BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2018-2019

Sub : **EEE 101** (Electrical Circuits I)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Find the values of the resistances in the following circuit. **(10)**

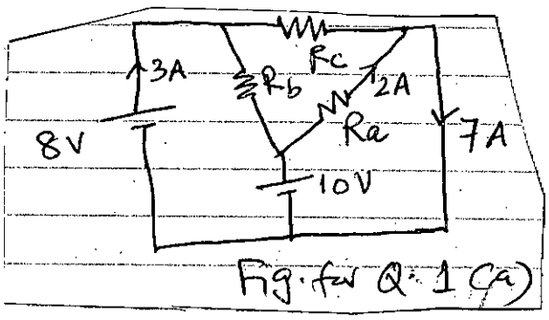

Fig. for Q. 1 (a)

(b) Find the reading of the voltmeter in the given circuit. **(10)**

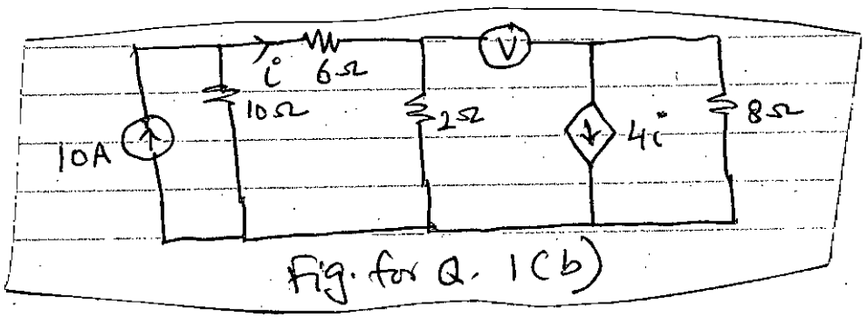

Fig. for Q. 1 (b)

(c) The conductors connecting the voltage sources have resistance r Ω/m. If x and L represent distances, and R can be moved in either source direction, neglecting resistances of the wires connecting sources to conductors, **(15)**

(i) Show that $v = \dfrac{v_1 RL + R(v_2 - v_1)x}{RL + 2rLx - 2rx^2}$ and

(ii) v will be minimum when $x = \dfrac{L}{v_2 - v_1}\left[-v_1 \pm \sqrt{v_1 v_2 - \dfrac{R}{2rL}(v_1 - v_2)^2}\right]$

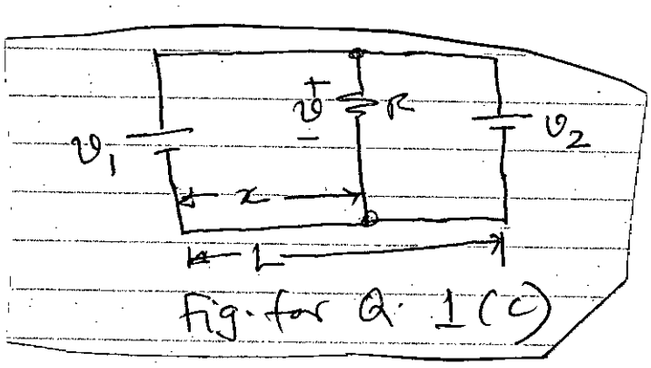

Fig. for Q. 1 (c)

Contd P/2

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2. (a) For the circuit given, find the values of R when it receives maximum power. Also find the maximum power delivered to R by the circuit and by the 280 V source alone. **(15)**

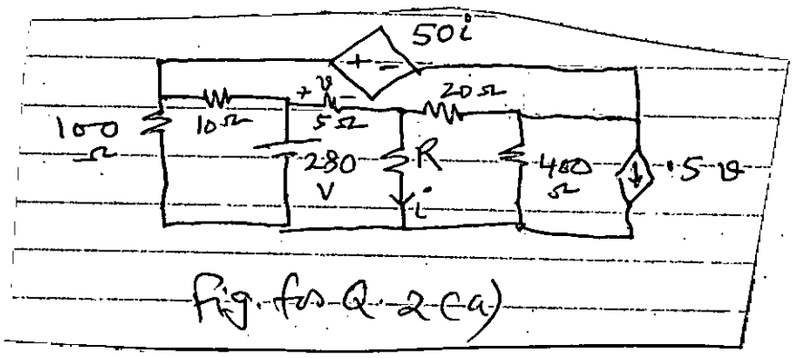

fig. for Q. 2 (a)

(b) Determine the Thévenin equivalent circuit of a-b. **(15)**

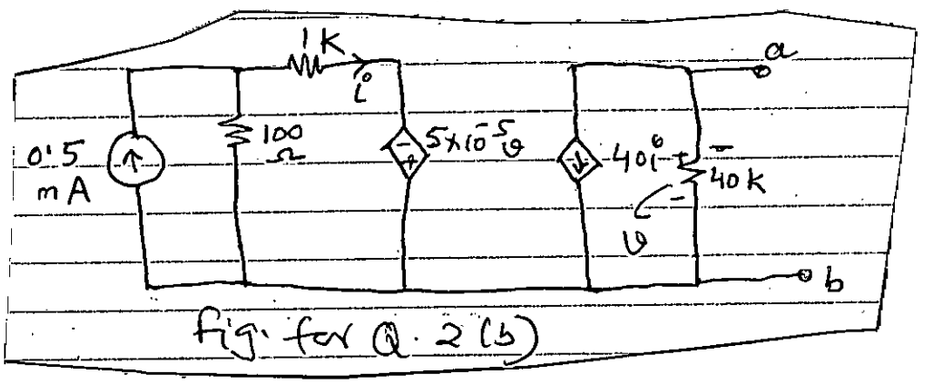

fig. for Q. 2 (b)

(c) Distinguish between ideal and actual voltage and current sources. **(5)**

3. (a) Connect a general resistance Y load into its equivalent Δ. Find the current delivered by the source. All resistance are in Ω. **(15)**

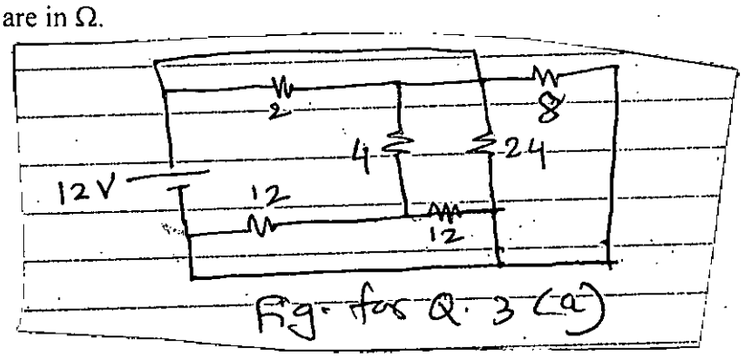

Fig. for Q. 3 (a)

