

CHUKA

UNIVERSITY



UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN PHYSICS, BACHELOR OF SCIENCE, AND BACHELOR OF EDUCATION (SCIENCE)

PHYS 428: PHYSICS PRACTICAL VIII

STREAMS: EB7, EB2 & AB5

TIME: 2 HOURS

DAY/DATE: FRIDAY 25/04/2025

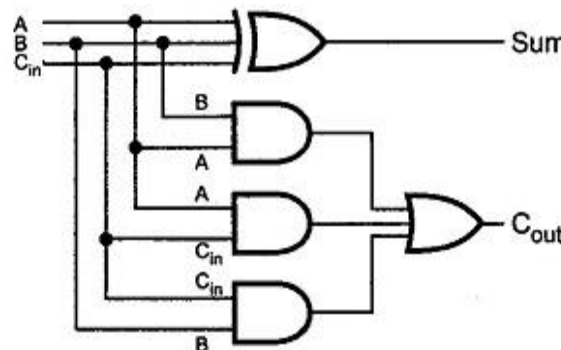
8.30 A.M. – 10.30 A.M.

INSTRUCTIONS

- Attempt **ALL** three questions.
- Question One has 30 marks While two and three have 20 marks each.
- Show all workings where necessary.

Question 1:

- a) Explain the significance of Boolean algebra in simplifying logic diagrams. (3 marks)



- b) Using the above Full adder circuit diagram shown above, write the Boolean expression for the sum part and step-by-step simplify it. (6 marks)
- c) Construct a truth table for the given logic circuit. (6 marks)
- d) State Newton's Law of Cooling and express it mathematically. (4 marks)

- e) Explain why forced convection is necessary for Newton's Law of Cooling to be valid. (4 marks)
- f) Given temperature data from an experiment, describe how to determine the cooling rate graphically. (5 marks)
- g) Discuss an application where a Newton's Law of Cooling is used. (2 marks)

Question 2:

- a) State Kirchhoff's Voltage Law and Kirchhoff's Current Law. (2 marks)
- b) Given a circuit with three resistors in series, derive the expression for the total voltage using Kirchhoff's Voltage Law. (3 marks)
- c) If a circuit consists of three branches with known currents, how can Kirchhoff's Current Law be used to verify the current at a junction? (3 marks)
- d) Explain one practical application of Kirchhoff's Laws in electrical engineering. (2 marks)
- e) Explain the principle of operation of a Zener diode. (2 marks)
- f) Describe the role of a current-limiting resistor in a Zener diode voltage regulator circuit. (3 marks)
- g) Derive the formula for line regulation and load regulation. (3 marks)
- h) Discuss an application where a Zener diode voltage regulator is used. (2 marks)

Question 3:

- a) What is the function of an XNOR gate, and what is its Boolean expression? (2 marks)
- b) Design an XNOR gate using transistors and resistors. (4 marks)
- c) Construct the truth table for an XNOR gate. (2 marks)
- d) Identify a real-world application of XNOR gates. (2 marks)
- e) Explain the concept of harmonics in a vibrating string. (2 marks)
- f) Derive the formula relating the wavelength of a harmonic to the length of a vibrating string. (3 marks)
- g) If a string is fixed at both ends and vibrating in its second harmonic, describe the wave pattern and calculate the wavelength in terms of string length. (3 marks)
- h) Discuss one factor other than tension that affects the harmonics of a vibrating string. (2 marks)