L-1/T-1/EEE **Date: 21/08/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2016-2017

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

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

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 a variable expression). Also, read the constraints/notes mentioned in each question carefully. You *must* adhere to the constraints in answering the respective question. Violation of constraint(s) will result in deduction of full marks.

1. (a) Write a program that can detect whether a point is inside or outside a square. The square's sides are parallel to the axes of the XY plane. Your input is 5 integers. The first 2 integers represent the (x, y) coordinates of the bottom left corner of the square. The next integer represents the length of each of its sides. The next 2 integers represent the (x, y) coordinates of the query point. Print "Inside the square" if the query point is inside or on the boundary of the square. Otherwise print "Outside the square". **(10)**

   (b) In the Gregorian calendar, years that are multiples of 4 are leap years. However, exception to this rule occurs on the century year. A century year is a multiple of 100. Such a year is deemed as leap year only if it is a multiple of 400. Write a program that takes a year as input and output "Leap Year" if the year is a leap year. Otherwise, it should output "Not a Leap Year". <u>You cannot use if statements, logical connectors and ternary operators for this task. Instead, solve the problem using nested switch statements.</u> **(10)**

   (c) Assuming the variables are defined, write necessary statements to perform the following printing operations. **(10)**

   (i) Print an integer variable *myInt*, right justified within 9 spots and with no leading zeros.

   (ii) Print *myInt* (defined above) in hexadecimal representation. Use small letters for a-f.

   (iii) Print a float variable *myFloat*; print 3 digits after the decimal point.

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

   (v) Print a char variable *myChar*.

Contd P/2

CSE 109

Contd... Q. No. 1

(d) What will be the output for the C program in Figure# 1? **(5)**

```
#include <stdio.h>

int a, b;

int main()
{
    int a = b++;
    int b = a++;

    printf("%d %d\n", ++a, b++);

    return 0;
}
```

Figure# 1: Program listing for question 1(d)

2. (a) A point in XY plane can be represented by 2 floating point numbers that represent its x, y coordinates respectively. A circle in the XY plane can be represented by its center (which is a point in XY plane) and a radius (which is a floating point number). A square in XY plane, whose sides are parallel to the axes of the XY plane, can be represented by its bottom-left corner (which is a point in XY plane) and length of its sides (which is a floating point number). A cone, whose base is on the XY plane, can be represented by its circular base and a height. A cylinder too can be represented by its circular base and a height. **(5+5+5=15)**

   (i) Based on the above information, define suitable structures to represent a point, circle, square, cone and cylinder.

   (ii) Read a circle, square, cone and cylinder from console, store them in appropriate structure variables.

   (iii) Then print out the area of the circle and square; and volume of the cylinder and cone.

Hint: Volume of a cylinder is height times its base area. For the cone it is one-third of height times its base area. Also, for value of π, use the fact that $\cos(\pi/2) = 0$.

(b) Write a program that counts the frequency of each unique word in a file. It then stores this information in another file. Read both file names from console. The total number of unique words in the input file does not exceed 100. Each word is no more than 20 characters long. **(3+3+3+5+3+3=20)**

   (i) Define a structure to store a word and its frequency. Let us call it *Keyword.*

   (ii) Declare an array of *Keyword* of appropriate size.

Contd P/3

CSE 109

Contd... Q. No. 2(b)

(iii) Read the file names from console. The first line contains the input file name. The second line contains the output file name. The file names do not contain any spaces. Open the files. Remember to do error check during file opening.

(iv) Read the input file until the end; update your *Keyword* array appropriately.

(v) In the output file, write a line for each keyword. The line should contain the keyword, followed by its frequency.

(vi) Finally, close both files.

Hint: Read each word of the specified input file using the %s format-specifier of fscanf() method. If the first letter of the word is capitalized, lower its case using tolower() method (in ctype.h). Also, check if the last letter is a punctuation character or not, using ispunct() method (also in ctype.h). If there is a punctuation character, remove it using the code segment shown in Figure 2. For your convenience a sample input file and the corresponding output file are shown in Figure 3 and 4 respectively.

```
len = strlen(str);
if (ispunct(str[len - 1]))
    str[len - 1] = '\0';
```

Figure#2: Code listing for Question 2(b)

Sample Input File Content
Hi how are you? I am fine, thank you! How about you? I am fine too, thank you for asking!

