Dept. Office

Bangabandhu Sheikh Mujibur Rahman University, Kishoreganj

1st Year 2nd Semester B. Sc. (Engg.) Final Examination-2022

Department of Computer Science and Engineering

CSE 1201: Digital Logic Design (3 Credits)

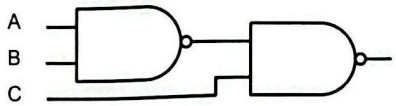
Time: 3 Hours **Full Marks: 70**

Instructions

Figures shown in the right margin indicate full marks.

Answer any **five** questions out of the **seven** questions.

1. Sazid recently got to know that NAND is a universal gate which means that any combinational circuit can be implemented using this gate. So, he went to the university lab and found some 2-input NAND gates there. In his primary experiment he tried to build a 3-input NAND gate using the existing 2-input NAND gates and so he made the connection as shown in the following figure.



But the connection did not provide the expected output.

a. Identify the problem of the circuit and explain why it occurred. After that, describe and illustrate how Sazid can achieve the expected behavior of a 3-input NAND gate using the existing 2-input NAND gates. 6

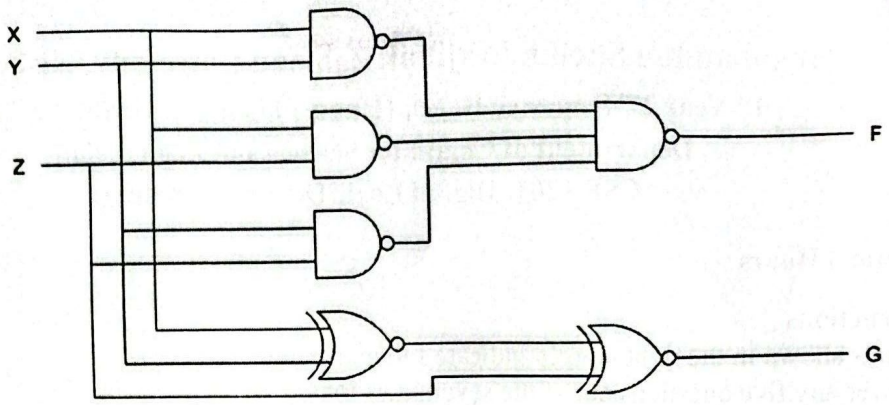
b. After solving the problem-1(a) Sazid got interested to see the implementation of the Boolean function $F(A, B, C, D) = \Sigma m(0, 2, 8, 15)$ from you using the existing 2-input NAND gates. Write down the necessary equations and illustrate the circuit diagram to implement the function F using the existing 2-input NAND gates for Sazid. 8

2 a. Consider that the characteristic of a Boolean function $F(A, B, C, D)$ is defined as the following Truth Table. 7

A	B	F
0	0	$\bar{C}D$
0	1	$\bar{C}D + C\bar{D}$
1	0	$CD + \bar{C}\bar{D}$
1	1	CD

Express the Boolean function F in the form of sum of minterms and product of maxterms.

b. The logic circuit below has three inputs, X, Y, and Z, and two outputs, F and G. 4



Find the minterm list and maxterm list representations for the outputs F and G. Show the details calculation.

Function	Minterm list	Maxterm list
F	Σ_{XYZ} ( )	Π_{XYZ} ( )
G	Σ_{XYZ} ( )	Π_{XYZ} ( )

c. Describe implicants, prime implicants, and essential prime implicants. Write down the consensus theorem in digital logic with conditions and an example of it. 3

3. a. Simplify the following Boolean function by using four-variable maps. 6

$$F(A,B,C,D) = \Sigma m(1,3,4,6,8,9,11,13,15) + \Sigma d(0,2,14)$$

b. Simplify the following Boolean function by using the Quine-McCluskey method. 8

$$F(w,x,y,z) = \Sigma(1,4,6,7,8,9,10,11,15)$$

4. a. Design a 4 bit Look Ahead Carry Generator and then construct a 4-bit Binary Adder using the graphical symbol of the designed Look Ahead Carry Generator. All the necessary equations must be derived and all the relevant diagrams must be illustrated. 7

