Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VI SEMESTER B.TECH. (AUTOMOBILE ENGINEERING)

END SEMESTER EXAMINATIONS, JUNE 2018

SUBJECT: VEHICLE AERODYNAMICS [AAE 3251]

REVISED CREDIT SYSTEM
(11/06/2018)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. With suitable sketch explain the pressure distribution over a vehicle shape. **(03)**

1B. Sketch and explain the forces and moments acting on a vehicle. **(03)**

1C. 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. **(04)**

2A. During major windstorms, high vehicles such as RVs and semis may be thrown off the road and boxcars off their tracks, especially when they are empty and in open areas. Consider a 5000-kg semi that is 9 m long, 2.5 m high, and 2 m wide. The distance between the bottom of the truck and the road is 0.75 m. Now the truck is exposed to winds from its side surface. Determine the wind velocity that will tip the truck over to its side. Take the air density to be 1.1 kg/m^3 and assume the weight to be uniformly distributed. Take drag coefficient as 2.2. **(03)**

2B. Sketch and explain the air flow phenomenon over A pillar and windshield inclinations of a passenger car. **(03)**

2C. With neat sketch explain the air flow patterns in a notch back car. **(04)**

3A. With suitable sketch explain the effect of non-streamlined wheel on overall drag of passenger car. **(03)**

3B. Sketch and explain the effect of front spoiler on drag and front axle lift of the passenger car. **(04)**

3C. A wind turbine with two or four hollow hemispherical cups connected to a pivot is commonly used to measure wind speed. Consider a wind turbine with four 8-cm-diameter cups with a centre-to-centre distance of 40 cm, as shown in Fig 1. The pivot is stuck as a result of some malfunction, and the cups stop rotating. For a wind speed of 15 m/s and air density of 1.25 kg/m^3, determine the maximum torque this turbine applies on the pivot. The drag coefficient for a hemispherical cup is 0.4 and 1.2 when the hemispherical and plain surfaces are exposed to wind flow, respectively. **(03)**

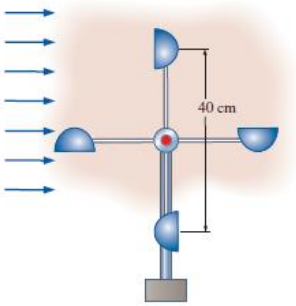

Figure 1

4A. With neat sketch explain the effects of different cab to trailer body heights with both sharp and rounded upper windscreen leading edges. **(04)**

4B. With suitable sketch explain the process involved in detail optimization of a vehicle model. **(03)**

4C. Sketch and explain the functions of each component of a subsonic open type wind tunnel. **(03)**

5A. With neat sketch explain the working of laser Doppler anemometer. **(04)**

5B. Define aerodynamic noise? Explain the design changes may be adopted in A pillar and side mirrors to reduce aerodynamic noise. **(03)**

5C. A 25000 kg truck coasts in a highway at 60 km/hr as shown in figure 2. Determine the power required assuming that the rolling resistance for a truck on concrete is 1.2% of the weight and the drag coefficient is 0.96. **(03)**

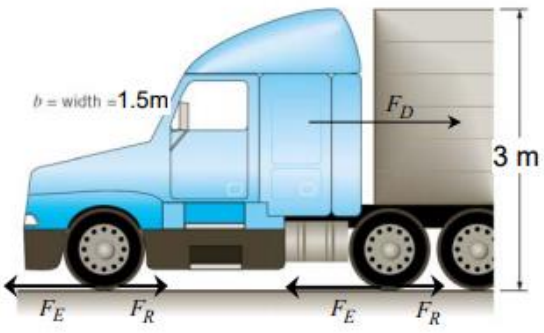

Figure 2