UNIVERSITY COLLEGE TATI

UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET	
COURSE CODE	: BCE2293
COURSE	: INSTRUMENTATION
SEMESTER/SESSION	: 1 - 2023/2024
DURATION	: 3 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 up your hands and ask the invigilator.

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

THIS BOOKLET CONTAINS 5 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

(a) i. How do process instruments compute and facilitate the conversion of raw process data into meaningful information for informed decision-making within industrial operations? (2 marks)

ii. Could you interpret the importance of process instrumentation in optimizing processes and improving energy efficiency in your own words? (2 marks)

(b) i. How can you classify instruments based on their performance characteristics? (2 marks)

ii. Illustrate, using relevant drawings, the distinction between a set of data that is accurate and precise and a set of data that is not accurate but precise. (2 marks)

(c) i. How do you differentiate between an instrument's dynamic and static characteristics? (2 marks)

ii. Based on the given data, construct a graph and elucidate the linearity of the data. (3 marks)
Given thermocouple measurement in mV for different water temperature.

Temperature (°C)	30	35	40	45	50
Voltage (mV)	60	68	76	90	110

QUESTION 2

(a) i. Show in a table the advantages and disadvantages of pneumatic signals. (4 marks)

ii. Compute the standard signal ranges for pneumatic signals (in psi) and electrical signals (current). (4 marks)

(b) i. Interpret the definition of signal conditioning and give two (2) purposes of signal conditioning. (6 marks)

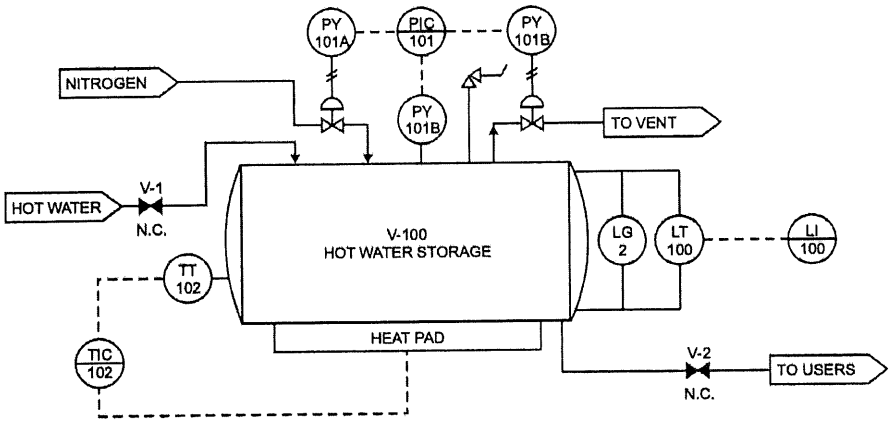
ii. Sketch the basic circuit diagram for an operational amplifier component. (6 marks)

(c) i. How can a P&ID diagram aid in troubleshooting? (2 marks)

iii. Sketch the P&ID symbol for following components: (8 marks)

a. Valve
b. Field mounted instrument
c. Pneumatic signal line
d. Piping break or gap

iv. Choose two (2) controlled variables from the following figure and interpret the controller function. (8 Marks)



QUESTION 3

(a) i. Classify the following signal noise as internal or external sources of signal noise. (6 marks)

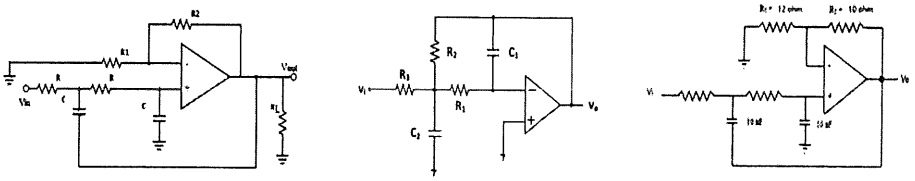
Thermal Noise	Flicker Noise	Electromagnetic Interference (EMI)
Cross-Talk	Resistor Noise	Ground Loops

(4 marks)

ii. Based on the definition of filters, how can we differentiate between low-pass and high-pass filters?

(b) i. Sketch the basic circuit diagram for RC low pass filter (Label V_{in} and V_{out}). (6 marks)

ii. Choose the circuit that shows the Butterworth and Bessel filter from the following figures. (4 marks)



(a) (b) (c)

(4 marks)

iii. Analyze and interpret the response of the following signal filtering filters.

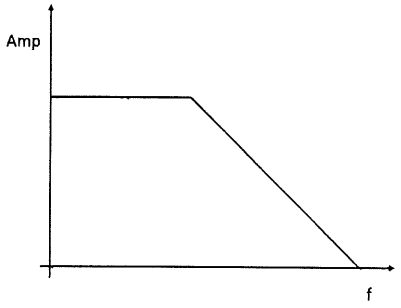


Figure A

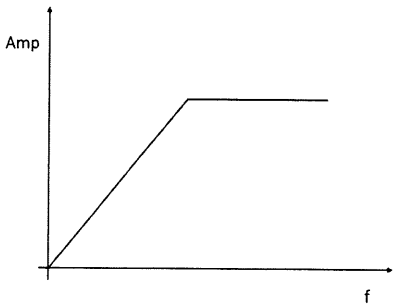
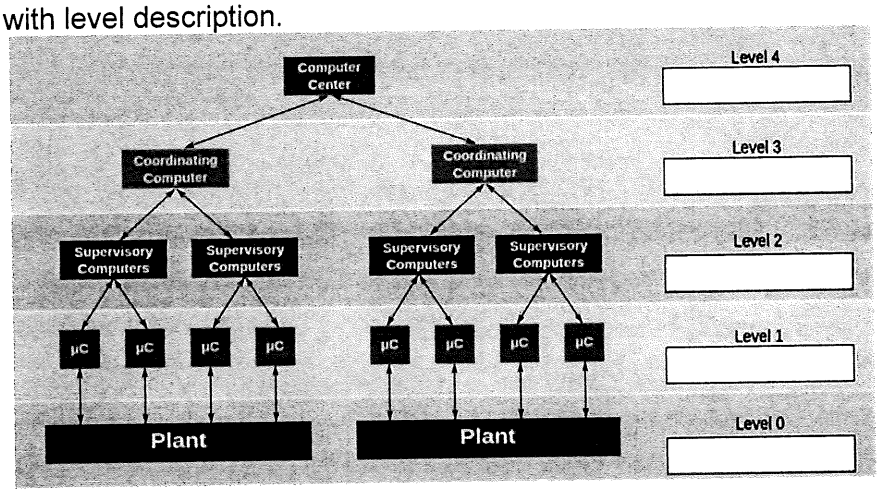


Figure B

QUESTION 4

(a) i. Analyze following DCS structure diagram and complete the diagram with level description. (10 marks)



ii. Discuss the advantages of DCS control system based on following DCS characteristic. (4 marks)

a. Scalability
b. Remote monitoring

(b) i. Interpret the definition of PLC control system and give one (1) key components of PLC control system. (3 marks)

ii. Construct a table to show the advantages and disadvantages of PLC control system. (8 marks)

---------- **End of questions**----------