b. Implement and describe the following function using a decoder and two OR gates. 4

$$S(x,y,z) = \Sigma(1,2,4,7)$$
$$C(x,y,z) = \Sigma(3,5,6,7)$$

c. Draw and discuss the operational mechanism of an 8 to 3 priority encoder. 3

5. a. Implement and design the following function using 4x1 MUX. 3

$$F = \Sigma m(1,2,3,6,7)$$

b. Design and implement a 32x1 MUX using 8x1 MUX. 4

c. Design and implement full subtractor using 1:8 Demultiplexer. 4

d. "A decoder can be used as a demultiplexer, and vice versa." -Justify this statement, whether it is valid or not. If it is valid, then describe the settings/scenarios required for that. 3

6. a. Write short note on SR latches. Write down the difference between latch and flip flop. 3

b. Define the race around problem. How do you overcome the race around problem? Show the steps to convert the SR flip flop to the JK flip flop. 4

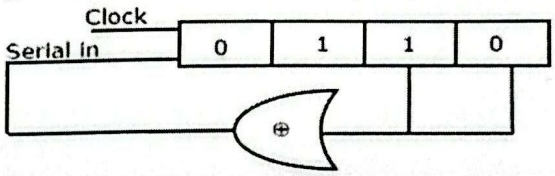
c. Write down the difference between an asynchronous and synchronous counter. Discuss the 3-bit asynchronous up counter. 4

d. Draw the logic diagram and timing diagram of MOD-6 ripple counter. 3

7. a. i. A serial in/parallel out, 4-bit shift register initially contains all 1s. The data nibble 0111 is waiting to be entered. After four clock pulses, determine the contents of the register. 4

ii. The bit sequence 10011100 is serially entered (right-most bit first) into an 8-bit parallel out shift register that is initially clear. What are the Q outputs after four clock pulses?

b. The initial contents of the 4-bit serial in serial out, right shift, shift register are 0110, which is shown in figure. After how many clock pulses will the contents of the shift register be 0110 again? Show the details of the steps in your calculation. 4



c Briefly describe the functionalities of a shift register. Construct a 4-bit bidirectional shift register with parallel load for the following function table. 6

Mode Control		Register Operation
S_1	S_0	
0	0	Parallel Load
0	1	No change
1	0	Shift Right
1	1	Shift Left

Bangabandhu Sheikh Mujibur Rahman University, Kishoreganj

1st Year 2nd Semester B. Sc. (Engg.) Final Examination-2022

Department of Computer Science and Engineering

CSE 1203: Structured Programming (3 Credits)

Time: 3 Hours **Full Marks: 70**

Instructions

- Figures shown in the right margin indicate full marks.
- Answer all the questions.

1

(Answer 7 out of 10 questions)

a. Explain the necessity of designing a header file and explain how a user defined header file can be included in a program written in C language. **2**

b. Identify among of the following loops that will execute for infinite times considering *k* is declared as an integer. Explain the reason for infinite execution. **2**

A. for(*k*=1; *k*>=1000; *k*++){}

B. for(*k*=0; *k*>=1000; *k* = *k* * 2){}

C. for(*k*=1024; *k*>0; *k*=*k*/2){}

D. for(*k*=1024; *k*>=0; *k*=*k*/2){}

c. Contrast between Call By Value and Call By Reference. **2**

d. Recommend how to declare two variables with the same name in the same program written in C language. **2**

e. Explain how the dereference operator can generate a segmentation fault in a program written in C language. **2**

f. Explain why a two dimensional array is used to store a number of space separated strings in C language. **2**

g. "A prefix must be a substring of a given string but a subsequence might not be a prefix of the given string" establish this argument with appropriate examples. **2**

h. Mention the differences between while and do-while loop with example. **2**

i. **2**

```
struct student{
   char name[50];
   int roll;
   float gpa;
}
```

```
union student{
   char name[50];
   int roll;
   float gpa;
}
```

Mention the differences between struct and enum based on the above code snippet.

j. Describe the memory allocation procedure of an array. **2**

PART-A (Answer 2 out of 3 questions)

i. x^n can be obtained by using the following method in a program written in C language: **5**

```
int res=1;
for(int i=1; i<=n; i++)     res=res*x;
```

