

**UNIVERSITY COLLEGE TATI (UCTATI)****FINAL EXAMINATION QUESTION BOOKLET**

COURSE CODE	: DEI 2002
COURSE	: SENSOR TECHNOLOGY
SEMESTER/SESSION	: 2-2024/2025
DURATION	: 2 HOURS

Instructions:

1. This booklet contains 4 questions. Answer **ALL** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise your hands and ask the invigilator.

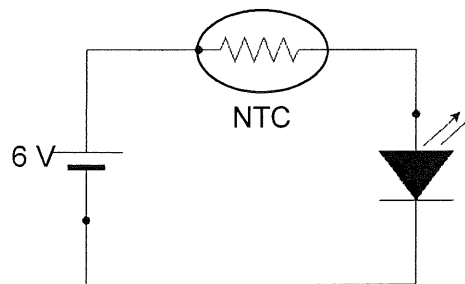
DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 6 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

- a) Describe the relationship between the resistance and temperature for NTC type using the typical resistance/ temperature curve. (2 marks)

- b) Explain how the NTC thermistor works as the temperature sensor in Figure 1. (8 marks)

**Figure 1**

- c) Thermocouples are a widely used type of temperature sensor for measurement and control. Describe thermocouple in terms of its construction and produced output. (4 marks)
- d) Draw a cold junction compensation in thermocouple. (6 marks)
- e) A thermocouple was found to have linear calibration between 0°C and 350°C with emf at maximum temperature (reference junction temperature 0°C) equal to 18.26 mV. Compute the sensitivity value of the thermocouple. (4 marks)
- f) The cold junction of a type K thermocouple is kept at 0°C . Determine the temperature by using Table 1 in the Appendix if the measured voltage is:
- i. 1653 μV (3 marks)
 - ii. 3931 μV (3 marks)

QUESTION 2

There are many types of proximity sensors available in the market. Two common proximity sensors are the inductive and also capacitive proximity sensors.

- a) State the difference between the two sensors in terms of the objects detected and the technology applied to detect the objects. (4 marks)
- b) Explain how an inductive proximity sensor works to detect the object. (6 marks)
- c) Explain how a capacitive proximity sensor works to detect the object. (6 marks)
- d) State two (2) applications for both inductive and capacitive sensors. (4 marks)

QUESTION 3

- a) Names two (2) types of ultrasonic transducer. (2 marks)
- b) Ultrasonic transducer can be used to measure distance or detect the presence or absence of targets. Explain how does ultrasonic transducer work in distance sensing. (6 marks)
- c) State two (2) applications of ultrasonic transducer besides distance sensing. (2 marks)
- d) Describe the general function of infrared sensor. (3 marks)
- e) Infrared spectrum is categorized into three regions based on its wavelength. Name the three (3) regions. (3 marks)
- f) List the three (3) key elements of infrared detection system. (3 marks)
- g) Explain how does an infrared sensor works. (8 marks)
- h) State three (3) applications of infrared sensor. (3 marks)

QUESTION 4

- a) Describe the general function of strain gauge. (6 marks)
- b) List four (4) categories of strain gauge. (4 marks)
- c) Bonded strain gauge falls under one of the categories in Question 4(b). There are four types of bonded strain gauge available which are the linear strain gauge, rosette, torque gauge and helical gauge. Draw those four (4) mentioned bonded strain gauge. (8 marks)
- d) State one application of strain gauge. (2 marks)

-----End of question-----

APPENDIX A

TABLE 1: Temperature (°C) versus emf (μV) for type K thermocouple with 0 °C reference

deg C	0	1	2	3	4	5	6	7	8	9
0	0	39	79	119	158	198	238	277	317	357
10	397	437	477	517	557	597	637	677	718	758
20	798	838	879	919	960	1000	1041	1081	1122	1163
30	1203	1244	1285	1326	1366	1407	1448	1489	1530	1571
40	1612	1653	1694	1735	1776	1817	1858	1899	1941	1982
50	2023	2064	2106	2147	2188	2230	2271	2312	2354	2395
60	2436	2478	2519	2561	2602	2644	2685	2727	2768	2810
70	2851	2893	2934	2976	3017	3059	3100	3142	3184	3225
80	3267	3308	3350	3391	3433	3474	3516	3557	3599	3640
90	3682	3723	3765	3806	3848	3889	3931	3972	4013	4055
100	4096	4138	4179	4220	4262	4303	4344	4385	4427	4468

Note:

Sensitivity of the thermocouple = maximum temperature / range