(b) Discuss linear circuit and superposition theorem. Find v by superposition. **(15)**

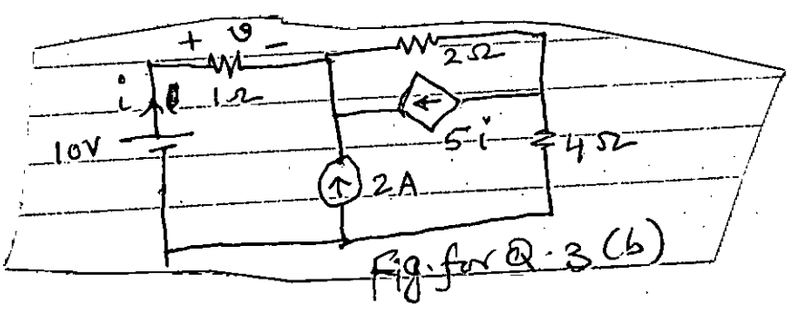

Fig. for Q. 3 (b)

Contd P/3

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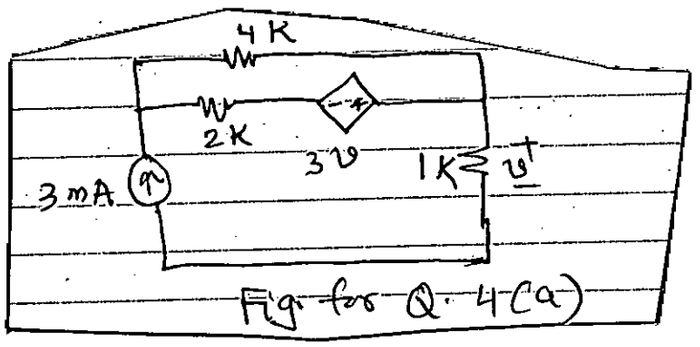
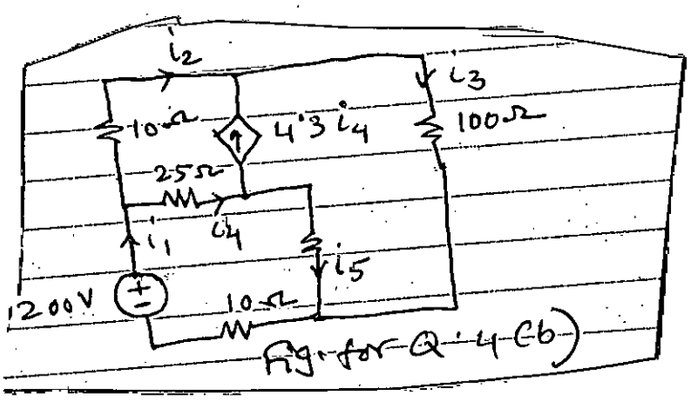
Contd... Q. No. 3

(c) Define static and dynamic resistances. Give suitable examples. **(5)**

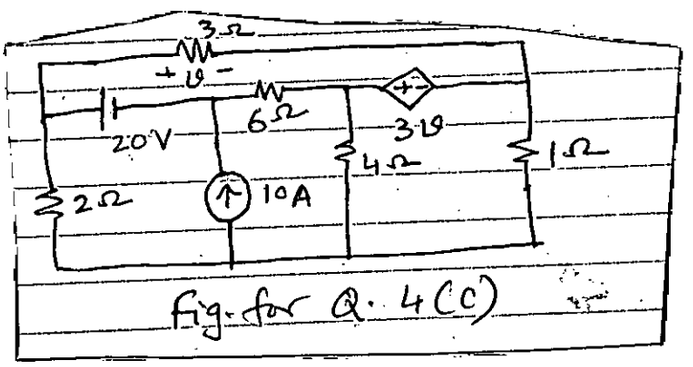
4. (a) Find v using source transformation. **(10)**



(b) Using mesh-current method, find the currents in the given circuit. **(10)**



(c) Find the node voltages of the following circuit **(15)**



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SECTION - B

There are **FOUR** questions in this section. Answer any **THREE**.

Symbols have their usual meaning.

5. (a) Determine values of the voltages $v_1(t)$ and $v_2(t)$ in the circuit of Figure for Q.5(a). **(17)**

(b) The two switches shown in the circuit Figure for Q. 5(b) operate simultaneously. Prior to $t = 0$ each switch has been in its indicated position for a long time. At $t = 0$ two switches move instantaneously to their new positions. Find $v_0(t)$ and $i_0(t)$ for $t \geq 0$. **(18)**

6. (a) Find the Thévenin equivalent of the circuit in Figure for Q. 6(a) at terminals A-B. **(15)**

(b) In the circuit in Figure for Q. 6(b), switch 1 has been in position a and switch 2 has been closed for a long time. At $t = 0$, switch 1 moves instantaneously to position b. Two hundred microseconds later, switch 2 opens, remains open for 600 μs, and then recloses. Find $v_0(t)$ for $t \geq 0$. **(20)**

7. (a) A circuit with an unspecified R, L, and C is shown Figure for Q. 7(a). The input source is $i_s = 10\cos 1000t$ A. Find the value of the components R, L, and C so that the node voltage is $v = 80\cos 1000t$ V. **(17)**

(b) For the circuit shown Figure for Q. 7(b), find V_s. Also calculate the value of capacitance required to make the power factor of input current 0.99 (lagging). **(18)**

8. (a) Find the power absorbed by a 5 ohm resistor if the waveform shown Figure for Q. 8(a) is applied across it. **(15)**

(b) At the time the switch is closed in the circuit in Figure for Q. 8(b), the voltage across the parallel capacitors is 50 V and the voltage across the 250 nF capacitor is 40 V. **(20)**

(i) What percentage of the initial energy stored in the three capacitors is dissipated in the 24k Ω resistor?

(ii) What percentage of the initial energy is trapped in the capacitors?