This method will iterate for n number of times to calculate x^n. Propose a faster solution that can calculate x^n by iterating for approximately $\log_2 n$ number of times.

ii. Inside a network each computer is recognized with an IPV4 address. An IPV4 address is a 32 bit binary string separated with a dot (.) after each 8-bit binary segment. Generally each 8-bit binary segment is represented as an integer. So, the format of an IPV4 address looks like as following: **5**

$$A.B.C.D\ [0 \le A, B, C, D \le 255]$$

Now write a program in C language that takes four integers A, B, C, D as input representing an IPV4 address and then displays the 32-bit binary representation of the address. For example if A = 172, B = 16, C = 0 and D = 1 then the output will be:

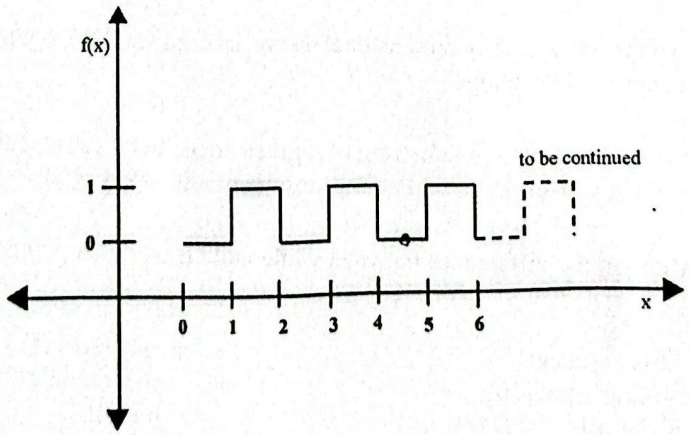
10101100.00010000.00000000.00000001

Note that, to develop this program, no arithmetic operations like division or modulus can be performed.

iii. Develop a program in C language that displays the square-root of a number. Note that, using library functions like *sqrt* is not allowed. Error up to 10^{-6} is acceptable. **5**

PART-B (Answer 1 out of 2 questions)

i. Define a function in C language to represent $f(x)$ of the graph given below where $x > 0$ and x is a real number. Note that, the function will take x as a parameter and will return the value of $f(x)$. **4**



ii. Explain how bitwise operators in C language can set the particular bit of a 32-bit integer. 4

Let $X = 5$ and $Y = 6$. Now, demonstrate leftshift, rightshift, and other operations in calculating 8 x X, $\frac{Y}{4}$, X (or) Y, X xor Y.

3

PART-A (Answer 2 out of 3 questions)

i. Consider a **recursive** function *f* that accepts four parameters. The parameters are listed below: 5

- *arr* (a sorted array of integers in ascending order indexed from 0)
- *x* (an integer)
- *low* (an integer)
- *high* (an integer)

The function returns the index of the first occurrence of *x* in *arr* using Binary Search. At each recursive state, the function calculates *mid* = (*low* + *high*)/2 and attempts to find the first occurrence of *x* in *arr*[*mid*]. If the first occurrence of *x* is not found in *arr*[*mid*] then the function executes its next recursive call. The initial call of the function is made with *low* = 0 and *high* = *n* - 1 where n is the number of elements in *arr*.

Now define the function in C language and after that, illustrate a state diagram mentioning the *low*, *high* and *mid* at each state of *f* for *x* = 6 and *arr* = {3, 3, 4, 5, 5, 6, 6, 6, 6, 8}

ii. In the area of graphics both the RGB and Hex-coding convention of a color is widely popular and you might know that they are convertible from one to another. A RGB color code consists of three integers *r*, *g* and *b* where $0 \leq r, g, b \leq 255$. The corresponding hex code is formed by converting the *r*, *g* and *b* in their corresponding hexa-decimal format sequentially. For example, the RGB code of a color is *r* =149, *g* = 255, *b* = 83 and its Hex-code is 95ff53. 5

Now you are given the hex code of a color as a string. Display the corresponding RGB code of the color. Note that the string might contain both uppercase and lowercase letters.

