Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent institution of MAHE, Manipal)

VI SEMESTER B.TECH. (MECHATRONICS ENGINEERING)

END SEMESTER MAKE UP EXAMINATIONS

SUBJECT: VEHICLE DYNAMICS [MTE 4026]

(/06/2018)

Time: 3 Hours **MAX. MARKS: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided may be suitably assumed.

1A A car is parked on an uphill road and has mass, m = 2495 kg, wheel base 3570 mm. If $a_1 = a_2$, h = 670 mm, angle of inclination $\phi = 30°$. Determine the forces under the wheels, if the car is front wheel braking. Also, calculate the tilting angle, ϕ_T. **04**

1B With the help of a diagram, explain the different parts of wheel and rim. **04**

1C Draw a radial tire and label its interior components and arrangements. **02**

2A Derive the expression $R_w = 1/3. (2R_g+R_h)$ for a tire where R_w is the effective radius of tire, R_g is the unloaded radius and R_h is the loaded radius of the tire. **04**

2B A car has a weight of 7500 N in the front axle and 6000 N in the rear axle with a wheel base of 3.0 m. Cornering stiffness on the rear axle of the tire is 232 N/degree and front axle is 195 N/degree. Determine the following cornering properties of the vehicle: **04**

i. Ackermann Steering Angle for 180 m turn radius
ii. Understeer Gradient
iii. Critical Speed
iv. Characteristic Speed

(Take g = 9.8 m/s^2)

2C List the requirements for antilock braking systems. **02**

3A Consider an accelerating car on a level road. (Figure 3A). If the forces under the front and rear wheels, F_{z1} and F_{z2}, are given then prove that the acceleration of the car is: **05**

$$a = \frac{a_2 - a_1 (F_{z_1}/F_{z_2})}{h + h (F_{z_1}/F_{z_2})} g$$

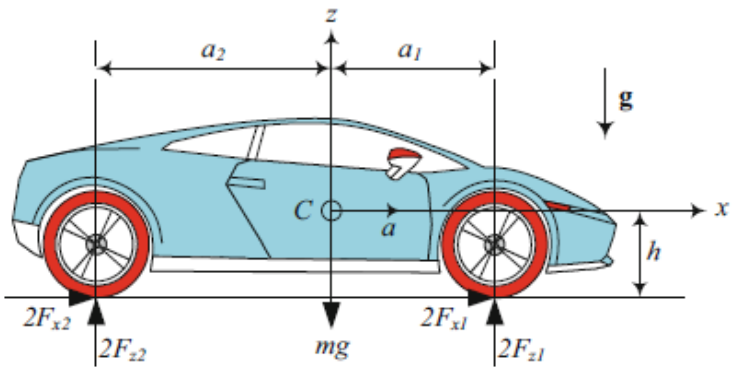

Figure 3A

3B Discuss the hysteresis effect in tires by using the stress – strain curve. **03**

3C State the reason for implementing antilock braking system and traction control system in a vehicle. **02**

4A Explain the bicycle model of a car and derive the expressions for the cornering forces for the wheels. **05**

4B Define the term hydroplaning and discuss the different types of hydroplaning. **05**

5A Honda CR-V is a midsize SUV car with a mass of 1550 kg, wheel base of 2620mm. Assume $a_1 = a_2$, h = 720mm, $\mu_x = 0.8$. Evaluate the maximum acceleration of the car if: **05**

i. the car is rear-wheel drive
ii. the car is front-wheel drive

5B Consider the situation where a car is pulling a trailer on an flat road. Draw the individual free body diagram of the car and trailer and mention all the forces that are acting on it. Write the equilibrium equations for the same. **03**

5C Describe the roll, pitch, and yaw motion in a car. **02**