

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**M. E. - SEMESTER – I • EXAMINATION – WINTER • 2013**

**Subject code: 711106N****Date: 06-01-2014****Subject Name: Vehicle Dynamics****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) Differentiate independent and rigid axle suspension system of a vehicle. **07**  
 (b) Define primary adjustable wheel alignment angles. Explain their effect on vehicle, when it is in motion. **07**

- Q.2** (a) Differentiate Hotchkiss and torque tube drives of vehicle. **07**  
 (b) Define roll center and roll axis. Locate the roll center for a) Four link Rear suspension b) Four link with parallel arms c) Short and long arms suspension d) McPherson suspension. **07**

**OR**

- (b) Explain the various loads acting on leaf spring and enlist the design consideration for leaf spring of a passenger car. **07**
- Q.3** (a) What is the effect of suspension damping on suspension isolation behavior? Explain the construction and working of twin tube type shock absorber. **07**  
 (b) (i) Derive the fundamental condition to be satisfied by two wheel steering mechanism, if true rolling for all the wheels of vehicle is to be obtained. **05**  
 (ii) Define Handling with respect to vehicle dynamics. How to measure Handling? **02**

**OR**

- Q.3** (a) Draw and explain Ackerman and Davis steering gear mechanism. **07**  
 (b) Explain neutral steer, under steer and over steer for vehicle. **07**
- Q.4** (a) Draw vehicle ride dynamic system and explain various single degree of freedom excited systems for vehicle. **07**  
 (b) Draw two degree of freedom suspension model by considering pitching motion in one plane. Determine the equation of motion for the same. **07**

**OR**

- Q.4** (a) Draw vehicle model for a harmonically base excited single degree of freedom system. Determine equation of motion for the absolute displacement. Calculate the absolute steady state amplitude of vibration of above mentioned vehicle model having,  
 Mass = 2kg; Suspension stiffness = 100 kN/m; and Suspension damping coefficient = 100 Ns/m. and base excitement  $Y=0.002\sin 350t$  is applied on the system. **07**  
 (b) Explain types of resistance of motion of a vehicle and also enlist the factors affecting the road resistances. **07**
- Q.5** (a) Draw free body diagram of a car and the trailer when moving on an inclined road and pulling a trailer. Determine equation for dynamic axle loading. **07**  
 (b) Determine the tire reaction forces of a parked car on a banked road having angle  $4^\circ$ . A car having following specifications: **07**  
 Mass of vehicle = 980kg  
 Height of CG from the road surface = 0.6 m

Wheel track = 1.52 m

Distance of CG from Front right wheel = Front left wheel.

**OR**

- Q.5 (a)** Explain the procedure for locating mass center of a passenger car and consider a car with the following specifications, which is parked on a level road. Determine the loads on the front and rear axles. **07**

Mass of vehicle = 1765 kg

Distance of front axle from mass center = 1.22 m

Distance of rear axle from mass center = 1.62 m

- (b)** Whether the four wheel drive vehicle having following specifications is able to pull a trailer or not? **07**

Vehicle engine power = 40.5 kW.

Weight of vehicle = 12500N

Trailer Weight = 10675 N

Speed of vehicle = 57.80 km/hr

Total resistance of motion  $R = 0.016 W + 0.055 V^2$ ; W in N and V in km/hr.

Transmission efficiency = 90%

Also calculate the pull in the coupling at this speed.

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