



Name: Roll No.:

Branch: Signature of Invigilator:

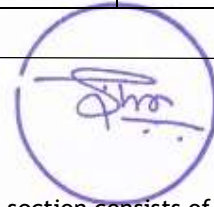
Semester: IVth

Date: 04/05/2022 (MORNING)

Subject with Code: EC333 SENSOR AND TRANSDUCERS

Marks Obtained	Section A (30)	Section B (20)	Total Marks (50)

INSTRUCTION TO CANDIDATE



1. The booklet (question paper cum answer sheet) consists of two sections. First section consists of MCQs of 30 marks. Candidates may mark the correct answer in the space provided / may also write answers in the answer sheet provided. The Second section of question paper consists of subjective questions of 20 marks. The candidates may write the answers for these questions in the answer sheets provided with the question booklet.
2. The booklet will be distributed to the candidates before 05 minutes of the examination. Candidates should write their roll no. in each page of the booklet.
3. Place the Student ID card, Registration Slip and No Dues Clearance (if applicable) on your desk. All the entries on the cover page must be filled at the specified space.
4. Carrying or using of mobile phone / any electronic gadgets (except regular scientific calculator)/chits are strictly prohibited inside the examination hall as it comes under the category of unfair means.
5. No candidate should be allowed to enter the examination hall later than 10 minutes after the commencement of examination. Candidates are not allowed to go out of the examination hall/room during the first 30 minutes and last 10 minutes of the examination.
6. Write on both side of the leaf and use pens with same ink.
7. The medium of examination is English. Answer book written in language other than English is liable to be rejected.
8. All attached sheets such as graph papers, drawing sheets etc. should be properly folded to the size of the answer book and tagged with the answer book by the candidate at least 05 minutes before the end of examination.
9. The door of examination hall will be closed 10 minutes before the end of examination. Do not leave the examination hall until the invigilators instruct you to do so.
10. Always maintain the highest level of integrity. Remember you are a BITian.
11. Candidates need to submit the question paper cum answer sheets before leaving the examination hall.

END SEMESTER EXAMINATION (SP-2022)

EC 333: Sensors and Transducers

Date: 04 May 2022

Maximum Marks: 50, Time: 120 Minutes

Note: Attempt all questions.

PART A: MCQ [30 Marks]

Q1: Which of the following are the main components of a biosensor system [1 Mark]

- (a) Analyte (b) Sensing layer (c) Signal conditioning (d) All of these

Q2: A bioreactor in a biosensor works as [1 Mark]

- (a) Analyte (b) Sensing layer (c) Signal conditioning (d) All of these

Q3: The following is an example of a digital transducer [1 Mark]

- (a) Thermistor (b) Strain gauge (c) Shaft encoder (d) Potentiometer

Q4: In a MEMS sensor fabrication, the portion exposed to UV light gets dissolved in the developer solution in case of [1 Mark]

- (a) Negative photoresist (b) Positive photoresist (c) Both (a, b) (d) None of these

Q5: LVDT works on the principle of [1 Mark]

- (a) Electromagnetic Induction (b) Ampere's Law (c) Kirchhoff's Law (d) Gauss Law

Q6: Following can be used to measure the angular displacement [1 Mark]

- (a) LVDT (b) RVDT (c) Photodiode (d) Either of these

Q7: The transducer that converts light energy to electrical energy is [1 Mark]

- (a) Piezoelectric (b) Photoelectric (c) Pyroelectric (d) Triboelectric

Q8: The transducer that converts light energy to electrical energy is [1 Mark]

- (a) Piezoelectric (b) Photoelectric (c) Pyroelectric (d) Triboelectric

Q9: A linear relationship between capacitance and displacement is found in capacitive transduction based on [1 Mark]

- (a) Change in overlap area (b) Change in distance between plates (c) Change in permittivity (d) Both (a, c)

Q10: The principle of operation of capacitive transducer is based on [1 Mark]

- (a) $C = \epsilon A/d$ (b) $C = \epsilon_0 A/d$ (c) $C = \epsilon d/A$ (d) $C = \epsilon r A/d$

Q11: Which of the following exhibits natural piezoelectric effect [1 Mark]

(a) Lithium sulphate (b) Rochelle salts (c) Quartz (d) Both (b, c)

