भारतीय प्रौद्योगिकी संस्थान पटना
Indian Institute of Technology Patna

Time: **3 Hours** Marks: **100**

Subject: **EE101 Electrical Science**

Answer all questions.

Q.1 Given the Boolean function F=xy'z+x'y'z+w'xy+wx'y+wxy

(a) Obtain the truth table of the function

(b) Draw the logic diagram using the original Boolean expression

(c) Simplify the function to a minimum number of literals using Boolean Algebra. **[5]**

Q.2 With the use of maps, find the simplest form in SUM of Products of the function F = fg, where f and g are respectively f=wxy'+y'z+w'yz'+x'yz' and g=(w+x+y'+z')(x'+y'+z)(w'+y+z') **[10]**

Q.3 In a certain application, four inputs A, B, C, D (both true and complements forms are available) are fed to a logic circuit, producing an output F which operates a relay. The relay turns ON when F(A B C D)=1 for the following states of the inputs (A B C D): 0000, 0010, 0101, 0110, 1101 and 1110. States 1000 and 1001 do not occur, and for the remaining states, the relay is OFF. Minimize F with the help of K- Map and realize it using a minimum number of 3 input NAND gates. **[7]**

Q.4 The circuit diagram of a synchronous counter is shown in Fig. 1. Determine the sequence of states of the counter assuming that initial state is 000. Give your answer in a tabular form showing the present states ($Q_{A(n)}$, $Q_{B(n)}$, $Q_{C(n)}$), JK inputs (J_A K_A J_B K_B J_C K_C), and the next state ($Q_{A(n+1)}$, $Q_{B(n+1)}$, $Q_{C(n+1)}$). Find the table, determine the modulus of the counter. **[8]**

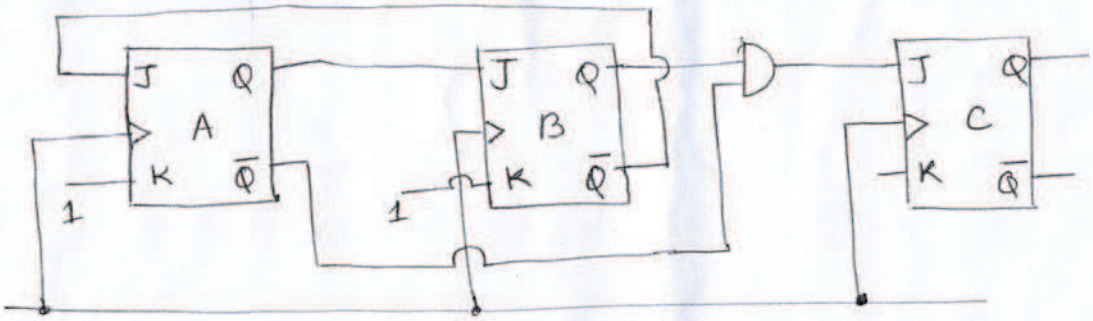

Figure 1

Q.5 (a) Represent the decimal number into binary equivalent. -27, -211, 27, 211.

(b) Write short note on not more than 2 sentences. (i) Linearity Principle, (ii)Decoder, (iii) Priority Encoder, (iv)Thevenin Theorem & (v) Norton Theorem. **[10]**

Q.6 (a) Use Nodal Analysis to determine the node voltage in Fig. 2.