Figure#3: Sample content of input file Question 2(b)

Sample Output to File
hi 1 how 2 are 1 you 4 i 2 am 2 fine 2 thank 2 about 1 too 1 for 1 asking 1

Figure#3: Sample content of input file Question 2(b)

3. (a) In C, the type *char* is 8 bits. It is possible to hold small integer values (in the range –128 to +127) in a variable of char type. Let *x and* y be 2 (signed) char variables. They are respectively initialized with values 98 and –82. Write down the following: **(15)**

Contd P/4

CSE 109

Contd... Q. No. 3(a)

- (i) bit pattern stored in x.
- (ii) bit pattern stored in y.
- (iii) bit pattern of $(x \& y)$
- (iv) bit pattern of $(x \mid y)$
- (v) bit pattern of $(x \wedge y)$
- (vi) signed decimal value of $\sim x$
- (vii) signed decimal value of $\sim y$

(b) Explain the following with example: **(3×5=15)**

- (i) static local variable of a function
- (ii) static member variable of a class
- (iii) static member function of a class

(c) When does the copy constructor get called? **(5)**

4\. (a) Implement a class called *String* to represent a string. In the class, keep a private member variable of character pointer type, called *pStr*. To store a string, you will dynamically allocate memory in *pStr* so that the candidate string just fits in. Perform the following **(10×3=30)**

- (i) Implement default constructor that sets *pStr* to an empty string (after appropriate memory allocation).
- (ii) Implement an overloaded constructor with a character pointer parameter. The null-terminated string pointed to by the pointer should be copied to *pStr* (after appropriate memory allocation).
- (iii) Implement the copy constructor.
- (iv) Implement the destructor.
- (v) Implement a public method in the class called *set*() to set/store a string. The parameter is a character pointer. The null-terminated string pointed to by the pointer should be copied to *pStr* (after appropriate memory allocation).
- (vi) Implement a public *get*() method that returns *pStr* to the caller.
- (vii) Overload the addition (+) operator to represent string concatenation operation. This would produce and return a *String* by concatenating the parameter *String* to the end of *this String*.
- (viii) Overload the multiplication (*) operator to produce and return a *String* by repeating *this String num* times, where *num* is an integer parameter to the overloaded operator.
- (ix) Overload the assignment (=) operator as appropriate.
- (x) Overload the equality comparison (==) operator as appropriate.

(b) Using the *String* class of question 4(a), dynamically allocate an array of 5 string objects. Then store the strings "I", "love", "exam", "very", "much" in them. Then concatenate them using the "+" operator to produce the *String* "I love exam very much". Print the produced string to console. Finally de-allocate the dynamically allocated array. **(5)**

Contd P/5

CSE 109

SECTION-B

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

5. (a) Consider the following (Figure A) code snippet. Rewrite the code using only do-while loop preserving the functionality of the code. **(5)**

```
int i=0;
int sum = 0;
for(i=1; i<=9; i++)
{
   printf("%d\n", i);
   sum += i;
}
printf("%d\n", sum);
```

Figure A: for Question no. 5(a)

(b) A palindrome is a string that reads the same backward as forward, for example, "madam" and "wow". Write a C function that converts a given string to a palindrome by appending minimum number of characters (insertion at the end). Sample input/output is given below: **(10)**

Sample Input	Sample Output
ma	mam
rad	radar
abcdc	abcdcba

(c) Carefully analyze the following code (Figure B) and write down the output. **(10)**

```
#include<stdio.h>
#include<math.h>
int main()
{
    int n = 5, m =10, k = 20;
    while(1)
    {
        if( !((m>0 ? m-- : m) | k) )
        {
            break;
        }
        if(!(n & 10))
        {
            k--;
        }
        if(!(k%2))
        {
            continue;
        }

        int value = k%3 ? k/3 : k %3;

        if(value)
            printf("%d\n",value);
    }
    return 0;
}
```

