Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER–II • EXAMINATION – SUMMER - 2017

Subject Code: 2722105 **Date: 25/05/2017**

Subject Name: Experimental Techniques and Instrumentations in Thermal Engineering

Time: 02:30 PM To 05:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Refer Table 1 given at the end of paper, if required.**

Q.1 **(a)** Following data is taken while calibrating a bourdon gauge with a dead weight gauge tester: **07**

Actual pressure(bar)	5	10	15	20	25	30	25	20	15	10	5
Gauge reading(bar)	4.5	9.6	14.2	18.0	22.5	28	26	21	16.2	11.4	7

Draw the calibration and the error curves. Make suitable comments on the results

(b) State the necessity of a data acquisition system. Present the schematics of such a system and point out the function of each element comprising it. **07**

Q.2 **(a)** State the objectives of flow visualization. Explain Schlieren system with neat sketch. **07**

(b) Define the following terms: **07**

1. Tolerance 2. Readability 3. Least count 4. Backlash 5. Repeatability 6. Reproducibility 7. Linearity

OR

(b) What are the different sources of errors in measurements and measuring instruments? Explain with suitable example. **07**

Q.3 **(a)** What is Thermistor? Explain its working with advantages and disadvantages. **07**

(b) A thermopile consisting of five junction pairs of Chromel-constantan is used to measure a temperature difference of 50 °C with the cold junctions at 25 °C. Determine the voltage output of the thermopile. Suppose the cold-junction temperature is incorrectly stated as 75 °C (in reality, the hot-junction temperature). What error in temperature-difference measurement would result from this incorrect statement? **07**

OR

Q.3 **(a)** What is RTD? Explain different methods of construction of RTD. Also compare RTD with thermocouple. **07**

(b) **07**

1. An iron-constantan thermocouple is connected to a potentiometer whose terminals are at 25 °C. The potentiometer reading is 3.59 mV. What is the temperature of the thermocouple junction?
2. A heat-exchanger facility is designed to use type J thermocouples to sense an outlet gas temperature. A safety device is installed to shut down the flow heating system when the gas temperature reaches 800 °C. During a periodic maintenance inspection, the thermocouple is judged to need replacement because of oxidation. By mistake, a type K thermocouple is installed as the

replacement. What may be the results of such an installation?

Q.4 **(a)** Draw and explain the working of Optical pyrometers. **07**

(b) Sketch and explain the hydraulic pump and 4 land control valve used in hydraulic control systems. **07**

OR

Q.4 **(a)** Explain TAGUCHI method for design of experiments. **07**

(b) State the essential difference between the hydraulic and pneumatic controllers. Enumerate the advantages and limitations of each of these controllers. **07**

Q.5 **(a)** Explain principle and operation of hot wire anemometer with neat sketch. **07**

(b) What is Uncertainty? Explain Kline and McClintock method for uncertainty measurement. Also explain uncertainty measurement for product functions. **07**

OR

Q.5 **(a)** Draw and describe the working principle of Orsat apparatus. **07**

(b) A radiometer is used for a temperature measurement at 400 K and 800 K. The emissivity of the surface being measured is estimated as 0.02±0.05 and the absolute uncertainty in the measurement of the emitted energy is estimated as 1 percent of the value of E at 800 K. Determine the uncertainty in the determination of the two temperatures. **07**

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Table 1: Thermal emf in absolute millivolts for commonly used thermocouple combinations, according to ITS (90) (Reference junction of 0 °C)

Temperature, °C	Copper vs. Constantan (*T*)	Chromel vs. Constantan (*E*)	Iron vs. Constantan (*J*)	Chromel vs. Alumel (*K*)	Platinum vs. Platinum–10% Rhodium (*S*)	Nicosil vs. Nisil (*N*)
−150	−4.648	−7.279	−6.500	−4.913		−1.530
−100	−3.379	−5.237	−4.633	−3.554		−1.222
−50	−1.819	−2.787	−2.431	−1.889	−0.236	−0.698
−25	−0.940	−1.432	−1.239	−0.968	−0.127	−0.368
0	0	0	0	0	0	0
25	0.992	1.495	1.277	1.000	0.143	0.402
50	2.036	3.048	2.585	2.023	0.299	0.836
75	3.132	4.657	3.918	3.059	0.467	1.297
100	4.279	6.319	5.269	4.096	0.646	1.785
150	6.704	9.789	8.010	6.138	1.029	2.826
200	9.288	13.421	10.779	8.139	1.441	3.943
300	14.862	21.036	16.327	12.209	2.323	6.348
400	20.872	28.946	21.848	16.397	3.259	8.919
500		37.005	27.393	20.644	4.233	11.603
600		45.093	33.102	24.906	5.239	14.370
800		61.017	45.494	33.275	7.345	20.094
1000		76.373	57.953	41.276	9.587	26.046
1200			69.553	48.838	11.951	32.144
1500					15.582	
1750					18.503	