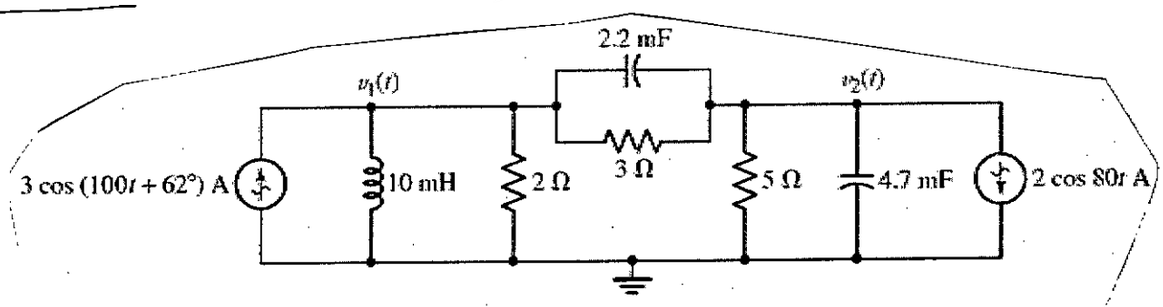

Figure for Q.5a

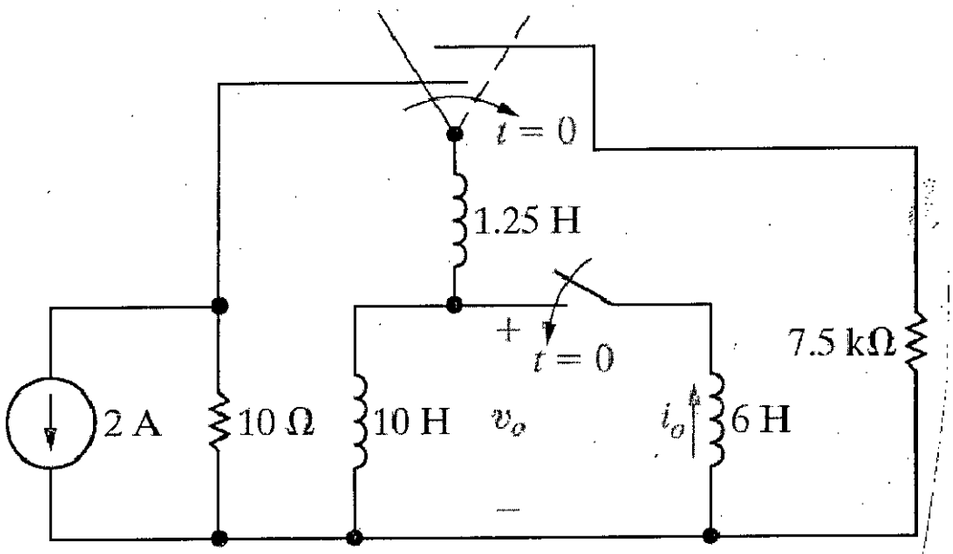

Figure for Q. 5b

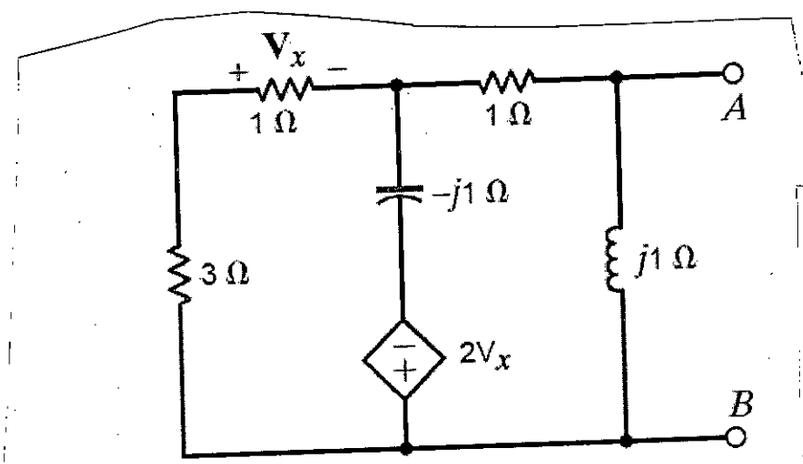

Figure for Q. 6a

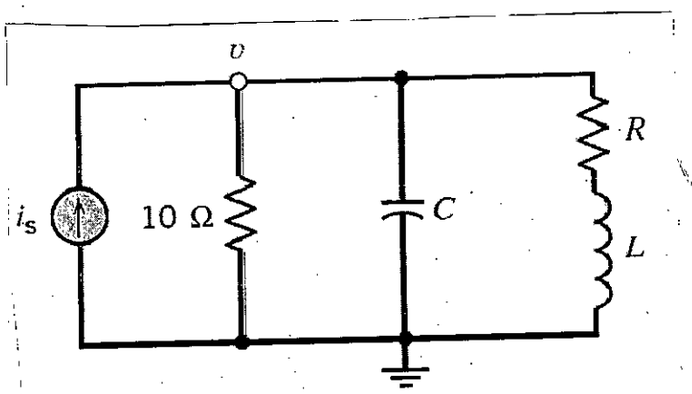

Figure for Q. 7a

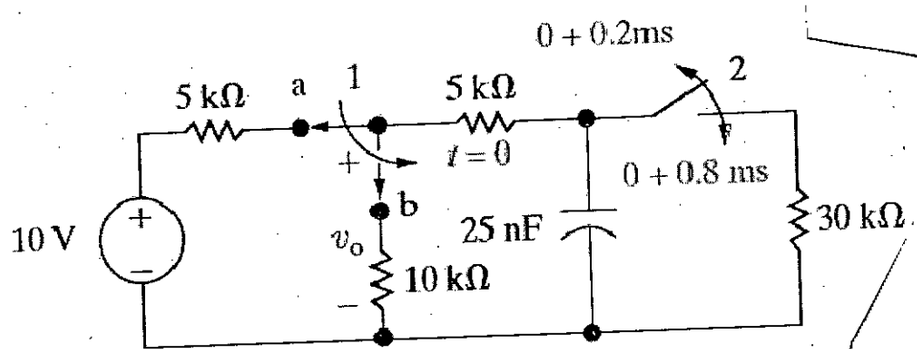

Figure for Q. 6b

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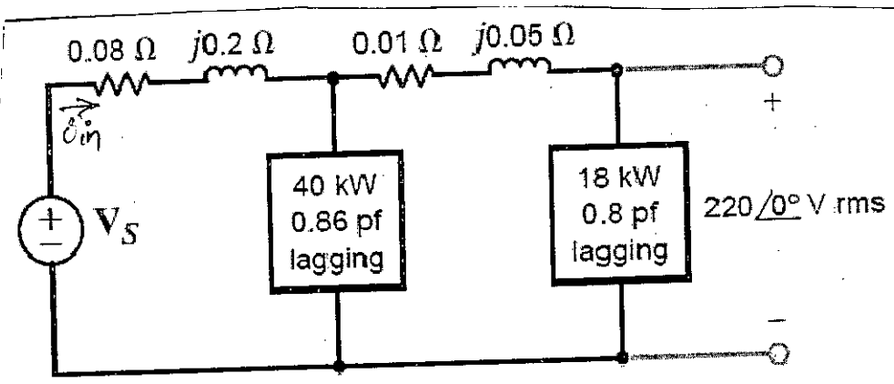