Figure B: for Question no. 5(c)

CSE 109

Contd... Q. No. 5

(d) Write a program to sort a set of integers in ascending order. You have to use "Bubble Sort" algorithm to do this task. The first line of input contains **n**, the number of integers to sort. The maximum value of **n** can be **255**. The next line contains the n integers, separated by space. Output the sorted integers in a single line, separated by space. **(10)**

6. (a) Implement the following function. The prototype is as follows: **(10)**

```
int* process(int *arr, int count, int divisor)
```

Where *arr* points to an array of integers, count represents the number of integers in the array, *arr*. You need to identify which integers are divisible by the parameter *divisor*. Create a new array (dynamically allocated) to store such integers. However, in the first position (index 0) of the array, store the number of such integers. Subsequently, store the divisible integers. Finally, return the pointer. Do not allocate extra memory in your array. For example, let *arr* points to the integer array {5, 1, 3, 15, 9, 10}. Then, the *count* is 6. Let *divisor* be 5. Then your function should return a pointer to a dynamically allocated integer array, whose content is: {3, 5, 15, 10}.

(b) Write a C function that receives a string parameter as input and finds the first repeated character in it. This means the function finds the character that occurs more than once and whose index of first occurrence is the smallest. Sample input/output is given below: **(10)**

Sample Input	Sample Output
bangladesh	a
shesher kabita	s

(c) Carefully analyze the following code (Figure C) and write down the output. **(5)**

```
#include<stdio.h>
#include<math.h>
double PI = 3.1416;

double myPower(double a, double n)
{
    return pow(a,n);
}
double getAreaOfCircle(double radius)
{
    return PI * myPower(2,radius);
}
int main()
{
    printf("%.2lf\n",myPower(5,3));
    printf("%.2lf\n",getAreaOfCircle(5));
    printf("%.2lf\n",ceil(5.50001));
    printf("%.2lf\n",floor(4.9999));
    printf("%.2lf\n",fabs(-4.557));
}
```

Figure C: for Question no. 6(c)

CSE 109

Contd... Q. No. 6

(d) In number theory, a perfect number is a positive integer that is equal to the sum of its proper positive divisors, that is, the sum of its positive divisors excluding the number itself. For example, 28 is a perfect number. Here, the positive divisors of 28 are: 1, 2, 4, 7, 14, and 28. The sum of the positive divisors excluding the number itself is: **(10)**

$$1 + 2 + 4 + 7 + 14 = 28$$

Now, write a C function to determine whether a given positive integer number, **n** is perfect or not. The function will return **1** if the given number **n** is perfect and **0** otherwise. The prototype of the function is given below:

```
int isPerfect(int n)
```

7. (a) In this problem, you are given a 2D square binary matrix (all the elements of this matrix are either **0** or **1**) as follows: the first line of input contains a single integer **n** ($1 \le n \le 20$), representing the number of rows and columns in the matrix. Then the elements of the binary matrix are given in row major order. (Meaning, the next line contains n space separated integers (**0** or **1**) representing the first row of the matrix; the next line represents the second line of the matrix and so on.) Store the matrix in a 2D array (say, **M**). Now, write a C program to check whether any of its two diagonals' values are same or not. For example, **(15)**

```
int M[3][3] = { {1, 0, 0},
                {0, 1, 0}
                {1, 0, 1}
              };
```

Here, in one diagonal direction, the values are {1, 1, 1}. In the other diagonal direction, the values are {0, 1, 1}. Since, in one direction the values are same, your program will give output "SAME". If neither of the two diagonals has the same value, then your program will give output "NOT SAME". **You cannot use nested loop to do this task.**

(b) Implement the ***strcmp*** library function. The prototype of the function is given below: **(10)**

```
int strcmp(char *s1, char * s2)
```

you have to use pointer syntax to do this task.