iii. Print the digits of an integer in reverse order using recursion. For example, Rev(123) should print 321. Rev(100) should print 001. 5

PART-B (Answer 1 out of 2 questions)

i. 4

```
int recursiveCount(int n){
  if(n<=0){
    return 0;
  }
  return 1 + recursiveCount(n / 10);
}
```

```
int main(){
  int result = recursiveCount(45678);
  printf("%d\n", result);
  return 0;
}
```

- Determine the output of the program
- Find out the input for which the program will fail (any critical output).

ii. 4

```
int trickyFunction(int n){
  if(n<=0){
    return 1;
  }
  return n + trickyFunction(n-1) - trickyFunction(n-2);
}

int main(){
  int result = trickyFunction(5);
  printf("%d\n", result);
  return 0;
}
```

- Determine the output of the statement simulating the code snippet.

4

PART-A (Answer 2 out of 3 questions)

i. Derive a logical explanation on how a Pascal's triangle is formed and then write a program in C language to print the Pascal's triangle of height n (n number of lines) where n is a positive integer and taken as input from the user. For example, the output should look like the following for $n = 5$. **5**

```
1
1 1
1 2 1
1 3 3 1
1 4 6 4 1
```

ii. Consider the following code-snippet in C language that generates all the prime numbers from 0 to n-1 where n is an integer. **5**

```
int flag[n+1];
for(int i=0; i<=n; i++)     flag[i]=0;
flag[0]++;     flag[1]++;
for(int i=4; i<=n; i+=2)     flag[i]++;
for(int i=3; i*i<=n; i+=2){
     if(flag[i]!=0) continue;
     for(int j=i*i; j<=n; j+=2*i)     flag[j]++;
}
```

If n is 50 then illustrate the values of all the elements of the *flag* array after executing the code-snippet and then analyze how a number can be decided as a prime number from the values of the *flag* array.

iii. Write down the output of the following code snippet.

```
#include <stdio.h>
int main() {
      int a[5] = {2, 7, 4, 9, 3}, b = 6, i;
      int *p = a, *q = p, *r = &b;
      *q *= *r;
      *(q+1) = *q + 5;
      p+=2;
      *p = 10;
      for(i=0; i<5; i++)
      {
            printf("%d ", *q**p);
            q++;
      }
      return 0;
```

PART-B (Answer 1 out of 2 questions)

i. Write a code snippet in C language to initialize a 3x3 matrix with sequential values starting from 1 and find the sum of all elements in a 3x3 matrix. **4**

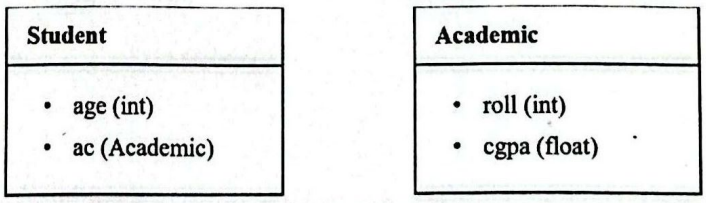
ii. Write a program in C language that takes an array and a target integer as input and then prints the count of occurrences of the target string in the paragraph. **4**

5

PART-A (Answer 2 out of 3 questions)

i. Write a program in C language that takes two strings *s* and *y* as input and determines whether *y* is a suffix of *s* or not. **5**

ii. Define two data types named "Student" and "Academic" as shown in the following diagram. **5**



Now consider that, the information of *n* number of "Student" data types is stored in an array. Write a code snippet to sort the array based on the following criteria:

The array must be sorted by the descending order of the *cgpa* but if two *cgpa* are equal then the array must be sorted by the descending order of *age*. If there is a tie between two *age* then the array should be sorted by the ascending order of *roll*. It is ensured that the *roll* of each element in the array is unique.

iii. Numbers that can not be stored in *long long* data type like 2^{100} can be considered as a big number. Suggest an appropriate data type in C language to deal with these big numbers and then define a function that accepts two big numbers as parameters and print their numerical summation.