Figure for Q. 7b

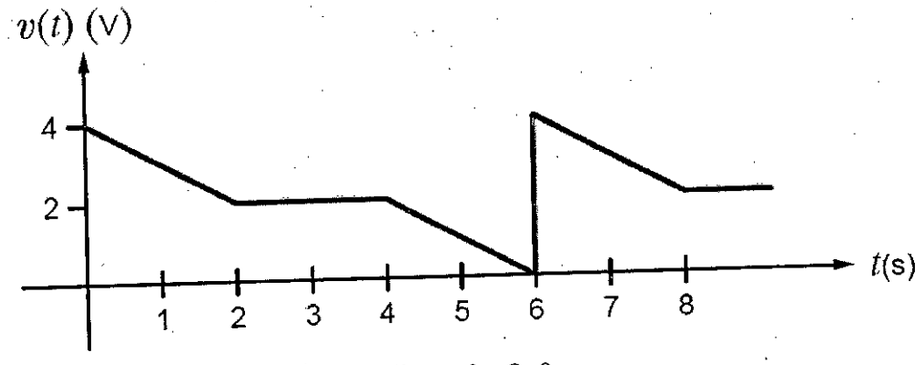

Figure for Q. 8a

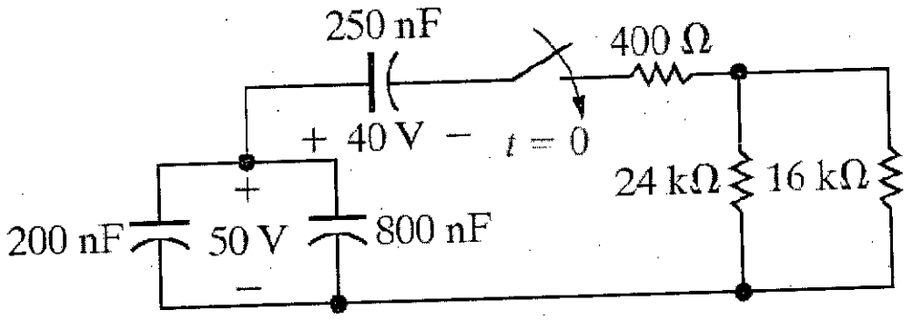

Figure for Q. 8b

L-1/T-1/EEE

Date : 31/10/2019

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2018-2019

Sub : **CSE 109** (Computer Programming)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

Do not use variable length array (i.e., array declarations like int x[y], where y is variable expression. Read the constraints/notes mentioned in each question carefully. You *must* adhere to the constraints in answering the respective question. Violation of constraint(s) may result in deduction of full marks.

1. (a) See the following C program. **(5)**

```
//C program of question 1(a)
#include<stdio.h>
float test(int i, float x)
{
    if(i%2)
        return x;
    else
        return x/2;
}

int main()
{
    int i;
    float f, value;
    scanf("%d %f",&i,&f);
    value = test(i,f);
    printf("%f",value);
    return 0;
}
```

Write a macro named ***test*** which can do the same task as the function. That means, if you exclude the function ***test*** from the program, and include the macro ***test*** in to the program, then the program will behave same as before. Note that, you don't need to write the whole program, just write down the definition of the macro.

(b) Write a C program that takes as unsigned integer number as input, and determines whether it is a multiple of 4 or not. The program should print "YES" if the number is a multiple of 4, and print "NO" otherwise. **(10)**

Constraint:

You have to solve the problem using bitwise operator.

Sample Input	Corresponding Output
12	YES
19	NO

Contd P/2

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Contd... Q. No. 1

(c) See the following code fragment.

```
//C Code fragment of question 1(c)
#include<stdio.h>

int main()
{
    int arr[50],i, n;
    scanf("%d",&n);
    for(i=0;i<n;i++)
        scanf("%d",&arr[i]);
    printf("%Mean: %lf\n",getMean(arr,n));
    printf("%Mode: %d\n",getMode(arr,n));
    printf("%Median: %lf\n",getMedian(arr,n));
    return 0;
}
```

Your task is to implement three functions ***getMean(), getMode(), getMedian()***. You can get hints about the parameters and return types of the functions from the arguments and usage of these functions in the given code fragment. Carefully note that, the value of *n* will always be less than 50, and each of the *n* input data values will be within 1 to 10 (including 1 and 10).

Mode: The mode of a set of data values is the value that appears most often in that set. If there are more than one such values, then you can consider any of these as mode.

Median: The median is the middle number, found by ordering all data values and picking out the one in the middle. If there are two middle numbers, median is the mean of these two numbers.

Note that, you don't need to write the whole program, just write down the full definitions of the functions.

Constraint:

You CANNOT use any library functions to solve the problem.

Sample Input	Corresponding Output
5 2 4 1 2 5	Mean: 2.80000 Mode: 2 Median: 2.000000
6 2 3 1 5 3 2	Mean: 2.666667 Mode: 2 // (3 is also a correct answer) Median: 2.500000

2. (a) Using ternary operator , write a C program that takes three integer number as input, and determine the maximum of these numbers. **(5)**

Constraint:

You have to solve the problem using a single statement having multiple ternary operators. You cannot use any other conditional or looping statements.

Contd P/3

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Contd... Q. No. 2

(b) Write a C program that takes an integer number *n* followed by *n* number of positive integers. Then, it determines the second maximum of these numbers. **(10)**

Constraint:

You CANNOT use any array or memory allocation function for this program.

Sample Input	Corresponding Output
5 2 4 1 2 5	4
6 2 3 1 5 3 2	3

(c) Write a C program that takes the single dimension *n* (the maximum value of n could be 20) of a square matrix followed by the integer elements of the matrix. Then it performs following two operations. **(10)**

(i) First, the program determines whether the matrix is a sparse matrix or not. A matrix is sparse if the number of 0's in the matrix is more than the number of non-zero elements. It prints "YES" if ir is a sparse matrix, and prints "NO" otherwise.

(ii) Secondly, the program transposes the matrix. Transposing a matrix means interchanging the rows with the columns. Carefully note that, you have to transpose the matrix first, and then print it. The program should print the transposed matrix.

