

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° .
- (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, $F_{x\max}$ (for power limited acceleration). **07**
 - ii) Find Max Tractive force, $F_{x\max}$ (for Traction limited acceleration) in case of rear wheel drive independent rear suspension. Distance of CG = 2 m,

from Front axle.

- iii) Find $F_{x\max}$, (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: 01
1. Cornering ability 01
 2. Directional response 01
 3. Handling 02
 4. Steering geometry errors. 02
 5. Define Roll over 07
- 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: 04
1. Anti Squat and Anti Dive Suspension Geometry. 03
 2. Define Roll Centre and Roll axis. 03