Q12: The electric field of a quartz piezoelectric crystal having a thickness of 1 mm, voltage sensitivity of 0.5 Vm/N under applied pressure of 10 N/m² is [1 Mark]

(a) 0.5 V/m (b) 5 V/m (c) 10 V/m (d) 20 V/m

Q13: Which is a resistive transducer [1 Mark]

(a) ADC (b) Solenoid (c) Relay (d) Potentiometer

Q14: The conversion time for a SAR type ADC for an analog input signal of 1 V is 0.5 ms. The conversion time for an input of 2 V is [1 Mark]

(a) 3 ms (b) 2 ms (c) 1 ms (d) 0.5 ms

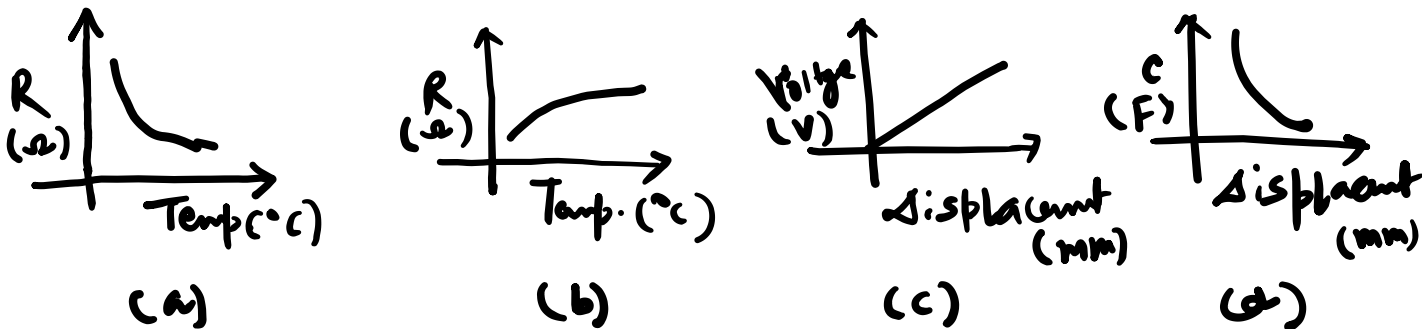
Q15: The unit of Hall Effect Coefficient is [1 Mark]

(a) V-m/(A-Wbm⁻²) (b) V/(A-Wbm⁻²) (c) V-m²/(A-Wbm⁻²) (d) V-m/(A-Wbm²)

Q16: Which is a passive transducer [1 Mark]

(a) Photovoltaic cell (b) Piezoelectric transducer (c) RTD (d) Thermocouple

Q17: Which graph describes RTD (resistance temperature detector) [1 Mark]



Q18: Strain gauge is generally used as [1 Mark]

(a) Primary transducer (b) Secondary transducer (c) Active transducer (d) Both (b, c)

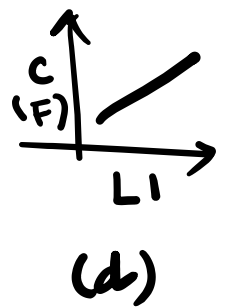
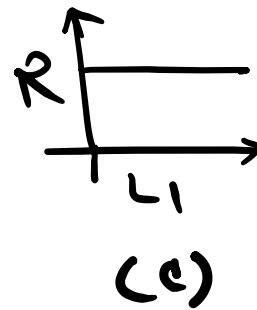
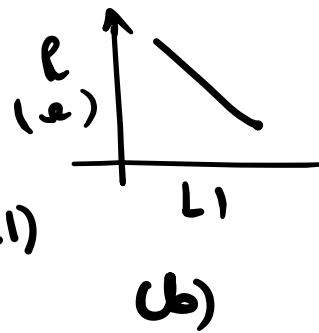
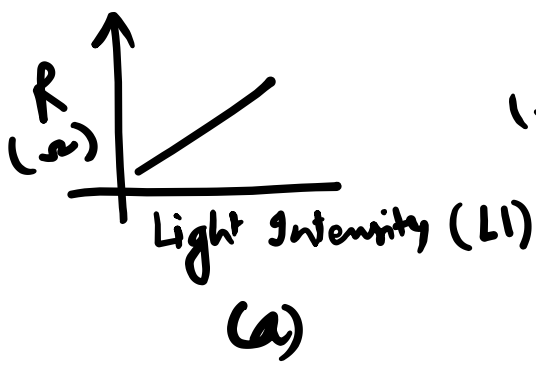
Q19: True value of quantity is 100 V and the measured value is 105 V. The relative static error percentage is [1 Mark]

