



0138

THE OPEN UNIVERSITY OF SRI LANKA  
DEPARTMENT OF COMPUTER SCIENCE  
BSC DEGREE PROGRAM – 2025/2026  
**FINAL EXAMINATION**  
**CSU5306: DIGITAL ELECTRONICS**  
DURATION: TWO HOUR (2 HOURS)

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Date: 01.12.2025

Time : 1.30pm - 3.30pm

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**General Instructions**

1. Read all instructions carefully before answering the questions.
2. This question paper consists of 06 questions on 04 pages.
3. Answer any 04 questions only. All questions carry equal marks.
4. The answer to each question should commence from a new page.
5. Draw fully labeled diagrams where necessary.
6. Involvement in any activity that is considered an exam offense will lead to punishment.
7. Use blue or black ink to answer the questions.
8. Clearly state your index number in your answer script.

## Q1.

The Smart Greenhouse Ventilation System is designed to automatically manage air quality and temperature to ensure optimal conditions for plant growth. It uses three sensors, X, Y, Z to monitor carbon dioxide levels, air temperature, and humidity, respectively. These sensors provide logical outputs that determine when the ventilation fans should be activated to maintain a healthy greenhouse environment.

| Sensor                              | Condition                 | Logical Value | Explanation                                            |
|-------------------------------------|---------------------------|---------------|--------------------------------------------------------|
| Sensor X<br>(CO <sub>2</sub> Level) | CO <sub>2</sub> > 800 ppm | 1 (active)    | Air has excess CO <sub>2</sub> ; ventilation required. |
|                                     | CO <sub>2</sub> ≤ 800 ppm | 0 (inactive)  | CO <sub>2</sub> level safe; no ventilation required.   |
| Sensor Y<br>(Air Temperature)       | Temperature > 32°C        | 1 (active)    | Air temperature too high for plants.                   |
|                                     | Temperature ≤ 32°C        | 0 (inactive)  | Air temperature within acceptable range.               |
| Sensor Z<br>(Humidity)              | Humidity > 85%            | 1 (active)    | Excess humidity: ventilation recommended.              |
|                                     | Humidity ≤ 85%            | 0 (inactive)  | Humidity level suitable for plant                      |

The smart ventilation system triggers the **ventilation fans** (warning signal) under two main situations. **Condition 1** occurs if either of the following happens,

1. If the CO<sub>2</sub> concentration goes above 800 ppm, the system immediately activates ventilation because excessive CO<sub>2</sub> can hinder plant respiration and affect photosynthesis efficiency.
2. If both the temperature rises above 32°C and the humidity exceeds 85%, the system considers this an unsafe combination. High heat and extreme humidity can lead to heat stress, promote mold and fungal pathogens, and reduce crop yield.

Alternatively, **Condition 2** triggers the warning signal when both of the following conditions are met,

1. If the CO<sub>2</sub> concentration goes above 800 ppm, the air quality becomes unsafe for plants.
2. If the temperature exceeds 32°C, the heat level becomes harmful to crops.

When both high CO<sub>2</sub> and high temperature occur together, the environment becomes dangerous for plant growth. Therefore, the system activates the ventilation fans immediately.

Together, these conditions ensure the greenhouse maintains balanced air quality, optimal temperature, and healthy humidity levels. By preventing heat stress, reducing fungal risks, and

maintaining clean air circulation, the system supports consistent growth and higher crop productivity.

- i. Derive the Truth Table for the above scenario.
- ii. Derive the simplified Boolean equation for the above scenario using K-maps.
- iii. Draw the circuit for the above (ii) simplified equation.
- iv. Derive the POS from the (i) truth table and simplify it using Boolean rules

### Q2.

- i. Convert the following Decimal numbers to BCD format.
  - a. 567
  - b. 891
- ii. Calculate the sum of the following decimal numbers using BCD addition.
  - a.  $68 + 29$
  - b.  $75 + 47$
- iii. Convert the following words into ASCII code. State the code in hexadecimal and binary.  
(Use the ASCII Table given in the Annex 1, at the end of the paper)  
" Environmental loss (-30%) since 1990 shows rapid decline."
- iv. Prove the following Boolean Algebra rules.
  - a. De Morgan's Theorem
  - b. Redundance law

### Q3.

- i. Explain the function of Master Slave JK Flip Flop. (Use Block diagrams, Logic Diagrams, and Timing Diagrams as needed)
- ii. Draw the logic diagram of a 4-bit asynchronous counter that resets at 1110 (14) using a NAND gate.
- iii. Design the timing diagram of the Johnson Ring Counter.
- iv. What are the properties of an asynchronous sequential circuit.