Sample Input	Corresponding Output
3 1 0 5 0 0 0 9 -7 0	YES 1 0 9 0 0 -7 5 0 0
4 1 2 3 4 5 6 7 8 9 0 1 2 2 8 8 9	NO 1 5 9 2 2 6 0 8 3 7 1 8 4 8 2 9

3. (a) What is the purpose of ***typedef*** keyword in C? Explain with an example. **(5)**

(b) Write a C program that takes a character as input. Then, the program converts the character to uppercase letter if it is a lowercase letter, and keeps, it unchanged if it is anything else. The program prints the result accordingly. For example, if the input is 'a', then program should print 'A'. On the other hand, if the input is 'M', it should print 'M'. Again, if the input is '1', it should print '1'. **(10)**

Contd P/4

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Contd... Q. No. 3(b)

Constraint:

(i) You have to solve the problem using a single switch-case ladder having at most two 'case' levels. You cannot use any other conditional or looping statements.

(ii) You cannot use any string library function.

(c) Write a C program that takes a string as input where the maximum possible length of the string can be 50. Assume that the string would always consist of some digit characters ('0' to '9') along with some alphabet characters ('a' to 'z' and 'A' to 'Z'). Now, your task is to create two separate strings namely *digitString* and *alphaString* which will store the digits and the alphabets respectively. Finally, print the two strings as output. **(10)**

Sample Input	Corresponding Output
H5ap5p98yCo2ding6	Digit String is 559826 Alpha String is HappyCoding
CSEEEE	Digit String is Alpha String is CSEEEE

(d) In C, the type *char* is 8 bits long. It is possible to hold small integer values (in the range -128 to 127) in a variable of char type. Let, x and y are 2 (signed) char variables. They are respectively initialized with values 43 and -23. Write down the following: **(10)**

(i) bit pattern of x

(ii) bit pattern of y

(iii) bit pattern of (x & y)

(iv) bit pattern of (x^y)

(v) bit pattern of $\sim x$

4. (a) Write down the rules of variable naming convention in C. Show with examples. **(5)**

(b) See the definition of a series below.

$$1 + 2 + 3 + 4 + 6 + 9 + \ldots$$

Here, the first three terms are fixed, and these are 1, 2 and 3. And the n^{th} ($n > 3$) term is the summation of $(n-1)^{th}$ term and $(n-3)^{th}$ term. Write a C program that takes a positive integer n as input, and print the value of the n^{th} term of the series. **(10)**

Constraint:

You CANNOT use any array or memory allocation function for this program.

Sample Input	Corresponding Output
1	1
4	4
6	9

Contd P/5

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Contd... Q. No. 4

(c) See the following code fragment. **(10)**

```
//C Code fragment of question 4(c)
#include<stdio.h>

int main()
{
    char str[50];
    gets(str);
    if(isPalimdrome(str))
       printf("The string is palindrome\n");
    else
       printf("The string is not palindrome\n");

    return 0;
}
```

Your task is to implement the ***isPalimdrome(str)*** function which returns 1 if the string contained in ***str*** is palindrome, and returns 0 otherwise. A palindrome is a word, number, phrase, of the other sequence of characters which reads the same backward as forward. For example, the string "madam" is palindrome where the string "sir" is not. Note that, you don't need to write the whole program, just write down the full definition of the function.

Constraint:

You CANNOT use any string library function.

(d) Assuming the variables are defined, write appropriate (correct) statements to perform the following printing operations. **(10)**

(i) Print an integer variable *intVal* so that the output is always of 10 digits width. If the value contains less than 10 digits, then it will be right justified and its left side will be filled up by spaces.

(ii) Print *intVal* in hexadecimal representation. Use uppercase letters A-F.

(iii) Print a float variable *floatVal*; Print 2 digits after decimal point.

(iv) Print a double variable *doubleVal* in scientific notation.

(v) Print the value of a long long unsigned variable *longLongUsVal*.

SECTION - B

There are **FOUR** questions in this section. Answer any **THREE**.

Read the constraints/notes mentioned in each question carefully. You must adhere to the constraints in answering the respective question. Violation of constraint(s) may result in deduction of full marks. **Answer all the parts (a,b,c,d) of a question one after another.**

5. (a) Write a recursive function

```
void str_reverse (char *s)
```

that prints the string s in reverse. For example, if s contains the string "the cow", this function will print the string "woc eht". **(10)**

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Contd... Q. No. 5

The function may print the string character by character. You are not allowed to use any array or dynamic memory allocation or loop.

(b) What are the differences between w+ and r+ mode in opening a file? Write a C program to calculate the size (number of characters) of a txt file named "a.txt" in the current directory without using random access. Assume that the file already exists. **(5+5=10)**

(c) What are the differences between *p.x, (*p).x, p->x, and *p->x? Here p is a pointer to a structure. You can use example to differentiate. **(10)**

(d) Consider the following two cases. In both cases, we want to take an input string (containing no whitespace character) and store the string in p. **(5)**

Case 1:
```
#include<stdio.h>
int main()
{
   char *p;
   scanf("%s",p);
   return 0;
}
```

Case 2:
```
#include<stdio.h>
int main()
{
   char p[100];
   scanf("%s",p);
   return 0;
}
```

What are the differences between the two cases as per our goal? Explain.

6. (a) Write a `stringMixer` function that takes two strings (`p` and `q`) as parameter and creates a mixture of the two strings in such a way that **(10)**

Character at index 0 of the resulting string comes from p[0]
Character at index 1 of the resulting string comes from q[0]
Character at index 2 of the resulting string comes from p[1]
Character at index 3 of the resulting string comes from q[1]
and so on

If any of the string is finished (either `p` or `q`), the rest of the other string should be copied to the resulting string.
Some sample cases are given here:

p	q	Resulting string
Cricket	Ball	cbrailclket
Club	Football	cflouobtball
Ball	Foot	bfaololt

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Contd... Q. No. 6

First form the resulting string, then print the string inside the function using one `printf/puts`. You cannot use array subscript operator or any function from `string.h`. You don't have to write main function.

The prototype of the `StringMixer` function should be as follows:

```
Void StringMixer (char *p, char *q)
```

(b) What will be the output of the following program? And what does the `func` function do actually? Dies it perform any specific mathematical operation? Justify your answer. **(5+5=10)**

```
#include <stdio.h>

int func(int x, int y)
{
    if (x < y)
        return func(y, x);
    else if (y != 0)
        return (x + func(x, y - 1));
    else
        return 0;
}

int main()
{
    int x = 5, y = 2;
    printf("%d\n",func(x, y));
    return 0;
}
```

(c) Create a structure (in C) named **PowerPlant** that has the following fields: **(8+2=10)**

name (at most 300 characters long)

location (at most 300 characters long)

capacity (an integer denoting capacity in MW)

fuel_type (an integer denoting the type of the fuel)

Defien OIL as 0, GAS as 1 and WATER as 2 using macros and use these (OIL, GAS, WATER) to denote the `fuel_type` of the structure. Except in macros, you cannot use 0, 1 and 2 directly anywhere in your code.