PART-B (Answer 1 out of 2 questions)

i. Explain how a pointer is used to access a file from a program in C language. After that, explain the role of EOF to read a text file and then consider a text file named "data.txt" consisting of some integers. Now write a program in C language that takes all the integers from the text file as input and writes the maximum of those integers at the end of the same file. Note that, previous data must not disappear after executing the program. For clarification see the following example: 4

"data.txt" : before executing program	**"data.txt" : after executing program**
10 12 25 18 17 4	10 12 25 18 17 4 Maximum: 25

ii. Explain what is a library in programming. Exemplify the use of string.h library function with the following operations. 4

- To compare two strings
- To concatenate two strings

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Department of Computer Science and Engineering

1st Year 2nd Semester B.Sc. (Engg.) Final Examination 2022

Course Code: MAT 1205 Course Title: Linear Algebra

Total Marks: 70 Time: 03.00 Hours Credit: 3

Answer any 05 out of 07 questions.

1. (a) Define Hermitian and Skew-Hermitian matrix. Prove that the following matrix is Hermitian matrix. [5]

$$A = \begin{pmatrix} 2 & 2-3i & 3+5i \\ 2+3i & 3 & i \\ 3-5i & -i & 5 \end{pmatrix}$$

(b) Prove that $(AB)^t = B^tA^t$ where A and B are matrices and ' t ' stands for transpose. [5]

(c) If A is a square matrix then prove that $A + A^T$ is symmetric and $A - A^T$ is skew-symmetric matrix. [4]

2. (a) If A is an $n \times n$ matrix, then prove that $\det[\text{adj}(A)] = [\det(A)]^{n-1}$ [3]

(b) Let A and B be two 3×3 matrices with $|A| = -2$, $|B| = 5$. Find the value of [3]

$$(i) det(A^2B) \quad (ii) det(AB^{-1}A^T)$$

(c) Let's given that [8]

$$\begin{aligned} x + y + 2z &= 9 \\ 2x + 4y - 3z &= 1 \\ 3x + 6y - 5z &= 0 \end{aligned}$$

(i) Solve by Cramer's rule.

(ii) Solve by Gauss-Jordan elimination.

(iii) Which method involves fewer computations?

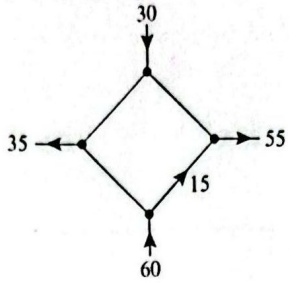
3. (a) Describe consistent and inconsistent system of linear equations. [2]

(b) Determine the values of λ such that the following system of linear equations has [7]

(i) no solution (ii) a unique solution (iii) more than one solution

$$\begin{aligned} x - 3z &= -3 \\ 2x + \lambda y - z &= -2 \\ x + 2y + \lambda z &= 1 \end{aligned}$$

(c) The following figure shows a network with four nodes in which the flow rate and direction of flow in certain branches are known. Find the flow rates and directions of flow in the remaining branches. [5]



4. (a) Write down the formula of Euclidean inner product, length and distance in $\mathbb{R}^n$ and $\mathbb{C}^n$ respectively. [4]

(b) Given that $\|\underline{u}+\underline{v}\| = 1$, and $\|\underline{u}-\underline{v}\| = 5$. Find the value of $\underline{u}\cdot\underline{v}$ [4]

(c) If $\underline{u} = (2+3i, 1+i, 3+7i), \underline{v} = (4-5i, 3i, -5+7i)$ and $\underline{w} = (-7i, 2+4i, 1)$ then find the value of $(i)\|3\underline{u}+4\underline{v}-5\underline{w}\|$ $(ii)(\underline{u}+\underline{v})\cdot(\underline{v}-\underline{w})$ $(iii)\left\|\frac{1}{\|\underline{w}\|}\underline{w}\right\|$ [6]

5. (a) Define vector space. Consider the set $V = \left\{\begin{pmatrix} a & 1 \\ 1 & b \end{pmatrix} \in M_2(\mathbb{R}) : a, b \in \mathbb{R}\right\}$. Test whether V is a vector space or not. If not, find the list of all axioms that fail to hold. [7]

