Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VI SEMESTER B.TECH. (AUTOMOBILE ENGINEERING)

END SEMESTER EXAMINATIONS, APRIL/MAY 2017

SUBJECT: VEHICLE AERODYNAMICS [AAE 3251]

REVISED CREDIT SYSTEM
(22/04/2017)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. Define Interference drag. With suitable sketch explain the effect on drag coefficient of cylinder one behind the other. **(03)**

1B. With suitable sketch explain the vortex system for a fast back with low and high drag coefficient vehicle models. **(03)**

1C. With neat sketch explain the flow field and pressure distribution for a vehicle shaped body in two dimensional flow. **(04)**

2A. Advertisement signs are commonly carried by taxicabs for additional income, but they also increase the fuel cost. Consider a sign that consists of a 0.30-m-high, 0.9-m-wide, and 0.9-m-long rectangular block mounted on top of a taxicab such that the sign has a frontal area of 0.3 m by 0.9 m from all four sides. Determine the increase in the annual fuel cost of this taxicab due to this sign. Assume the taxicab is driven 60,000 km a year at an average speed of 50 km/h and the overall efficiency of the engine is 28 percent. Take the density, unit price, and heating value of gasoline to be 0.72 kg/L, 50/L, and 42,000 kJ/kg, respectively, and the density of air to be 1.25 kg/m^3. Take drag coefficient as 2.2. **(03)**

2B. With suitable sketch explain the vortex formation in a wheel with sharp and rounded shoulders. Also explain the effect of wheel hosing on drag and lift. **(04)**

2C. Sketch and explain the free body pressure distribution of cab and trailer with and without deflector. **(03)**

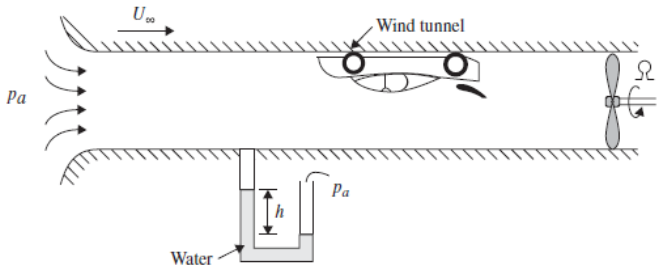
3A. With neat sketch explain the types of cab to trailer gap seals. **(03)**

3B. What do you mean by wind tunnel balancer? With suitable sketch explain the different types of balancer used in wind tunnel. **(04)**

3C. A 650 kg racecar was attached to a wind tunnel ceiling as shown in the sketch. Next, airspeed was increased up to a point (and beyond) when the aerodynamic forces could keep the car attached to the ceiling. **(03)**

a. If the lift coefficient of the car is $C_L = -3.0$, and its frontal area is 1.5 m^2, calculate at what speed the aerodynamic forces are equal to its weight.

b. What is the water column height h in the manometer measuring the tunnel speed? (ρ_{water} = 1000, ρ_{air} =1.22kg/m^3)



4A. During steady motion of a vehicle on a level road, the power delivered to the wheels is used to overcome aerodynamic drag and rolling resistance (the product of the rolling resistance coefficient and the weight of the vehicle), assuming the friction at the bearings of the wheels is negligible. Consider a car that has a total mass of 950 kg, a drag coefficient of 0.32, a frontal area of 1.8 m^2, and a rolling resistance coefficient of 0.04. The maximum power the engine can deliver to the wheels is 80 kW. Determine (a) the speed at which the rolling resistance is equal to the aerodynamic drag force and (b) the maximum speed of this car. Take the air density to be 1.20 kg/m^3. **(03)**

4B. With suitable sketch explain the influence of aerodynamic forces on braking performances. **(03)**

4C. With neat sketch explain the working of Laser Doppler Anemometer. **(04)**

5A. What are the functions of front spoiler? With suitable sketch explain effect of spoiler height on lift at front and rear axle, and effect on drag **(04)**

5B. What do you mean by aerodynamic noise? Explain the types of noise and list the different design modifications adopted to reduce noise in a vehicle. **(04)**

5C. What is Soiling? Explain the methods adopted in buses to reduce soiling on side wall and rear soiling. **(02)**