(c) Write a recursive function to count the number of zeros in an array of integers, **n**. This function will return the number of zeros. The prototype of the recursive function is given below: **(10)**

```
int countZeros(int n[], int size)
```

Here, *size* represents the size of the integer array. **No global memory, static variable or loops can be used in this task.**

Contd P/8

CSE 109

8. (a) Magic square is an ancient mathematical problem that many people try to solve. A magic square is an arrangement of numbers from 1 to n^2 in an $[n \times n]$ matrix, with each number occurring exactly once, and such that the sum of the entries of any row, any column, or any main diagonal is the same. For n = 3, as an example, a matrix representing magic square is shown in the following figure (Figure D). **(15)**

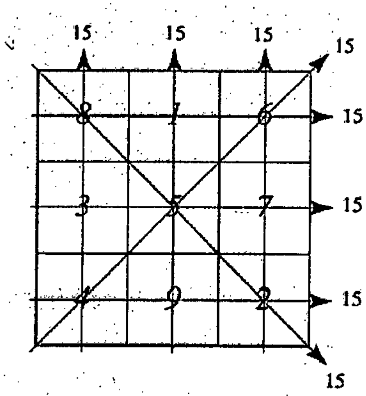


Figure D: for Question no. 8(a)

Write a complete C program to test whether a square [2D array] is a Magic square or not.

(b) (i) Write a recursive function to print the digits of an integer number. The prototype of the function should be: **(15)**

```
void printDigit(int n)
```

Same input/output is given below:

Sample Input	Sample Output
56731	5 6 7 3 1

(ii) Write a recursive function that returns the sum of the digits of an integer number. The prototype of the function should be:

```
int sumDigit(int n)
```

Sample input/output is given below:

Sample Input	Sample Output
56731	22

(iii) Write a recursive function that returns the sum of square of digits of an integer number.

```
int sumSqDigit(int n)
```

Contd P/9

CSE 109

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

Sample input/output is given below:

Sample Input	Sample Output
256	65

(c) Carefully analyze the following code (Figure E) and write down the output. **(5)**

```
#include<stdio.h>

void main()
{
    int *pb,i;
    int b[]={0,4,11,14,19};
    pb=b;
    for(i=0;i<5;i++)
    {
      (*pb)++;
       printf("%d ",*pb++);
    }
}
```

Figure E: for Question no. 8(c)

L-1/T-1/EEE **Date : 17/08/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2016-2017

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Represent graphically the set of values of z for which **(5)**

(i) $|z+i| \leq 3$

(ii) $|z-4i|+|z+4i|=10$

(b) Show that $\left|Re\left(2+\bar{z}+z^3\right)\right| \leq 4$, when $|z| \leq 1$ **(5)**

(c) Find all roots of $\left(-8-8\sqrt{3}i\right)^{1/4}$ and exhibit graphically the distinct roots as vertices of a square. **(10)**

(d) Test the continuity and differentiability of the function

$$f(z)=\begin{cases}\dfrac{(Im\,z)^2}{|z|} & ;\ z \neq 0 \\ 0 & ;\ z=0\end{cases}$$ at the point $z = 0$. **(15)**

2. (a) (i) Determine where the function $f(z)=i\,\bar{z}^2$ is differentiable. Is this function analytic anywhere? **(6)**

(ii) Show that $f(z)=-ie^{iz}$ is an entire function. **(4)**

(b) Show that $Log(-1+i)^2 \neq 2Log(-1+i)$ **(10)**

(c) Solve the equation $sinz = cosh4$ by equating the real parts and imaginary parts of $sinz$ and $cosh4$. **(15)**

3. (a) Show that $v(x,y)=x^2-y^2+\dfrac{x}{x^2+y^2}$ is a harmonic function in some domain. Find an analytic function $f(z)=u(x,y)+iv(x,y)$ and express $f(z)$ in terms of z. **(12)**