(a) 100 % (b) 5 % (c) 105 % (d) 4.76 %

Q20: Instrument A measures a current of 1000 A with static error of ± 2 A. While Instrument B measures a current of 10 A with static error of ± 2 A. Which has higher accuracy [1 Mark]

(a) A (b) B (c) Both (d) None of these

Q21: The graph related to LDR (Light dependent resistor) is [1 Mark]



Q22: The linear and angular displacement, both, can be measured by [1 Mark]

- (a) Linear POT (b) Rotary POT (c) Helical POT (d) Both (b, c)

Q23: A device that converts one form of energy to another form is [1 Mark]

- (a) Amplifier (b) Transducer (c) Battery (d) Inverter

Q24: A physical signal is converted to a processable signal by [1 Mark]

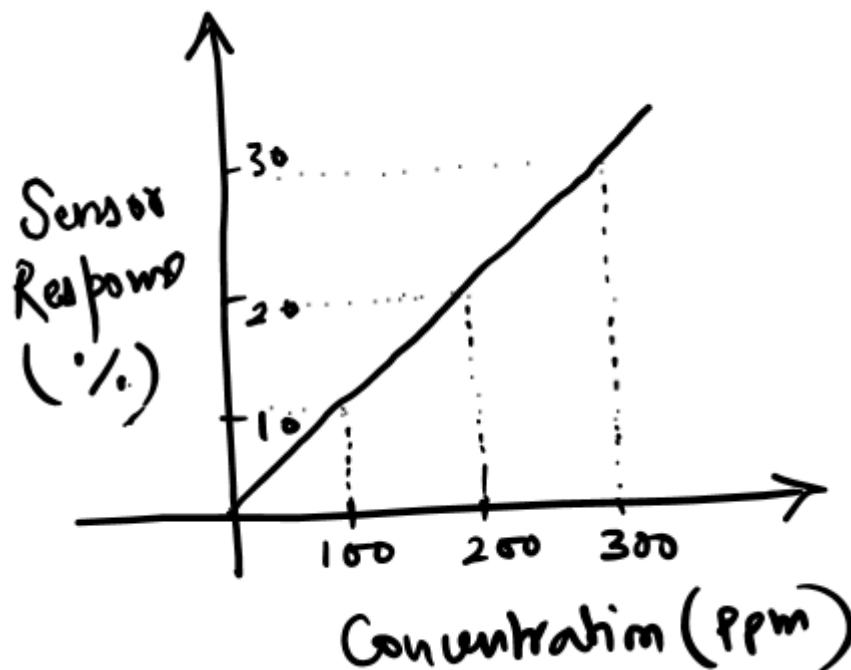
- (a) Amplifier (b) Sensor (c) Actuator (d) Filter

Q25: The magnitude of sensitivity from given sensor response curve is [1 Mark]

- (a) 1 (b) 2 (c) 0.1 (d) 0.2

Q26: The unit of sensitivity from given sensor response curve is [1 Mark]

