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UNIVERSITY EXAMINATIONS 2022/2023

THIRD YEAR, SECOND SEMESTER SPECIAL/SUPPLEMENTARY EXAMINATION
FOR DEGREE OF BACHELOR OF SCIENCE IN MATHEMATICS AND PHYSICS AND
BACHELOR OF EDUCATION SCIENCE

SPH 3353: DIGITAL ELECTRONICS

DATE: AUGUST 2023

TIME: 2 HOURS

INSTRUCTIONS: Answer Question ONE and any other TWO questions.

QUESTION ONE (30 MARKS)

- a) Design the logic system for controlling a boiler used in a hot-water space heating system.
The boiler is switched 'ON' when the air temperature falls below a predetermined level or when the water temperature falls below a present level. (5 Marks)
- b) Draw the logic symbols, and write the Boolean expression for a three-input NAND gate (2 Marks)
- c) Prove that $A(\bar{A} + C)(\bar{A}B + \bar{C}) = 0$ (4 Marks)
- d) Simplify the following SOP equation using the Karnaugh map technique. (4Marks) $X = \bar{A}B + \bar{A}\bar{B}\bar{C} + ABC + A\bar{B}\bar{C}$ (
- e) Convert hexadecimal 7EA to binary then to decimal equivalent (3 Marks)
- f) i. What is a demultiplexer (1 Mark)
ii. State three (3) advantages of multiplexers (3 Marks)
- g) Differentiate between Synchronous and Asynchronous Sequential Circuit. (4 Marks)
- h) Explain two (2) advantages of CMOS over TTL devices (4 Marks)

QUESTION TWO (20 MARKS)

- a) Define a truth table. (2 Marks)
- b) Design a OR gates using NAND gates only and draw the truth table. (5 Marks)
- c) Given the following logic expression: $AB + A(B + C) + B(B + C)$
- Simplify using Boolean Algebra (4 Marks)
 - Implement the simplified expression using gate and draw the truth table. (4 Marks)
- d) Convert $(6327.4051)_8$ into its equivalent decimal number (3 Marks)
- e) Add $(7F)_{16}$ and $(BA)_{16}$ (2 Marks)

QUESTION THREE (20 MARKS)

- a) i. Draw te truth table for a RS flip flop (2 Marks)
- ii. State which condition must be avoided and why (3 Marks)
- b) State four (4) applications of counters (4 Marks)
- c) Distinguish the following types of ROM: PROM, EPROM and EEPROM (6 Marks)
- d) Prove the following SOP $ABC + \bar{A}\bar{B}C + \bar{A}BC + AB\bar{C} + \bar{A}\bar{B}\bar{C}$ expression is equal to $\bar{A}\bar{B} + B(A + C)$ (5 Marks)

QUESTION FOUR (20 MARKS)

- a) i. State three (3) types of encoders (3 Marks)
- ii. Explain the working of a priority encoders (4 Marks)
- b) Design a 1 by 32 de-multiplexer using 1 by 8 de-multiplexer (4 Marks)
- c) Simplify the following Boolean expression and implement the minimized from using logic gates. (5 Marks)
- d) Describe the procedure of combinational circuit design (4 Marks)