



Reg. No. : .....

Name : .....

**Second Semester M.Tech. Degree Examination, September 2015**  
**Mechanical Engineering – Thermal Science**  
**MTC 2002 : MEASUREMENTS IN THERMAL SCIENCE**  
**MPE 2001 : Measurements in Fluid Flow and Heat Transfer**

Time : 3 Hours

Max. Marks : 60

- Instructions :** 1) **Use of Heat and Mass Transfer Data book is permitted.**  
2) Answer **any two** questions in full from **each Module**.

**MODULE – I**

1. a) Discuss the different types of errors in measurement. **4**
- b) A guarded hot plate apparatus is used to measure the thermal conductivity of a metal having  $k = 0.188 \text{ W/mk}$ . The thickness of the specimen is  $(3.175 \pm 0.05) \text{ mm}$  and the heat flux may be measured within 1 percent. Calculate the accuracy necessary on the  $\Delta T$  measurement in order to ensure an overall uncertainty in the measurement of  $k$  of 5%. If one of the plate temperature is  $422 \text{ K}$  calculate the nominal value of the other plate temperature and the tolerable uncertainty in each temperature measurement assuming a heat flux of  $63076 \text{ W/m}^2$ . Use the equation below to estimate the uncertainty. **6**
- $$k = \frac{(q/A)\Delta x}{\Delta T} \text{ (use the Kline and McIntock method)}$$
2. a) Explain Goodness of fit and index of correlation. **4**
- b) With neat sketch explain the working of vanishing filament pyrometer. **6**
3. a) A pyrometer gives the brightness temperature of an object to be  $800^\circ\text{C}$ . The optical transmittance collected by the pyrometer is known to be  $0.965$  and the target emissivity is  $0.260$ . Estimate the temperature of the object. Take  $\lambda = 0.655 \mu\text{m}$  as the effective wavelength of the pyrometer. **4**
- b) Explain any one heat flux measurement technique. Show that the heat flux, measured using a foil type heat flux gauge, is proportional to the voltage generated across the two copper wires of the gauge. **6**



### MODULE – II

4. a) A U tube manometer employs special oil having a specific gravity of 0.82 as the manometer liquid. One limb of the manometer is exposed to the atmosphere at a pressure of 740 mm of Hg and the difference in column heights is measured as  $20 \text{ cm} \pm 1 \text{ mm}$  when exposed to air source at  $25^\circ\text{C}$ . Calculate the air pressure in Pa and the uncertainty. 2
- b) The above manometer was carelessly mounted with an angle of  $30^\circ$  with respect to the vertical. What is the error in the indicated pressure due to this, corresponding to the data given above ? 2
- c) With neat sketch explain the working of McLeod gauge. 6
5. a) With neat sketch explain Mach-Zehnder interferometer. 5
- b) An orifice plate is to be used to measure flow of air at 5 bar and  $25^\circ\text{C}$ . The maximum flow rate is 1 kg/s and the minimum flow rate is to be 0.3 kg/s. Determine the size of the orifice plate such that the pipe Reynolds number is not less than  $10^5$ . 5
6. a) Describe the flow calorimeter. 5
- b) How does a sling psychrometer measure relative humidity ? 5

### MODULE – III

7. Explain any one non separation method for measurement of gas concentration. 10
8. a) What are the different techniques in thermal analysis ? Explain any two of them in detail. 5
- b) What are the functions of a low pass filter ? 5
9. a) In what kinds of situations would data transmission be necessary ? 3
- b) Explain the methods of signal conditioning. 4
- c) With neat sketch explain any one of digital to analog converter. 3