- (a) Ppm/ % (b) %/ppm (c) ppm (d) % ppm



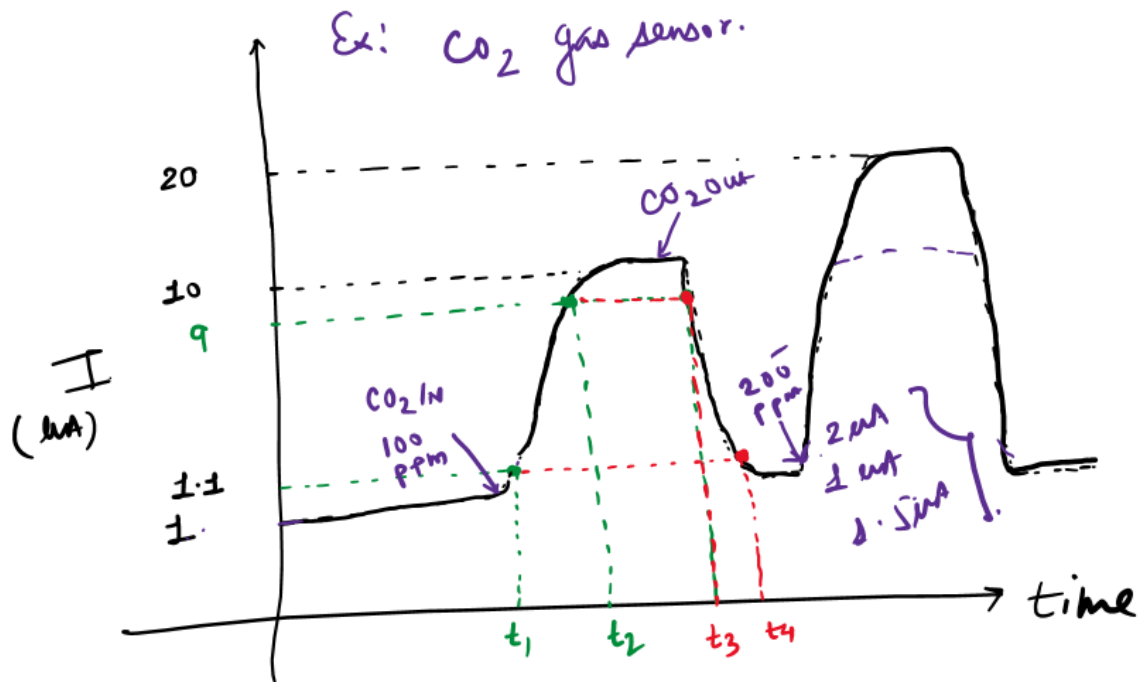
Q27: The baseline resistance of a resistive sensor is 50Ω . This resistance changes to 100Ω after an exposure to 100 ppm of SO_2 gas. The sensor response is [1 Mark]

- (a) 100 % (b) 50 % (c) 10 % (d) 5 %

Q28: A device that utilizes electrical energy to carry out some mechanical action or motion is [1 Mark]

- (a) Amplifier (b) Sensor (c) Actuator (d) Filter

Q29:



The response time for the shown CO_2 sensor is [1 Mark]

- (a) $t_1 - t_2$ (b) $t_3 - t_4$ (c) $t_2 - t_1$ (d) $t_4 - t_3$

Q30: The recovery time for the shown CO_2 sensor is [1 Mark]

- (a) $t_1 - t_2$ (b) $t_3 - t_4$ (c) $t_2 - t_1$ (d) $t_4 - t_3$

END SEMESTER EXAMINATION (SP-2022)

EC 333: Sensors and Transducers

Date: 04 May 2022

Maximum Marks: 50, Time: 120 Minutes

Note: Attempt all questions.

PART B: Subjective [20 Marks]

Q1:

- What is a digital transducer? [1 Mark]
- Draw the block diagram of a generic digital transducer system. [1 Mark]
- Give one example of a digital transducer. [1 Mark]
- Write two points for HART protocol. [2 Marks]

Q2:

- What is an RTD? Why RTD shows a PTC of resistance? [2 Marks]
- A platinum thermometer has a resistance of $100\ \Omega$ at 50°C . (a) Find its resistance at 100°C if the platinum has a resistance temperature co-efficient of $0.00392/^\circ\text{C}$. (b) If the thermometer has a resistance of $150\ \Omega$, calculate the temperature. (c) The device shows NTC or PTC behaviour? [3 Marks]

Q3: The output of an RVDT is connected to a 100 V voltmeter through an amplifier with a factor of 100. An output of 10 mV appears across the terminals of RVDT when the core moves an angular displacement of 1 mm. Calculate the sensitivity of RVDT and the whole system. The voltmeter scale has 100 divisions, and the scale can be read to 1/50 of a division. Calculate the resolution of the instrument in mm. [5 Marks]

Q4: The sensor response of a CO sensor is given in terms of resistance variation. Find the sensor response for each gas concentration. Plot the sensor response curve against gas concentration and calculate its sensitivity along with units. [5 Marks]

CO (ppm)	Resistance of Sensing layer ($k\Omega$)
0	100
10	150
20	200
30	250
40	300