(b) Test whether the following subset are subspace of $\mathbb{R}^3$ or not. [7]
$(i)\ W_1 = \{(a,b,c)|a^2+b^2+c^2 \geq 1, \quad a,b,c \in \mathbb{R}\}$
$(ii)\ W_2 = \{(a,b,c)|a+b+c = 0, \quad a,b,c \in \mathbb{R}\}$

6. (a) Define Image, kernel, rank and nullity of a linear transformation. [4]

(b) Let $T : V(F) \to U(F)$ be a linear mapping. Then show that KerT is a subspace of $V(F)$. [4]

(c) If $T : \mathbb{R}^3 \to \mathbb{R}^3$ be a linear transformation defined by $T(x,y,z) = \{(3x, x-y, 2x+y+z)\}$. Is T is invertible? If so find T^{-1}. Also prove that $(T^2 - I)(T-3I) = 0$ [6]

7. (a) What do you mean by eigenvalue and eigenvector of a square matrix? Prove that if λ is an eigenvalue of a non-singular matrix A, then λ^{-1} is an eigenvalue of the matrix A^{-1}. [2+4]

(b) Verify the Cayley-Hamilton theorem for the matrix $A = \begin{pmatrix} 1 & 2 & 3 \\ 2 & -1 & 1 \\ 3 & 1 & 1 \end{pmatrix}$ and using this find A^{-1}. [8]

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1st Year 2nd Semester B. Sc. (Engg.) Final Examination-2022

Department of Computer Science and Engineering

EEE 1207: Electrical Circuits (3 Credits)

Time: 3 Hours **Full Marks: 70**

Instructions

- Figures shown in the right margin indicate full marks.
- Answer 05 out of 07 questions.

1 **a.** Consider the circuit elements shown in *Figure-1*. Calculate the power for each element. If each element is a battery, is it being charged or discharged? **4**

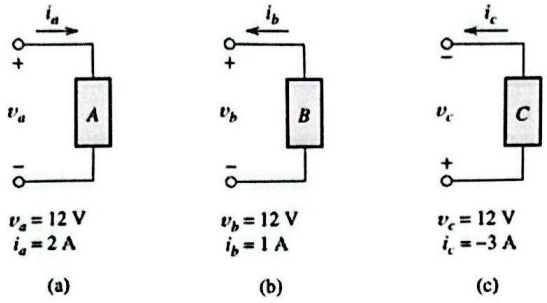

Figure-1

b. Use repeated application of KVL to find the values of v_c and v_e for the circuit of *Figure-2*. **5**

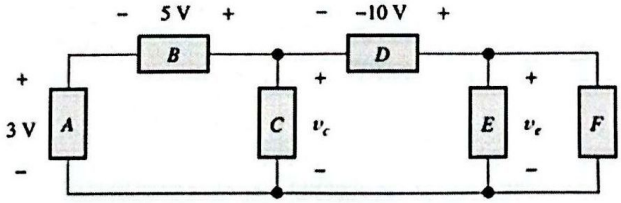

Figure-2

c. Solve for the source voltage in the circuit of *Figure-3* in which we have a current-controlled current source and we are given that the voltage across the 5-Ω resistance is 15 V. **5**

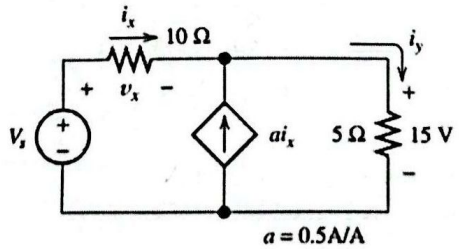

Figure-3

2 **a.** For the circuit shown in *Figure-4*, find the node voltages v_1 and v_2.

