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PRESIDENCY UNIVERSITY BENGALURU

 SCHOOL OF ENGINEERING

 MAKEUP EXAMINATION - JULY 2024

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| **Semester : III** | **Date : 08-JULY-2024** |
| **Course Code : ECE2002** | **Time : 1:30 PM to 4:30 PM** |
| **Course Name : Digital Electronics** | **Max Marks : 100** |
| **Program : B.Tech.**  | **Weightage : 50%** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Question paper consists of 3 parts.*
3. *Scientific and non-programmable calculator are permitted.*
4. *Do not write any information on the question paper other than Roll Number.*

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| **PART A** |
|  **ANSWER ANY 5 QUESTIONS 5Q X 2M=10M** |
| 1 | NOR gates are a type of universal gates and can be used to build any logic diagram. Design (logic diagram) an active high SR latch using NOR gates. | (CO 3) | [**Apply**] |
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| 2 | Combinational circuits do not have feedback paths. List any 4 examples of combinational logic circuits. | (CO 2) | [**Apply**] |
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| 3 | NAND gates are a type of universal gates and can be used to build any logic diagram. Write the truth table of an active low S’R’ latch using NAND gates. | (CO 3) | [**Apply**] |
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| 4 | Boolean algebra is a branch of mathematics that deals with logical operations on binary variables. The variables are represented as binary numbers, where 1 represents true and 0 represents false. Simplify the logical expression $\overbar{(A+\overbar{B})(C+\overbar{D})}$ | (CO 2) | [**Apply**] |
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| 5 | SOP is useful for representing Boolean expressions as a sum of product terms. POS is useful for representing Boolean expressions as a product of sum terms. Convert the Boolean expression from SOP to POS for $AB+BC$ | (CO 2) | [**Apply**] |
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| 6 | A sequential circuit is used to control the operation of an elevator. Include considerations for floor selection, door opening and closing, and emergency stops. Draw the logic diagram for a 3-bit sequential circuit based on Serial In Parallel Out using D flip-flops. | (CO 3) | [**Apply**] |
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| 7 | Write the characteristic equations and truth tables of SR and T flip flops.  | (CO 3) | [**Apply**] |
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| **PART B** |
|  **ANSWER ANY 5 QUESTIONS 5Q X 10M=50M** |
| 8 | Multiplexers are also known as data selectors. Implement $Y=A⊕B⊕C$ using a 4x1 multiplexer. | (CO 2) | [**Apply**] |
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| 9 | Registers are used to store a group of bits. Explain any 2 different types of shift registers with 4-bit storage. | (CO 4) | [**Analyze**] |
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| 10 | A digital system is to be designed in which the week of the month is given as input in three-bit form. The day Monday is represented as '000', Tuesday as '001' and so on. The output of the system should be '1' corresponding to the input of the day containing “t” letter or otherwise it is '0'. If don’t care exist then consider the excess numbers in the input as don't care conditions for system of three variables (x,y,z). Implement the simplified logic using a) basic gates and b) NAND gates only. | (CO 4) | [**Analyze**] |
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| 11 | Encoders are used to convert digital data into an analogue signal, which can then be transmitted over a communication channel. Decoders are used to convert an analogue signal into digital data, which can then be processed by a computer. Draw the logic diagram for 2:4 Decoder using logic gates. | (CO 2) | [**Apply**] |
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| 12 | Flip-flops and latches are fundamental building blocks of digital electronics systems used in computers, communications, and many other types of systems. They are circuits that have two stable states that can store 1-bit information. For the given truth table of a flip flop, draw the logic symbol, logic diagram, characteristic table, characteristic equation, and excitation table. | (CO 3) | [**Apply**] |
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| 13 | A NAND gate is a universal gate that can implement any Boolean function without the need to use any other type of logic gate. i) Below is a circuit implemented using only NAND gates. What is the output at point Q. Identify the logic gate realized here using these NAND gates. ii) The sum-of-products (SOP) form is a method (or form) of simplifying the Boolean expressions of logic gates. In this SOP form of Boolean function representation, the variables are operated by AND (product) to form a product term and all these product terms are ORed (summed or added) together to get the final function. The SOP form representation is most suitable to use them in FPGA (Field Programmable Gate Arrays). One such SOP equation is given, f = ∑m (1,2,5,7). Implement this using NAND gates only. | (CO 4) | [**Analyze**] |
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| 14 | A full subtractor is a combinational circuit that performs subtraction of two bits, one is minuend and the other is subtrahend, taking into account borrow of the previous adjacent lower minuend bit whereas a half subtractor is a digital logic circuit that performs binary subtraction of two single-bit binary numbers a minuend bit and a subtrahend bit. Implement full subtractor using two half subtractors and one OR gate. | (CO 2) | [**Apply**] |
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| **PART C** |
|  **ANSWER ANY 2 QUESTIONS 2Q X 20M=40M** |
| 15 | Almost all traffic signals carry a down counter to indicate the remaining time before red/green lights are turned off. Design a 3-bit down counter using JK flipflops. | (CO 5) | [**Analyze**] |
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| 16 | The priority encoder is another type of combinational circuit like a binary encoder, except that it generates an output code based on the highest prioritized input. Priority encoders are used extensively in digital and computer systems as microprocessor interrupt controllers, where they detect the highest priority input. Draw the truth table and logic circuit diagram using logic gates for 8 inputs and 3 output lines and write the encoded output (3 bits) if the inputs (8 bits) are 11111001 | (CO 4) | [**Analyze**] |
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| 17 | 1. Lata wants to design a combinational circuit that can perform the addition of two input bits: A and B, that represent the two significant bits to be added and produce two outputs. Draw the logic diagram using the basic gates of this circuit and write its truth table.

 1. Geeta wants to design a combinational circuit that can perform the addition of three input bits: A and B, that represent the two significant bits to be added, and a Cin input that is a carry-in from the previous significant position. Draw the logic diagram using the basic gates of this circuit and write its truth table.
2. Implement Geeta’s circuit using Lata’s circuit.
 | (CO 5) | [**Analyze**] |
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