Write a function `change_fuel` that takes two parameters:

(i) A pointer to structure of type PowerPlant

(ii) New fuel type as integer

The function changes the type of the fuel of the power plant according to the type mentioned as parameter and returns nothing.

Declare a oil powered power plant having the name "ECE Power Plant", location "West Palashi Campus, BUET" and a capacity of 400 MW in main function. Then change the fuel type to gas using the `change_fuel` function.

Explain two reasons why we have used pointer to structure instead of normal structure variable as the parameter of the function.

(d) What is the advantage of using function-like macros? **(5)**

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7. (a) What is the output of the following program? Explain with reasons. **(10)**

```
#include<iostream>
#include<cstring>
using namespace std;

class my
{
    char *s;

public:

    my(char *p)
    {
        s=new char[100];
        strcpy(s, p);
    }
    char* get_s()
    {
        return s;
    }
    void show()
    {
        cout<<s<<endl;
    }

};

void f(my a)
{
    strcpy(a.get_s(), "how");
}
```

```
int main()
{
    my ob("what");
    ob.show();
    f(ob);
    ob.show();
    delete[] ob.get_s();
    return 0;
}
```

(b) In 7(a), the allocated memory was freed in main function. Write a destructor function of class **my** so that the allocated memory is now freed in destructor and not in the main function. You don't have to rewrite the other functions of the class, just write the destructor and the main function. **(15)**

What will be the out of the edited program now? Will it be different from 7(a)? If yes, explain the reason and devise a way (with explanation) to produce the same output as 7(a) without removing the destructor function.

(c) What will be the output of the following program? **(6+4=10)**

```
#include<iostream>
using namespace std;

class A
{
    int i;
    void increment() { i++; }
public:
    A() { i=1;  cout<<"constructing A\n"; }
    A(int a) { i=a; }
    int get_i() { return i; }
};
```

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```
class B:private A
{
    int j;
public:
    B(int b) { j=b;  cout<<"constructing B\n"; }
    void show() { cout<<get_i()<<endl; }
};

class C:public A
{
    int j;
public:
    C(int b) { j=b;  cout<<"constructing C\n"; }
    void show() { cout<<get_i()<<endl; }
};
```

```
int main()
{
    B b(5);
    b.show();
    C c(10);
    cout<<c.get_i()<<endl;
    return 0;
}
```

Can we use

`cout<<i<<endl;`

instead of

`cout<<get_i<<endl;`

in the `show()` function of B? Can we do so in the `show()` function of C? Can we call `b.get_i()` in the function? Explain all these with reasons.

8. (a) Create a 5×4 int array dynamically in C. Then write an equivalent program in C++ using new and delete. You must free the allocated memory at the end in both programs. You don't need to take any input or print anything. **(10)**

(b) Is there any compilation or runtime error in the following code? If yes, correct the error. What will be the output of the program? **(10)**

```
#include<iostream>
using namespace std;

class tf
{
    int a;
public:
    tf(int a)
    {
        cout<<"constructing\n";
        this->a=a;
    }
    tf()
    {
        cout<<"constructing default\n";
        a=0;
    }
    ~tf()
    {
        cout<<"destructing "<<a<<"\n";
    }

};
```

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Contd... Q. No. 8(b)