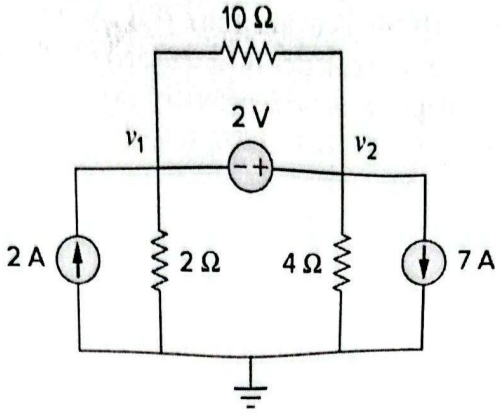

Figure-4

b. For the circuit in *Figure-5*, find the branch currents I_1, I_2, and I_3 using mesh analysis. **7**

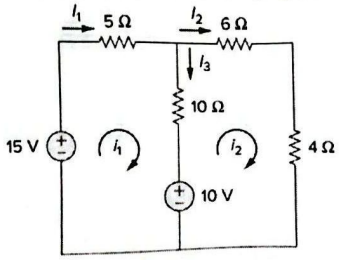

Figure-5

3 **a.** Find the Thevenin equivalent circuit of the circuit shown in *Figure-6*, to the left of the terminals *a-b*. Then find the current through $R_L = 6\ \Omega$. **7**

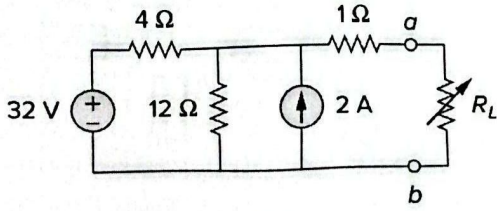

Figure-6

b. Find the Norton equivalent circuit of the circuit in *Figure-7* at terminals a-b. **7**

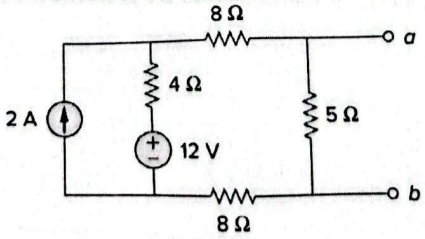

Figure-7

4 **a.** For the circuit in *Figure 8*: **7**

I. Find the mathematical expression for the transient behavior of v_C, i_C, and v_R if the switch is closed at t = 0 s.

II. Plot the waveform of v_C versus the time constant of the network.

III. Plot the waveforms of i_C and v_R versus the time constant of the network.

IV. What is the value of v_C at t = 20 ms?

V. On a practical basis, how much time must pass before we can assume that the charging phase has passed?

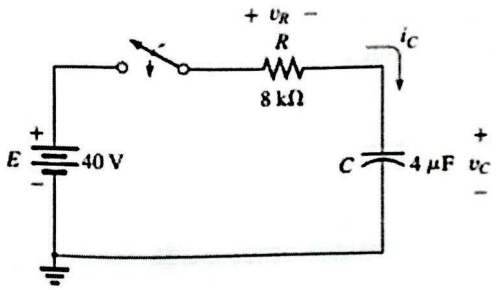

Figure-8

b. Find v_x and i_x for the circuit shown in *Figure-9* for t >> 0. **7**

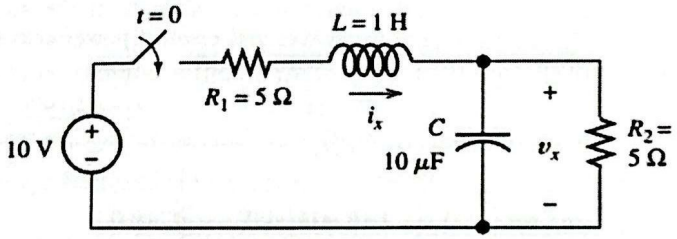

Figure-9

5 **a.** A dc source is connected to a series *RLC* circuit by a switch that closes at $t = 0$ as shown in *Figure-10*. The initial conditions are $i(0) = 0$ and $v_C(0) = 0$. Write the differential equation for $v_C(t)$. Solve for $v_C(t)$ if $R = 300$ W **10**

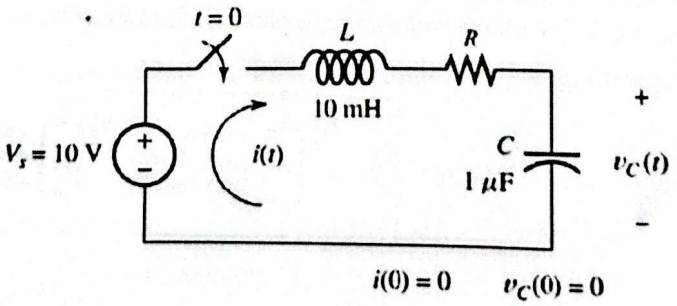

Figure-10

b. Find the steady state current i_a and voltage v_a in the circuit shown in Figure 11.