(b) Determine whether the integral $\int_C \left(x^2-iy^2\right)dz$ is independent of the path. Then evaluate $\int_C \left(x^2-iy^2\right)dz$ along the parabola $y=2x^2$ from (1, 2) to (2, 8). **(12)**

Contd P/2

MATH 159(EEE)

Contd ... Q. No. 3

(c) Use Cauchy's integral formula to find the value of $\int_C \frac{dz}{z^2(z-2)(z-4)}$ where 'C' is the rectangle with vertices 3 + i, –1 + i, – 1–i, 3 – i, taken counterclockwise. **(11)**
[Do not use Cauchy's residue theorem]

4. (a) Expand $f(z) = \frac{1}{(z+1)(z+3)}$ in Laurent series **(15)**

   (i) in powers of z valid in $1 < |z| < 3$

   (ii) in powers of $(z + 1)$ valid in the region $0 < |z + 1| < 2$.

   (b) Use Cauchy's residue theorem to find the value of the following integrals:

   (i) $\int_C \frac{\cosh \pi z}{z(z^2+1)} dz$; where 'C' is the circle $|z| = 2$ described in positive sense. **(10)**

   (ii) $\int_C \frac{dz}{z^3(z+4)}$; where C is the circle $|z + 2| = 3$ taken counterclockwise. **(10)**

SECTION – B

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

5. (a) Show that any vector **r** can be represented as a linear combination of three non coplanar vectors **a**, **b**, **c**. Hence find a linear relation among the vectors (1, 3, 4), (1, – 2, 3), (1, 5, –2) and (6, 14, 4) **(15)**

   (b) Given points $A(2, 1, 3)$, $B(1, 2, 1)$, $C(-1, -2, -2)$ and $D(1, -4, 0)$, find the shortest distance between lines AB and CD. **(10)**

   (c) Prove that, $[\mathbf{a} \times \mathbf{p}, \mathbf{b} \times \mathbf{q}, \mathbf{c} \times \mathbf{r}] + [\mathbf{a} \times \mathbf{q}, \mathbf{b} \times \mathbf{r}, \mathbf{c} \times \mathbf{p}] + [\mathbf{a} \times \mathbf{r}, \mathbf{b} \times \mathbf{p}, \mathbf{c} \times \mathbf{q}] = 0$ **(10)**

6. (a) Derive the Frenet-Serret formulae. **(10)**

   (b) Define normal and directional derivative. Find the values of the constants a, b, c so that the directional derivative of $\phi = ax^2 + by^2 + cz^2$ at (1, 1, 2) has a maximum magnitude 4 in the direction parallel to y-axis. **(15)**

   (c) Prove that, $\nabla^2 f(r) = f''(r) + 2\frac{f'(r)}{r}$, where $\mathbf{r} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ and $r^2 = x^2 + y^2 + z^2$ **(10)**

7. (a) If $\mathbf{F} = 2xyz^2\mathbf{i} + (x^2z^2 + z\cos yz)\mathbf{j} + (2x^2yz + y\cos yz)\mathbf{k}$, show that $\int_C \mathbf{F}.d\mathbf{r}$ is independent of path. Find the work done in moving an object in the force field **F** from (0, 0, 1) to $(1, \frac{\pi}{4}, 2)$. **(13)**

Contd P/3

MATH 159(EEE)

Contd ... Q. No. 7

(b) Evaluate $\iiint_V (2x+y)dV$ where V is the closed region of the parabolic cylinder bounded by $z = 4 - x^2$, $x = 0$, $y = 0$, $y = 2$, $z = 0$. **(12)**

(c) Using Green's theorem in the plane, find the area of the region bounded by $y^2 = 8x$ and $x = 2$ **(10)**

8. (a) State Divergence theorem and verify it for $\mathbf{F} = (x^2 - yz)\mathbf{i} + (y^2 - zx)\mathbf{j} + (z^2 - xy)\mathbf{k}$ taken over the rectangular parallelepiped $0 \le x \le a,\ 0 \le y \le b,\ 0 \le z \le c$. **(20)**