(b) Find the Nodal voltages of the circuits in Fig. 3. **[10]**

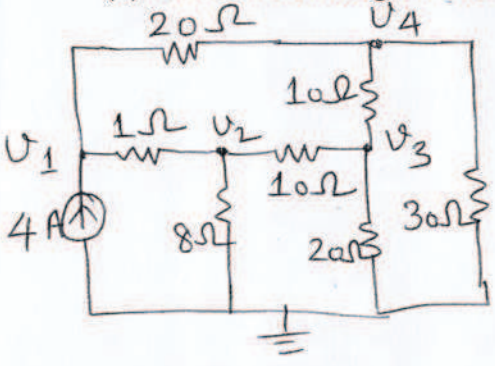

Figure: 2

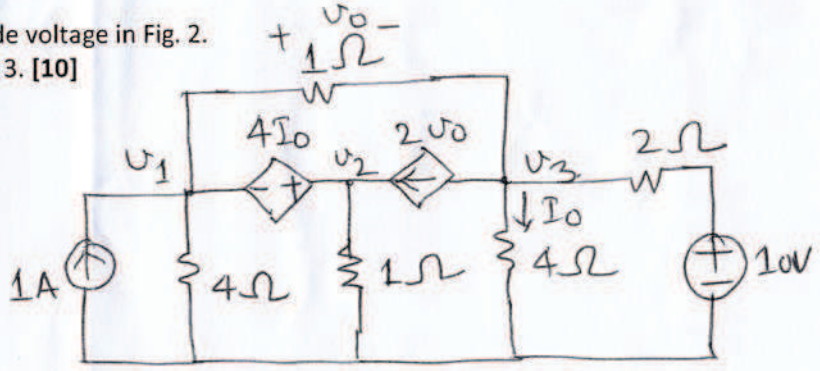

Figure: 3

Q.7 Determine the Gain v_0/v_i of the circuit in Fig. 4. **[5]**

Q.8 Calculate I_0 in the circuit in Fig. 5. **[5]**

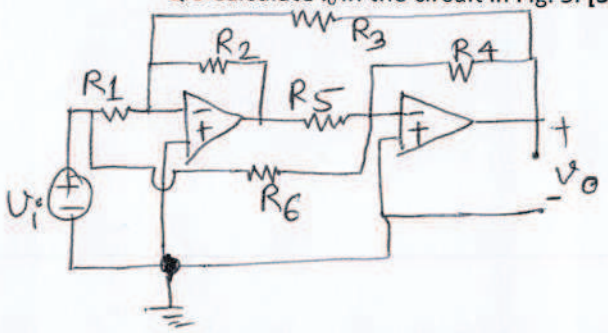

Figure: 4

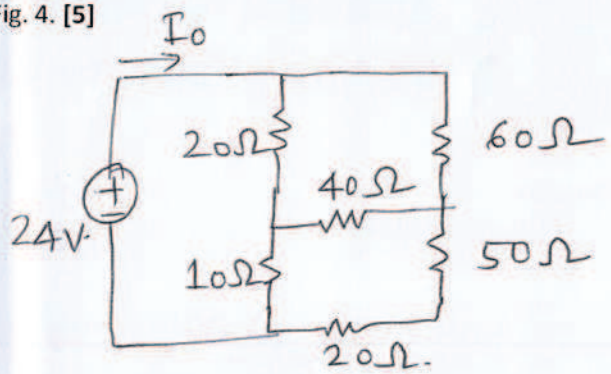

Figure: 5

Q.9 For the circuit in Fig. 6, use Superposition to find i. Calculate the power delivered to 3 Ohm. **[10]**

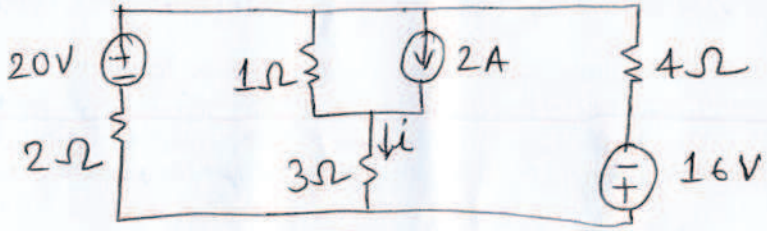

Figure: 6

Q.10 (a) Obtain Thevenin and Norton equivalent circuits at terminal a-b of the circuit in fig. 7. Calculate maximum power delivered to the load. **[10]**

(b) Find the Thevenin equivalent of the circuit in Fig. 8. Calculate maximum power delivered to the load. **[10]**

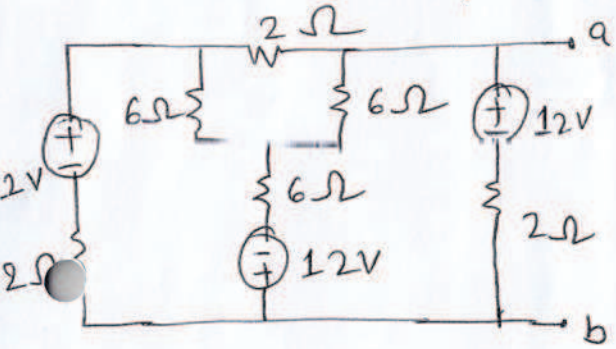

Figure: 7

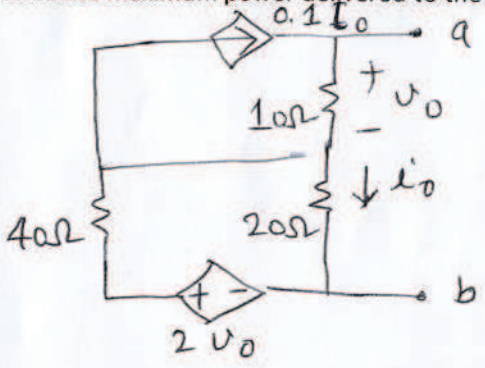

Figure: 8

Q.11 In the circuit shown in Fig. 9, Find i_0, v_0, and I for all time, assuming that the switch was open for a long time. **[10]**

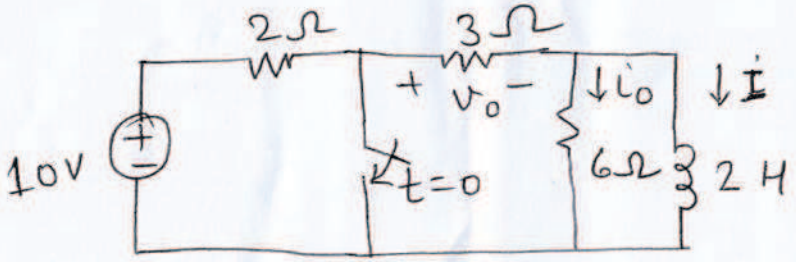

Figure: 10