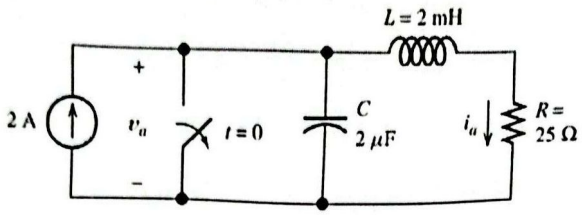

Figure-11

6 **a.** A voltage $v_C(t) = 100\cos(200t)$ is applied to a 100 mF capacitance. Find the impedance of the capacitance, the phasor current, and the phasor voltage. Also, draw the phasor diagram. 7

b. Obtain the Thevenin equivalent at terminals *a-b* of the circuit in Figure 12. 7

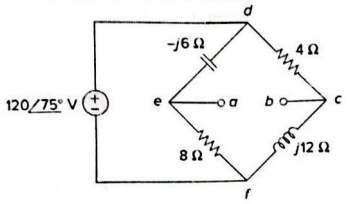

Figure-12

7 **a.** Compute the power and reactive power taken from the source for the circuit of Figure-13. Also, compute the power and reactive power delivered to each element in the circuit. 7

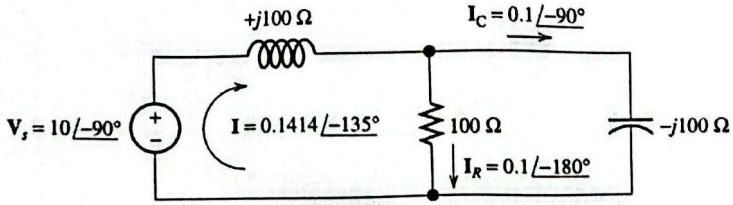

Figure-13

b. Consider the situation shown in Figure 14. Here, a voltage source delivers power to two loads connected in parallel. Find the power, and reactive power. 7

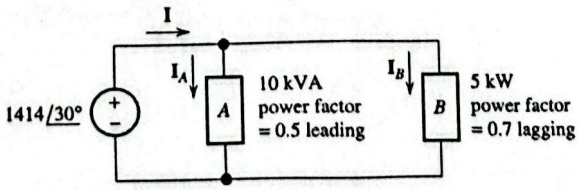

Figure-14

Bangabandhu Sheikh Mujibur Rahman University, Kishoreganj

1st Year 2nd Semester B. Sc. (Engg.) Final Examination-2022

Department of Computer Science and Engineering

GED 1209: Bangladesh Studies (3 Credits)

Time: 3 Hours **Full Marks: 70**

Instructions

Figures shown in the right margin indicate full marks.

Answer any ***05*** out of ***07*** questions.

1	a.	What is the Renaissance?	4
	b.	Examine the key features of the Bengal Renaissance in the first half of the 19th century.	10
2	a.	Examine the politics of the "Partition of Bengal" in 1905 by the British colonial rulers.	7
	b.	Why did Hindus and Muslims take different positions regarding the partition?	7
3	a.	What is the "two-nation" theory?	7
	b.	Briefly discuss the partition of India and the formation of Pakistan in 1947.	7
4	a.	Write the six-point demand raised by the Awami League president, Sheikh Mujibur Rahman in 1966.	6
	b.	Analyze the proclamation of independence, formation, and the role of the Mujibnagar Government in the liberation war of Bangladesh.	8
5	a.	Discuss the sovereign power and limitations of the Bangladesh Jatiya Sangsad.	7
	b.	How does Jatiya Sangsad impose control over finance? Explain.	7
6	a.	Briefly examine the nature of changes that the rural economy of Bangladesh has experienced since its independence.	6
	b.	Discuss the contribution of remittance and the involvement of women in economic activities.	8
7	a.	How can poverty be measured from a gender perspective?	6
	b.	Examine the reasons behind gender discrimination in Bangladesh.	8