Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**B. E. - SEMESTER – VII • EXAMINATION – WINTER 2012**

**Subject code: 170203** **Date: 01/01/2013**

**Subject Name: Vehicle Dynamics**

**Time: 10.30 am - 01.00 pm** **Total Marks: 70**

Instructions:

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

**Q.1 (a)** A car moving on plain road has Static front Axle Weight = 1000 Kg , and Static Rear Axle Weight = 500 Kg , Wheel base = 1.5 meters and Height of CG from ground at 200 mm. **07**

i) Find out distance of CG from front axle

ii) Calculate Dynamic Axle loads on front & rear Axles when Vehicle is accelerating on plain road at 19.62 m/sec$^2$.

iii) Calculate Dynamic Axle loads on front & rear Axles when Vehicle is moving on a gradient of 15$^o$.

**(b)** Give detailed explanation of main sources of Drag and types of Aerodynamic Aids used in passenger cars. **07**

**Q.2 (a)** Draw a neat sketches of the following:

i) SAE vehicle axis system. **02**

ii) Earth fixed coordinates system. **02**

iii) Tyre Axis System **03**

**(b)** Explain the following:

i) Importance of Empirical & Analytical methods. **02**

ii) The concept of Euler Angles. **02**

iv) Construction of Bias & Radial tyre with the help of neat sketch. **03**

**OR**

**(b)** i) What are the basic functions of Tyres. **01**

ii) Explain the importance of Power to weight ratio in performance of vehicle. **03**

iii) Explain Anti lock braking system. **03**

**Q.3 (a)** Explain the concept of Ride performance and write detailed note about various Excitation forces, their impact on ride and damping characteristics. **07**

**(b)** With the help of a neat sketch explain Arbitrary Forces acting on a Vehicle, at gradient θ and derive the equations for $W_f$ & $W_r$ **07**

**OR**

**Q.3 (a)** Explain the following turning response properties: **07**

Under steer gradient.

Neutral steer.

Under steer.

Over steer.

Characteristic speed and Critical speed

**(b)** 1. Describe functions of Suspension and different types of suspensions. **05**

2. Effect of stiffer springs on Sprung mass natural Frequency and Effect of damping on suspension isolation behavior. **02**

**Q.4 (a)** i) Find Max Tractive force, $F_{xmax}$ (for power limited acceleration). **07**

ii) Find Max Tractive force, $F_{xmax}$ (for Traction limited acceleration) in case of rear wheel drive independent rear suspension. Distance of CG = 2 m,

from Front axle.

iii) Find $F_{xmax}$ , (for Traction limited acceleration) in case of front wheel drive with independent front suspension. Distance of CG = 1.2 m, from Front axle.

The Vehicle is moving on level road and without hitch load, at a steady speed without acceleration. Assume the loss of tractive force due to inertia of engine, transmission, drive shaft & wheel is already included in the Combined transmission efficiency of Transmission & Rear Axle, $\eta_{tf} = 0.90$

Following are the vehicle specifications:

- Weight of the vehicle acting at CG = 1800 kg.
- Maximum Engine Torque = 60 Kg-m
- 1st Gear Ratio = 3.89
- Final Drive Ratio = 6.74
- Tyre Rolling Radius = 0.5 m
- Wheel Base = 3.2 m
- Height of CG = 0.7 m, from ground
- Coefficient of Friction at tyre & road contact area, $\mu = 0.7$

**(b)** Draw a neat sketch of Pressure distribution along the centerline of a car and explain how the knowledge of Pressure distribution can be utilized. **07**

**OR**

**Q.4 (a)** Explain the following:

1. Cornering ability **01**
2. Directional response **01**
3. Handling **01**
4. Steering geometry errors. **02**
5. Define Roll over **02**

**Q.4 (b)** Explain the Tyre tractive properties in terms of Peak & Slide Coefficients of friction AND its dependence on Vertical Load, Inflation Pressure, Surface Friction, Speed. **07**

**Q.5 (a)** i) Write the differences between Disc brake system and Drum brake system. **03**

ii) A car having total weight of 2500 kg, is attempted to stop from 100 kms/hr speed find (a) how much energy will be absorbed due to braking. (b) The vehicle if stopped within 6 sec, how much power is absorbed by braking system. **04**

**(b)** What is brake proportioning? With help of graph explain why it is important. **07**

**OR**

**Q.5 (a)** i) If a vehicle decelerates due to application of brakes at 2g deceleration, from its speed of 100 km/hr, what will be the stopping distance and stopping time for this vehicle? **05**

ii) explain the proportionality importance of stopping distance and stopping time **02**

**(b)** Explain the following:

1. Anti Squat and Anti Dive Suspension Geometry. **04**
2. Define Roll Centre and Roll axis. **03**

**********