



**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY  
SCHOOL OF INFORMATICS AND INNOVATIVE SYSTEMS  
DEPARTMENT OF COMPUTER SCIENCE AND SOFTWARE  
ENGINEERING**

**UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR SCIENCE IN  
COMPUTER SECURITY AND FORENSICS**

**2<sup>ND</sup> YEAR 2<sup>ND</sup> SEMESTER 2020/2021 ACADEMIC YEAR**

**MAIN CAMPUS**

**(SUPPLEMENTARY/SPECIAL EXAMINATION)**

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**COURSE CODE: IIT 3226**

**COURSE TITLE: DIGITAL ELECTRONICS**

**EXAM VENUE:**

**STREAM: BSC COMP. SECURITY**

**DATE:**

**EXAM SESSION:**

**TIME: 2.00 HOURS**

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**INSTRUCTIONS:**

- 1. Answer Question 1 (Compulsory) and ANY other two questions**
- 2. Candidates are advised not to write on the question paper**
- 3. Candidates must hand in their answer booklets to the invigilator while in the examination room**

**QUESTION ONE****[30 MARKS]**

- a) Define the following terms and concepts as applies to digital electronics [4 Marks]
- |                   |                        |
|-------------------|------------------------|
| (i) Logic Family  | (iii) State Assignment |
| (ii) Ring Counter | (iv) Saturated Logic   |
- b) Verify that NAND and NOR operations are communicative and not associative. [4 Marks]
- c) A two seated airplane requires that both the pilot and the navigator have their seat belts tightened, before the plane can take off. However it is desired, that in case of solo flights, (without the navigator), the state of the navigator seat belt should not have any effect on the takeoff. Make the truth table and obtain the simplified logic expression for system and design it using NAND gates. [4 Marks]
- d) Perform the subtraction using 2's complement method for 0011.1001 [6 Marks]
- e) Design a BCD to Excess-3 code counter using minimum of NAND gates. [4 Marks]
- f) Explain the difference between a flip-flop and a latch. [4 Marks]
- g) Design a 32:1 multiplexer using two 16:1 multiplexers and a 2:1 multiplexer. [4 Marks]

**QUESTION TWO****[20 MARKS]**

- a) Write down simplified sum of products (SOP) and product of sums (POS) expressions for the Boolean functions:  $X = A \oplus B \oplus C$ . [6 Marks]
- b) Anne likes to study on Mondays, Tuesdays and Wednesdays, practice chess on Thursdays and Sundays and go for choir practice on Fridays and Saturdays. Assuming a 3-digit binary number can represent days of the week with Mondays = 0 0 0 etc.
- (i) Develop a truth table for the problem, use X's for additional values for days beyond Sundays. [4 Marks]
- (ii) Develop a k-map for each of Anne's activities. [4 Marks]
- (iii) Limiting your design to two-input NAND gates (74LS00), draw the NAND ONLY implementation of the study, chess and choir activities. [6 Marks]

**QUESTION THREE****[20 MARKS]**

- a) Realize a 8:1 multiplexer using  $Y(D,C,B,A) = \Pi(1,4,6,9,10,11,14,15)$ . [4 Marks]
- b) Design a sequential circuit with two D flip flops A and B, and one input X. When  $X = 0$ , the state of the circuit remains the same. When  $X = 1$  the circuit goes through the state of transitions from 00 to 01 to 11 to 10 back to 00 and repeats. [5 Marks]
- c) Explain the race around condition in JK flip flop and how it is it overcome. [3 Marks]
- d) It is desired to get an output frequency of 1.2 KHz from an input frequency of 18KHz. Draw a circuit of asynchronous counter for this purpose. [4 Marks]
- e) An 8 bit universal shift register contents are 11000110. What are the register contents after 2 right shifts, 3 left shifts and 1 right shift  $D_{in} = 1$ ? [2 Marks]
- f) In a 5 bit ripple counter, the input frequency is 8 MHz, compute the output frequency? [2 Marks]

**QUESTION FOUR****[20 MARKS]**

- a) Determine the binary, octal and hexadecimal values represented by the decimal number  $88.6875_{10}$ . [6 Marks]
- b) Convert decimal number 430 to Excess-3 code. [3 Marks]
- c) A staircase light is controlled by two switches one at the top of the stairs and one at the bottom of the stairs. Realize a circuit using AND-OR gates. [4 Marks]
- d) With a suitable diagram, explain how to convert a JK Flip-flop to a T type flip-flop. [4 Marks]
- e) With the help of an example, explain the workings of a demultiplexer. [3 Marks]

**QUESTION FIVE****[20 MARKS]**

- a) Outline the necessary steps for designing asynchronous sequential circuits. [4 Marks]
- b) “To design a circuit, a designer can select from the available ICs most appropriate for the circuit, usually working from a block diagram design concept”. Explain an advantage and also one disadvantage of this design method. [4 Marks]
- c) Using a truth table, explain the working of the following; [12 Marks]
  - (i) Tri-state logic

- (ii) Digital comparator
- (iii) Shift register
- (iv) Half-Subtractor

- **END** -