(b) Evaluate $\iint_S (\nabla \times \mathbf{A}).\,\mathbf{n}dS$ where $\mathbf{A} = (x^2 + y - 4)\mathbf{i} + 3xy\mathbf{j} + (2xz + z^2)\mathbf{k}$ and S is the surface of the hemisphere $x^2 + y^2 + z^2 = 16$ above the xy plane. **(15)**

L-1/T-1/EEE **Date : 17/07/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2016-2017

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Test the continuity and differentiability of $f(x)=|x-2|+|x-3|$ at $x = 2$ and $x = 3$. Also sketch the graph of $f(x)$. **(20)**

   (b) Find the n-th derivative of the function $y=\tan^{-1}\frac{\sqrt{1+x^2}-1}{x}$. **(15)**

2. (a) If $y=\cos(a\sin^{-1}x)$ then find the value of $(1-x^2)y_{n+2}-(2n+1)xy_{n+1}+(a^2-n^2)y_n$. Also find the value of $(y_n)_0$. **(12)**

   (b) Find the infinite series of the function $y=\sqrt{1-x^2}\sin^{-1}x$. **(12)**

   (c) Evaluate: $\lim_{x\to 1}\left[\frac{x}{x-1}-\frac{1}{\ln x}\right]$. **(11)**

3. (a) If $u=\ln r$ and $r^2=(x-a)^2+(y-b)^2+(z-c^2)$ then express $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}+\frac{\partial^2 u}{\partial z^2}$ in terms of r. **(12)**

   (b) Show that the largest rectangle inscribable in a circle is a square. **(12)**

   (c) Find in what intervals the function $f(x)=x^3-3x^2-4x+12$ is increasing, decreasing, concave up and concave down. Also find the inflection points and hence, sketch the graph. **(11)**

4. (a) Find the area of the triangle formed by the axes and the tangent to the curve $x^{2/3}+y^{2/3}=a^{2/3}$ at any point. **(12)**

   (b) Find the equation of the circle of curvature at the point (0, 1) on the curve $y=x^3+2x^2+x+1$. **(12)**

   (c) Find the asymptotes of the curve $x^3+y^3=3axy$. **(11)**

Contd P/2

MATH 157(EEE)

SECTION – B

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

5. Carry out the following: **(11+12+12)**

(a) $\int \frac{dx}{\cos(2x-a)\cos(2x+a)}$,

(b) $\int \frac{(3x-2)dx}{\sqrt{3+2x-4x^2}}$,

(c) $\int \frac{2}{(2-x)^2}\sqrt[3]{\frac{2-x}{2+x}}dx$.

6. (a) Find a reduction formula for $I_n = \int x\sin^n x dx$ and hence, obtain $\int x\sin^4 x dx$. **(13)**

(b) Evaluate:

$$\lim_{n\to\infty}\left[\left(1+\frac{1}{n^2}\right)^{\frac{2}{n^2}}\left(1+\frac{2^2}{n^2}\right)^{\frac{4}{n^2}}\left(1+\frac{3^2}{n^2}\right)^{\frac{6}{n^2}}\cdots\left(1+\frac{n^2}{n^2}\right)^{\frac{2n}{n^2}}\right].$$ **(10)**

(c) Find the value of $\int_0^a \frac{x^4}{(a^2+x^2)^4}dx$. **(12)**

7. (a) Evaluate: $\int_0^\pi \frac{x^3\cos^4 x\sin^2 x}{\pi^2-3\pi x+3x^2}dx$. **(12)**

(b) Evaluate: $\int_0^1 \frac{dx}{(1+x)(2+x)\sqrt{x(1-x)}}$. **(11)**

(c) Prove that

(i) $\int_0^\infty x^{3/2}e^{-4x}dx = \frac{3\sqrt{\pi}}{128}$. **(6)**

(ii) $\int_0^{\pi/2}\sqrt{\tan x}\ dx = \frac{\pi}{\sqrt{2}}$. **(6)**

8. (a) Find the area enclosed by the following curve $x = a\cos^3 t, y = b\sin^3 t$. **(11)**