## Q4.

- i. Explain the data selection function.
- ii. Draw the schematic Diagram (Logic Diagram) to add 1101 (base2) and 1010 (base2).
- iii. Design a block diagram of 16 to 1 Multiplexer using only 2 to 1 Multiplexer.
- iv. Draw the following tables to the given circuit (Figure 1).
  - a. Transaction table with possible transitions.
  - b. State table.

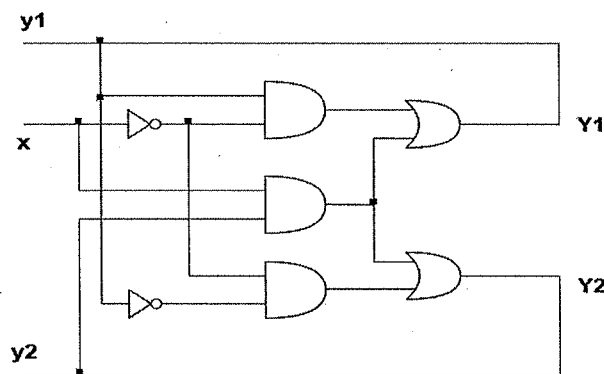


Figure 1: Digital Circuit

## Q5

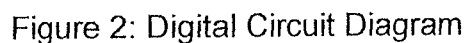
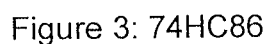
- i. Derive 32-bit RAM using a one-bit memory cell. (Use properly labeled block diagram).
- ii. Explain the following policies.
  - a. Write Through with No Write Allocate.
  - b. Write Back with Write Allocate.
- iii. What are the differences between RAM and ROM.
- iv. Design the logic circuit of PAL for the following Boolean function.

$$A \rightarrow x'yz + xy$$

$$B \rightarrow wx'yz' + x'yz + wxy'$$

$$C \rightarrow xz' + w'xy'z$$

$$D \rightarrow wxy'z + wz + xz' + w'xy'z$$



- 5

## Annex 1

|        |        |       |      |      |      |      |
|--------|--------|-------|------|------|------|------|
| 00 NUL | 10 DLE | 20 SP | 30 0 | 40 @ | 50 P | 60 ` |
| 01 SOH | 11 DC1 | 21 !  | 31 1 | 41 A | 51 Q | 61 a |
| 02 STX | 12 DC2 | 22 "  | 32 2 | 42 B | 52 R | 62 b |
| 03 ETX | 13 DC3 | 23 #  | 33 3 | 43 C | 53 S | 63 c |
| 04 EOT | 14 DC4 | 24 \$ | 34 4 | 44 D | 54 T | 64 d |
| 05 ENQ | 15 NAK | 25 %  | 35 5 | 45 E | 55 U | 65 e |
| 06 ACK | 16 SYN | 26 &  | 36 6 | 46 F | 56 V | 66 f |
| 07 BEL | 17 ETB | 27 '  | 37 7 | 47 G | 57 W | 67 g |
| 08 BS  | 18 CAN | 28 (  | 38 8 | 48 H | 58 X | 68 h |
| 09 HT  | 19 EM  | 29 )  | 39 9 | 49 I | 59 Y | 69 i |
| 0A LF  | 1A SUB | 2A *  | 3A : | 4A J | 5A Z | 6A j |
| 0B VT  | 1B ESC | 2B +  | 3B ; | 4B K | 5B [ | 6B k |
| 0C FF  | 1C FS  | 2C ,  | 3C < | 4C L | 5C \ | 6C l |
| 0D CR  | 1D GS  | 2D -  | 3D = | 4D M | 5D ] | 6D m |
| 0E SO  | 1E RS  | 2E .  | 3E > | 4E N | 5E ^ | 6E n |
| 0F SI  | 1F US  | 2F /  | 3F ? | 4F O | 5F _ | 6F o |

|     |                     |     |                           |     |         |
|-----|---------------------|-----|---------------------------|-----|---------|
| NUL | Null                | FF  | Form feed                 | CAN | Cance.  |
| SOH | Start of heading    | CR  | Carriage return           | EM  | End of  |
| STX | Start of text       | SO  | Shift out                 | SUB | Substi  |
| ETX | End of text         | SI  | Shift in                  | ESC | Escape  |
| EOT | End of transmission | DLE | Data link escape          | FS  | File se |
| ENQ | Enquiry             | DC1 | Device control 1          | GS  | Group   |
| ACK | Acknowledge         | DC2 | Device control 2          | RS  | Recor   |
| BEL | Bell                | DC3 | Device control 3          | US  | Unit se |
| BS  | Backspace           | DC4 | Device control 4          | SP  | Space   |
| HT  | Horizontal tab      | NAK | Negative acknowledge      | DEL | Delete  |
| LF  | Line feed           | SYN | Synchronous idle          |     |         |
| VT  | Vertical tab        | ETB | End of transmission block |     |         |

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