```
int main()
{
    tf arr[3];
    tf *p=new tf[3];
    return 0;
}
```

(c) How default argument can cause ambiguity in function overloading? How reference can use ambiguity in function overloading? Explain with examples. **(5+5=10)**

(d) "Encapsulation is achieved through class in C++"-explain. **(5)**

L-1/T-1/EEE **Date : 27/10/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2018-2019

Sub : **PHY 121** (Waves and Oscillations, Optics and Thermal Physics)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) What do you understand by degrees of freedom of a gas molecule? Calculate the total number of degrees of freedom for linear and non-linear polyatomic gas molecules. **(12)**

(b) State and prove the principle of equipartition of energy. Show that the ratio of two specific heats $\frac{C_p}{C_v} = 1 + \frac{2}{n}$ for a perfect gas whose molecules have n degrees of freedom. **(13)**

(c) Calculate specific heat of one mole of a monoatomic gas (i) at constant volume and (ii) at constant pressure. Also, find out the kinetic energy of translation of an oxygen molecule at 127°C. **(10)**

2. (a) State first law of thermodynamics. Calculate the work done in each operation of a Carnot cycle and find the net work done in the cycle when the working substance is a perfect gas. **(16)**

(b) Show that no engine can be more efficient than a Carnot engine working between the same two temperatures. **(10)**

(c) An engine works in a Carnot cycle between the temperatures of 500 K and 250 K. If the engine receives 1.5 kcal of heat from the source in each cycle, calculate (i) amount of heat rejected to the sink in each cycle, (ii) efficiency of the engine and (iii) work done in joules by the engine in each cycle. **(9)**

3. (a) Using Maxwell thermodynamics relation derive the Clausius Clapeyron's latent heat equation $\frac{dP}{dT} = \frac{L}{T(v_2 - v_1)}$, where the symbols have their usual meaning. **(7)**

(b) Show from the considerations of Maxwell thermodynamics relations that **(18)**

(i) $C_p - C_v = T\left(\frac{\partial P}{\partial T}\right)_V \left(\frac{\partial V}{\partial T}\right)_P$

(ii) $C_p - C_v = R\left(1 + \frac{2a}{RTV}\right)$ for a Van der Waals' gas

(iii) $C_p - C_v = R$ for a perfect gas

Where the symbols have their usual meaning.

Contd P/2

PHY 121

Contd... Q. No. 3

(c) Define Gibbs' free energy (G) and prove that **(10)**

$$S = -\left(\frac{\partial G}{\partial T}\right)_P \text{ and } V = \left(\frac{\partial G}{\partial P}\right)_T$$

Where the symbols have their usual meaning.

4. (a) What do you mean by the term aberration? What is spherical aberration for a thin lens? How spherical aberration can be reduced? **(10)**

(b) Explain how the Newton's rings experiment can be employed for the determination of the radius of curvature of a lens. Why the central spot due to reflected light is dark? **(15)**

(c) A Newton's rings apparatus is to be used to determine the radius of curvature of a lens. The radii of the n-th and $(n + 20)$-th bright rings are measured and found to be 0.162 and 0.368 cm, respectively, for light of wavelength 546 nm. Calculate the radius of curvature of the lower surface of the lens. **(10)**

SECTION - B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What do you mean by diffraction of light? Distinguish between Fresnel and Fraunhofer classes of diffraction. **(10)**

(b) What is diffraction grating? Write down the grating equation. Show that the dispersive power is proportional to the number of lines per cm of the grating surface. **(15)**

(c) Explain that the smallest object that can be resolved by an optical microscope is about the same size of the wavelength of light being used. **(10)**

6. (a) What is polarization of light? Why sound waves cannot be polarized? **(10)**

(b) Explain how light can be polarized by reflection. Sate Brewster's law for polarization of light. **(15)**

(c) Explain double refraction phenomenon in a calcite crystal. Write down the working principle of a Nicol prism. **(10)**

Contd P/3

PHY 121

7. (a) What do you mean by free vibration? Explain why it is not possible to obtain free vibration in reality. **(7)**

(b) Set up the differential equation of motion for free oscillation of a system. Assume that, a very large damping force is opposing the motion of the system. Solve the differential equation of motion of the system and show that the motion for such a system is non-oscillatory in nature. **(18)**

(c) According to classical electromagnetic theory an accelerated electron radiates energy at the rate Ke^2a^2/c^3 where $K = 6\times10^9 N-m^2/C^2$, e = electronic charge (C), a = instantaneous acceleration (m/sec^2), and c = speed of light (m/sec). If the electron was oscillating along a straight line with frequency $\nu(hz)$ and amplitude A, how much energy would it radiate during 1 cycle. **(10)**

8. (a) What do you mean by resonance of oscillation? Briefly describe the applications of resonance in our daily life. **(8)**

(b) A system is acted on by external periodic force $F = F_0 \cos \omega t$ where F_0 is the amplitude and ω is frequency of that force. Derive expressions for the resonance amplitude and resonance frequency. **(15)**

(c) If an alternating emf $E = E_0 \sin\omega t$ is applied to a series LCR circuit the resulting alternating current is given by $i = I \sin(\omega t - \varphi)$ **(12)**

(i) Find the current amplitude I and phase constant φ

(ii) Find the resonance frequency and resonant current amplitude.

Extra

L-1/T-1/EEE **Date : 27/10/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2018-2019

Sub : **PHY 121** (Waves and Oscillations, Optics and Thermal Physics)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

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Contd P/2

PHY 121

Contd... Q. No. 3

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SECTION - B

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Contd P/3

PHY 121

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(c) If an alternating emf $E = E_0 \sin\omega t$ is applied to a series LCR circuit the resulting alternating current is given by $i = I \sin(\omega t - \varphi)$ **(12)**

(i) Find the current amplitude I and phase constant φ

(ii) Find the resonance frequency and resonant current amplitude.

L-1/T-1/EEE **Date : 04/11/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2018-2019

Sub : **MATH 157** (Calculus I)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

Symbols have their usual meaning.

1. (a) Let $f(x)=\begin{cases}\sqrt{|x|}, & if\ x\geq 0\\ -\sqrt{|x|}, & if\ x<0\end{cases}$; discuss the continuity and differentiability of $f(x)$ at $x=0$. **(12)**

(b) If $y=\dfrac{x^2+x-1}{x^3+x^2-6x}$; find y_n. **(12)**

(c) State Mean value theorem.

Suppose, you are driving on a straight high way on which the speed limit is 55 m/h. At 8:05 a.m. a police car clocks your velocity at 50 m/h and 8:10 a.m. A second police car posted 5 m down the road clocks your velocity at 55 m/h. Explain why the police have a right to charge you with a speeding violation. **(11)**