(b) Determine the area inside the circle $r = \sin\theta$ and outside the cardioid $r = 1-\cos\theta$. **(12)**

(c) Find the volume generated by revolving one loop of $y^2(a+x) = x^2(3a-x)$ about x – axis. **(12)**

L-1/T-1/EEE **Date : 12/08/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2016-2017

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) What are Lissajous Figures? On what factors does it depend? **(7)**

(b) Derive a general expression for the resultant vibration of a particle simultaneously acted upon by two initially perpendicular simple harmonic vibrations having same period but different phase and amplitude. Find out the condition for circle and straight line. **(20)**

(c) Two ideal springs are joined and connected to a mass M as shown in Figure 1. The surface is frictionless. If the springs separately have force constants k_1 and k_2, show that frequency of oscillation of the mass M is **(8)**

$$f = \frac{1}{2\pi}\sqrt{\frac{k_1 k_2}{(k_1 + k_2)M}}$$

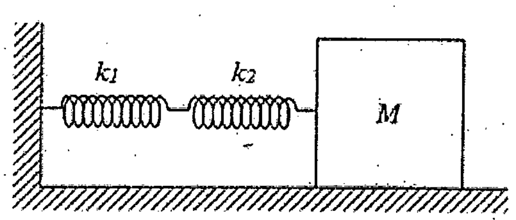


Figure 1

2. (a) Define forced vibrations. What is the effect of the frequency of driving force on the forced vibration? **(7)**

(b) Two oscillating bodies of masses m_1 and m_2 are connected by a spring on a horizontal frictionless surface. Show that their relative motion can be represented by the oscillation of a single body having reduced mass μ. **(20)**

(c) Two masses 2 kg and 3 kg are connected by a spring. Find the oscillation frequency of the two body system. Given that the extension of the spring is 2.5 cm for the applied force of 2.5 N. **(8)**

3. (a) Explain the term wave motion and discuss about the different types of waves. **(7)**

(b) Obtain expressions for energy density and intensity of a plane progressive wave. **(20)**

(c) A source of sound has a frequency 700 Hz and amplitude 2.0 cm. What is the flow of energy across a square cm per second, if the velocity of sound in air is 332 m/s and density of air is 0.000129g/cm^3? **(8)**

Contd P/2

PHY 121(EEE)

4. (a) What is chromatic aberration for a thin lens? How chromatic aberration can be minimized? **(10)**

(b) Explain the experimental arrangement of Newton's rings experiment. How can you determine the wavelength of light by using Newton's rings experiment? **(18)**

(c) In the Newton's rings experiment, the radius of curvature of the curved surface is 50 cm. The radii of the 9^{th} and 16^{th} rings are 0.18 and 0.2235 cm, respectively. Calculate the wavelength of light being used in the experiment. **(7)**

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 Fraühofer classes of diffraction. **(12)**

(b) Write down the equation for diffraction grating by mentioning each term. A diffraction grating 3 cm wide produces a deviation of 33 degrees in the second order with light of wavelength 600 nm. What is the total number of lines on the grating? **(10)**

(c) What is the 'resolving power' of an optical instrument? Show that the smallest detail that can be resolved in an optical microscope is about the same size as the wavelength of light being used. **(13)**

6. (a) What do you mean by polarization of light? How plane polarized light can be produced by reflection? **(12)**

(b) Explain the phenomenon of double refraction in a calcite crystal. Show how Nicol prism can be used as a polarizer as well as an analyzer. **(15)**

(c) Explain the term 'optical activity' of an optically active substance. What is specific rotation? **(8)**

7. (a) Deduce Vander Waal's equation for a real gas. **(12)**

(b) Obtain expressions for the critical pressure and critical temperature in terms of Vander Waal's constants (a and b) and R. What are the main defects of Vander Waal's equation? **(15)**

(c) Calculate the critical temperature of helium. Given that critical pressure = 2.5 atm, critical density = 0.07 gm/cm^3 and R = 8.31 J $mol^{-1}k^{-1}$. **(8)**

Contd P/3

PHY 121(EEE)

8. (a) Derive the parent equation of Maxwell's thermodynamic relations and prove that

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

(ii) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$ **(17)**

(iii) $\left(\frac{\partial P}{\partial T}\right)_S\left(\frac{\partial V}{\partial S}\right)_T - \left(\frac{\partial P}{\partial S}\right)_T\left(\frac{\partial V}{\partial T}\right)_S = 1$

where symbols have their usual meaning.

