 4882 N is given for vehicle standing on straight road.
Passenger weight of 890 N is distributed 49% on front axle and 51% on rear axle.
Consider height of CG of vehicle from road surface is 51 cm and wheel base is 2.7m. Assume that aerodynamic forces are negligible and there are no trailer hitch forces acting on the vehicle.
- (b) Discuss power limited acceleration and traction limited acceleration of motor vehicle. 07**
- Q.2 (a) (i) Calculate the maximum tractive effort and corresponding road speed in first and top gears of the car when inertia losses are neglected. The information about engine and drive train components for a passenger car as follows: 04**
Engine Maximum Torque = 272.52 Nm
Engine Speed for corresponding max. torque = 4400 RPM
Gear ratio for 1st gear = 4.28 and top gear = 1.00
Transmission efficiency for 1st gear = 0.966%
Transmission efficiency for top gear = 0.970%
Final drive ratio = 2.92 and Final drive efficiency = 0.99%
Radius of wheel = 32 cm
- (ii) Define: Brake factor, Brake efficiency & Brake proportioning 03**
- (b) Discuss the performance of braking on dry and wet road condition with vehicle slip and explain the effect of vehicle velocity, inflation pressure and vertical load on braking coefficients. 07**
- OR**
- (b) (i) Consider LCV weighing 16175 N, performing a full stop from 97 km/h on a level surface with a brake application that develops a steady brake force of 8900 N. Determine deceleration, stopping distance, time to stop and brake power at initial application of brake and over the stop. Neglect aerodynamic and rolling resistance forces. 04**
- (ii) Differentiate Bias ply and Radial ply tire based on construction, ride comfort and directional stability of vehicle. 03**

- Q.3 (a)** Define cornering stiffness and camber stiffness. Discuss the parameters affecting cornering properties of tire. **07**
- (b)** (i) Explain tire axis system. **04**
(ii) "Turning radius of vehicle can be reduced by the use of four wheel steering"- Justify the statement. **03**
- OR**
- Q.3 (a)** What is steering geometry error? Explain the effects of steering geometry error. **07**
- (b)** (i) What is the effect of steering torque, arising from later inclination angle and caster angle while steering? **02**
(ii) Derive the expression for the roll moment distribution on front and rear axle when vehicle is in steady state cornering. **05**
- Q.4 (a)** What is Understeer gradient? Discuss understeer gradient for Neutral, Understeer and Oversteer. **07**
- (b)** Define different aerodynamic forces acting about the principal axes of the car. Explain the effect of aerodynamic aids provided in passenger car on aerodynamic drag. **07**
- OR**
- Q.4 (a)** (i) A heavy truck weighing 32887 kg moving at a speed of 108 km/h. The projected frontal area of truck is 6.5 m^2 and has an aerodynamic drag coefficient of 0.65. Calculate aerodynamic drag, rolling resistance and engine power required to overcome drag and rolling resistance. **04**
Take, Density of air = 1.2 kg/m^3 ; Rolling resistance coefficient = $[0.015 + 0.00016V]$, Where V is in km/h.
(ii) Enlist the various mechanisms responsible for rolling resistance. **03**
- (b)** Explain the factors affecting rolling resistance. **07**
- Q.5 (a)** (i) Draw quarter-car model representing the comparative ride performance of passive and active system. **04**
(ii) Write down the function of vehicle suspension system with dynamics point of view. **03**
- (b)** Explain the sources of vehicle ride vibration. **07**
- OR**
- Q.5 (a)** Define suspension roll center and roll axis and explain the procedure for finding roll centers for independent suspension with sketch. **07**
- (b)** Explain passive suspension, semiactive suspension and full active suspension system. Compare them based on their vehicle ride and handling performance potential. **07**
