R	eg	۱.	JO.



I SEMESTER M.TECH (TSES) END SEMESTER EXAMINATIONS,

MAKE-UP DECEMBER 2018

SUBJECT: MEASUREMENTS IN THERMAL ENGINEERING [MME 5144] REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

4

3

2

Instructions to Candidates:

- Answer ALL the questions.
- Missing data may be suitably assumed.
- **1A.** Derive an expression for the theoretical flow rate through a Venturi-meter.
- 1B. With a neat diagram explain the calibration of a gas flow meter by using bell prover system.3
- **1C.** With a neat diagram explain the working of vortex-shedding flow meter.
- 2A. A U-tube manometer employs special oil having specific gravity of 0.85 as a manometer liquid. One limb of the manometer is exposed to the atmospheric pressure of 760 mm of Hg. The difference in the oil level in the limbs of manometer is 200±1 mm when exposed to air source at 25°C.

i) Calculate the air pressure and uncertainty associated with it.

ii) If the manometer is carelessly mounted with an angle of 3° w.r.t the vertical, what is the error in the indicated pressure?

- **2B.** Name the instruments used to measure pressure of the order of 10^6 mm of Hg and above.
- **2C.** With a neat diagram explain the construction of Prandtl type micro-manometer. **3**
- **2D.** With a neat diagram explain the working of Bridgeman gauge.

MME 5144

3A. A mercury-in-steel thermometer employs a Bourdon pressure gauge which has a range of 0 to 6 MPa for the pointer rotation of 0° to 270°. In the temperature calibration process the pointer was set to 0° at 0°C and the instrument indicated 250° rotation at 200° C. Determine;

i) Sensitivity of the instrument in rad/°C.

ii) The error due to ambient temperature rise of 16°C, if the thermometer bulb has volume 8 times that of combined volume of capillary and Bourdon tube.

iii) The error in the observed temperature values if the bulb is raised by 600 mm from the calibration elevation.

- **3B.** With neat sketches show the construction of following thermocouple junctions;
 - i) Grounded junction
 - ii) Exposed junction
 - iii) Button junction

Also mention their uses.

- 3C. With a neat schematic diagram explain the working of chopped (AC) selective band (photon) radiation thermometer.3
- **3D.** What is a thermopile? What is its use?
- **4A.** Describe the response of a first order instrument to a step function input. **4**
- **4B.** For steady incompressible pipe flow, the D'Arcy friction coefficient *f* is related to the Reynolds number (Re) as; $f = a(\text{Re})^b$. Determine constants *a* and *b* using the following experimental data.

Re	500	1000	1500	2000
f	0.032	0.016	0.0107	0.008

4

2

3

3

1

4C. What is cold junction compensation? How it is done?

- 5A. What is the input and output signal for the following transducers;a) Thermocouple, b) Manometer, c) Spring balance, d) Piezo-electric sensor2
- **5B.** What do you mean by the sensitivity drift of a measuring instrument?
- 5C. what is calibration? Differentiate between primary and secondary calibration? 2
- **5D.** The coefficient of discharge of an orifice is given by $c_d = \frac{W}{t\rho A\sqrt{2gh}}$. Calculate the value of c_d with its uncertainty for the following data.

 $W = (500 \pm 0.2) \text{Kg}, \quad d = (15 \pm 0.02) \text{mm}, \quad t = (500 \pm 2) \text{s}, \quad \rho = (1000 \pm 0.1\%) \text{kg/m}^3,$ $g = (9.81 \pm 0.1\%) \text{m/s}^2, \text{ and } h = (4 \pm 0.05) \text{m}$

2