Reg. No.

MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal)

II SEMESTER M.TECH. (AUTOMOBILE ENGINEERING) END SEMESTER EXAMINATIONS, APRIL / MAY 2019

SUBJECT: VEHICLE AERODYNAMICS [AAE 5240]

REVISED CREDIT SYSTEM (29/04/2019)

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ALL the questions.
- Missing data may be suitable assumed.
- **1A.** Calculate the specific weight, density and specific gravity of one litre of a liquid **(02)** which weighs 7N
- **1B.** If the velocity distribution over a plate is given by $u = \frac{x}{y}y y^2$ in which 'u' is the (03) velocity in meter per second at a distance 'y' meter above the plate. Determine the ' τ ' at y=0 and y=0.5 m. Take dynamic viscosity of fluid as 8.63 poise.
- 1C. With the help of neat diagrams explain the classifications of all fluid flows. (05)
- 2A. A 30 cm diameter pipe carrying water branches into two pipes of diameter 20 (02) cm and 15 cm respectively. If the average velocity in the 30 cm pipe is 2.5 m/sec. find the discharge in this pipe. Also determine the velocity in 15 cm pipe if the average velocity 20 cm diameter pipe is 2 m/sec.
- **2B.** Derive three dimensional flow continuity equation.

- (03)
- 2C. A bluff body flat edge 1.5m X 1.5m moves at 50 km/hr in stationary air of (05) density 1.15 kg/m². if the coefficient of drag and lift are 0.15 and 0.75 respectively. Determine (i) Lift force (F_L) (ii) Drag force (F_D) (iii) Resultant force (F_R) (iv) Power required to keep the vehicle in motion (P) and (v) Direction of resultant force (θ).
- **3A.** Find the displacement thickness (δ^*), the momentum thickness (θ) and energy **(05)** thickness (δ^{**}) for the velocity distribution in the boundary layer given by $\frac{u}{v} = \frac{y}{\delta}$ where 'u' is the velocity at a distance 'y' from the plate and u=U at y= δ . Where δ =Boundary layer thickness. Also calculate the value of δ^*/θ and δ^*/δ^{**} .
- **3B.** Discuss at least five advantages of aerodynamics in modern performance cars. **(05)** Also explain any three aerodynamic devices used in modern performance cars.

- **4A.** Explain the purpose of using wire meshes in the effuser of a wind tunnel?
- 4B. A low subsonic wind tunnel has a diffuser of area ratio 9. At a test section (03) velocity of 30m/s and a temperature of 330K, the diffuser is found to have an efficiency of 90%. If the pressure at the inlet to the diffuser is 1.195 x 10⁵N/m² calculate the head loss in the diffuser.

(02)

- **4C.** Explain the working principle of a small scale sub sonic closed wind tunnel with **(05)** suitable sketch.
- 5A. Briefly explain the measurement of pressure, velocity and force in a wind tunnel. (02)
- **5B.** Describe the principle of constant temperature and constant current type **(03)** anemometer with a neat sketch.
- 5C. A U-tube manometer is used to measure the pressure of water in a pipe line, (05) which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U tube is 10cm and the free surface of mercury is in level with the center of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m², calculate the new difference in level of mercury. Sketch the arrangements in both the cases.