2. (a) If $V=\left(x^2+y^2+z^2\right)^{-1/2}$, show that $\dfrac{\partial^2 V}{\partial x^2}+\dfrac{\partial^2 V}{\partial y^2}+\dfrac{\partial^2 V}{\partial z^2}=0$. **(12)**

(b) Show that $sin^{-1}x=x+\dfrac{1}{2}\dfrac{x^3}{3}+\dfrac{1.3}{2.4}\dfrac{x^5}{5}+\dfrac{1.3.5}{2.4.6}\dfrac{x^7}{7}+....$ **(13)**

(c) A electrical circuit consisting of an electromotive force that produces a voltage V, a resistor with resistance R, and an inductor with inductance L. It is shown in electrical circuit theory that if the voltage is first applied at time $t = 0$, then the current I flowing through the circuit at time t is given by $I=\dfrac{V}{R}\left(1-e^{\frac{-Rt}{L}}\right)$. What is the effect on the current at a fixed time t if the resistance approaches 0 $(i.e., R\rightarrow 0+)$? **(10)**

3. (a) A wire of length 20 metre is bent so as to form a circular sector of maximum area. Find the radius of the circular sector. **(12)**

(b) Define pedal equation. Find the pedal equation of the parabola $y^2=4ax$ with respect to its vertex. **(13)**

(c) If x_1, y_1 be the parts of the axes of x *and* y intercepted by the tangent at any point (x,y) to the curve $(x/a)^{2/3}+(y/b)^{2/3}=1$, show that $\dfrac{x_1^2}{a^2}+\dfrac{y_1^2}{b^2}=1$. **(10)**

Contd P/2

MATH 157

4. (a) Find all the asymptotes of the curve $x^3 - 2y^3 + xy(2x-y) + y(x-y) + 1 = 0$. **(12)**

(b) Define curvature and radius of curvature. In the ellipse $\frac{x^2}{a^2} + \frac{x^2}{b^2} = 1$, show that, the radius of curvature at the end of the major axis is equal to the semi-latus rectum of the ellipse. **(13)**

(c) Find the radius of curvature of $r = a(\theta + \sin\theta)$ at $\theta = 0$. **(10)**

SECTION - B

There are **FOUR** questions in this section. Answer any **THREE**.

5. Evaluate the following integrals:

(a) $\int \frac{6\sin x + 14\cos x}{3 + 4\sin x + 5\cos x} dx$ **(12)**

(b) $\int e^x \frac{2 + \sin 2x}{1 + \cos 2x} dx$ **(11)**

(c) $\int (x+2)\sqrt{2x^2 + 2x + 1}\, dx$. **(12)**

6. (a) Sketch the graph of $\int_3^4 x^3 dx$ and find its area as a limit sum. **(11)**

(b) Evaluate: $\underset{n \to \infty}{Lim} \frac{1}{n}\left[\sin^{2k}\left(\frac{\pi}{2n}\right) + \sin^{2k}\left(\frac{2\pi}{2n}\right) + \sin^{2k}\left(\frac{3\pi}{2n}\right) + ... + \sin^{2k}\left(\frac{\pi}{2}\right)\right]$. **(12)**

(c) Evaluate: $\int_0^{\frac{\pi}{2}} \frac{\sin x \cos x}{a^2 \sin^2 x + b^2 \cos^2 x} dx$ **(12)**

7. (a) Prove that $\int_0^{\frac{\pi}{2}} \sin^m x \cos^n x\, dx = \frac{\Gamma\left(\frac{m+1}{2}\right)\Gamma\left(\frac{n+1}{2}\right)}{2\Gamma\left(\frac{m+n+2}{2}\right)}$. **(11)**

(b) Evaluate: $\int_0^{\infty} \frac{x dx}{(1+x)(1+x^2)}$ **(12)**

(c) Evaluate: $\int_0^{\frac{\pi}{4}} \frac{dx}{\sqrt{1 - \frac{1}{2}\sin^2 x}}$ **(12)**

8. (a) Find the total area of the loops of the curve $r = 2\sin 4\theta$. **(11)**

(b) Find the volume of the solid generated by revolution of the area $y^2(a+x) = x^2(x-a)$ about the x-axis. **(12)**

(c) Find the surface area of the solid obtained by revolving the graph **(12)**

$$\left(\frac{x}{3}\right)^{2/3} + \left(\frac{x}{4}\right)^{2/3} = 1 \text{ about y-axis.}$$

L-1/T-1/EEE **Date: 11/11/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2018-2019

Sub: **MATH 159** (Calculus II)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks

Symbols used have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. (a) Prove that f(z) = ln z has a branch point at z = 0. **(11)**

(b) Let $f(z)=\begin{cases}\dfrac{z^2+4}{z-2i} & \text{if } z\neq 2i\\ 3+4i & \text{if } z=2i\end{cases}$ **(12)**

(i) Determine whether $\lim_{z\to i} f(z)$ exists or not.

(ii) Is $f(z)$ continuous at $z = 2i$? Explain.

(iii) Is $f(z)$ continuous at $z \neq 2i$? Explain.

(c) Locate and name all the singularities of the function $f(z)=\dfrac{z^8+z^4+2}{(z-1)^3(3z+2)^2}$.

Also determine where $f(z)$ is analytic. **(12)**

2. (a) Prove that $\dfrac{d}{dz}(z^2\bar{z})$ does not exist anywhere. **(11)**

(b) State Cauchy-Rienmann equations. Find the orthogonal trajectories of the family of curves in the xy plane defined by $e^{-x}(x \sin y - y \cos y) = \alpha$ where α is a real constant. **(12)**

(c) Evaluate $\oint_C |z|^2$ around the square with vertices at (0, 0), (1, 0), (1, 1), (0, 1). **(12)**

3. (a) Prove Cauchy's theorem $\oint_C f(z)dz = 0$ if $f=(z)$ is analytic with derivative $f'=(z)$ which is continuous at all points inside and on a simple closed curve C. **(15)**

(b) State Complex form of Green's theorem. Verify the theorem for the function $F(z,\bar{z}) = z^3 - iz^2 - 5z + 2i$ if C is the region bounded by the ellipse $|z-3i|+|z+3i| = 20$. **(20)**

4. (a) Evaluate $\oint_C \dfrac{dz}{(z-a)^5}$ where $z = a$ is inside the simple closed curve C. **(11)**

(b) Suppose $A(x, y) = 2xy - ix^2y^3$. Find (i) grad A, (ii) div A, (iii) $|curl\ A|$ **(12)**

(c) State Residue theorem. Evaluate $\oint_C \dfrac{2z^2+5}{(z+2)^3(z^2+4)z^2}dz$ where, C the circle with equation $|z-2i| = 6$. **(12)**

Contd P/2

MATH 159

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5. (a) Prove that the area of the triangle formed by joining the mid-point of one of the non-parallel sides of a trapezium to the extremities of the opposite side is half of that of the trapezium. **(15)**

   (b) If the system of vectors $\mathbf{a}'$, $\mathbf{b}'$, $\mathbf{c}'$, is reciprocal to the system of vectors $\mathbf{a}$, $\mathbf{b}$, $\mathbf{c}$, then prove that any vector $\mathbf{r}$ is given by $\mathbf{r} = (\mathbf{r}.\mathbf{a})\mathbf{a}' + (\mathbf{r}.\mathbf{b})\mathbf{b}' + (\mathbf{r}.\mathbf{c})\mathbf{c}'$ **(10)**

   (c) Show that $\nabla.(\mathbf{A}\times\mathbf{B})=\mathbf{B}.(\nabla\times\mathbf{A})-\mathbf{A}.(\nabla\times\mathbf{B})$. **(10)**

6. (a) Find the curvature, principal normal and binomial vectors of the space curve $r(t) = \cosh t\mathbf{i} + \sinh t\mathbf{j} + t\mathbf{k}$. **(15)**

   (b) Find the equation of the tangent plane and the normal line to the surface $z = 2x^2 - 3y^2$ at the point A(1, −1, −1) **(10)**

   (c) Solve the vector equation $\mathbf{a} \times \mathbf{x} + \mathbf{a}(\mathbf{a}.\mathbf{x}) + \mathbf{b} = \mathbf{0}$ for he vector $\mathbf{x}$. **(10)**

7. (a) Show that $\nabla^2(r^n\mathbf{r}) = n(n + 3)r^{n-1}\mathbf{r}$ **(10)**

   (b) Is the vector field $\mathbf{F} = (x^3z-2xyz)\mathbf{i} + (xy-3x^2yz)\mathbf{j} + (yz^2 - xz)\mathbf{k}$ solenoidal? If so, find a vector function $\mathbf{V}$ such that $\mathbf{F} = \nabla\times\mathbf{V}$. **(15)**

   (c) Define tangential derivative and normal derivative. Find the direction along which the directional derivative of $Q = x^2yz^3$ at the point (2, 1, −1) is the greatest. Determine the greatest value as well. **(10)**

8. (a) State and verify Gauss's divergence theorem for $\mathbf{F} = 2xy\mathbf{i} + yz\mathbf{j} + zx^2\mathbf{k}$ taken over the region bounded by the cylinder $y^2 + z^2 = 9$ and the planes $x = 0$, $x = 3$. **(18)**

   (b) Find the work done by the force field $\mathbf{F}$ on a particle that moves along the curve C where $\mathbf{F}(x, y) = (3x^2 + y)\mathbf{i} + (y^2 + 2x^2)\mathbf{j} + (zy^2 + 2x)\mathbf{k}$; C: along line segments from (0, 0, 0) to (1, 2, 1) to (−2, 1, 3). **(17)**