(b) Using Maxwell's thermodynamic relations show that

$$C_P - C_V = T\left(\frac{\partial P}{\partial T}\right)_V\left(\frac{\partial V}{\partial T}\right)_P$$ **(6)**

where symbols have their usual meaning.

(c) Prove that following relations using the above equation: **(12)**

(i) For a perfect gas $C_P - C_V = R$

(ii) For a Vander Waal's gas $C_P - C_V = R\left(1 + \frac{2a}{RTV}\right)$

where symbols have their usual meaning.

L-1/T-1/EEE **Date : 06/08/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2016-2017

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

Symbols have their usual meaning.

1. (a) The circuit shown in Figure for Q. 1a is at steady state before the switch opens at t = 0. The switch remains open for 0.5 second and then closes. Determine v(t) for t ≥ 0. **(17)**

   (b) Design the circuit shown in Figure for Q. 1b(i) to have the rresponse shown in Figure for Q. 1b(ii) by specifying the values of L, R_1 and R_2. **(18)**

2. (a) The voltage source voltage in the circuit shown in Figure for Q. 2a is $Vs(t) = 5 + 20\,u(t)$. Determine $i_b(t)$ for t ≥ 0. **(15)**

   (b) Qualitatively draw phasor diagram for I, I_C, I_L, V_p and V_s in the circuit shown in Figure for Q.2b. **(12)**

   (c) Derive the expression for inductor current $i(t)$ for $t > 0$ in response to a step voltage in the RL Circuit shown in Figure for Q. 2c. **(8)**

3. (a) Find the average power absorbed by the network in Figure for Q. 3a(i) if the output of the current source is shown in Figure for Q. 3a(ii). **(16)**

   (b) Determine the voltage v(t) for the circuit in Figure for Q. 3b. **(19)**

4. (a) What is the value of the resistance R in Figure for Q. 4a that maximizes the average power delivered to the load? Also calculate the maximum average power transferred to the load. **(10+5)**

   (b) A 220-V rms 50-Hz source supplies two loads connected in parallel, as shown in Figure for Q. 4b. **(12+8)**

      (i) Find the real power, reactive power and power factor of the parallel combination.

      (ii) Calculate the value of the capacitance connected in parallel that will raise the power factor to unity.

Contd P/2

SECTION – B

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

5. (a) Find voltages V_1, V_2, V_3 and V_4 for the circuit shown in Fig. for Q. 5(a). Also find current I_1. **(18)**

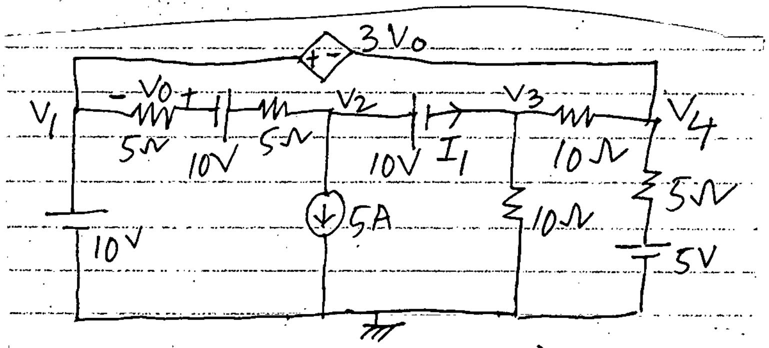


Fig. for Q.5(a)

(b) For the current shown in Fig. for Q. 5(b), find Vx using superposition principle. **(17)**

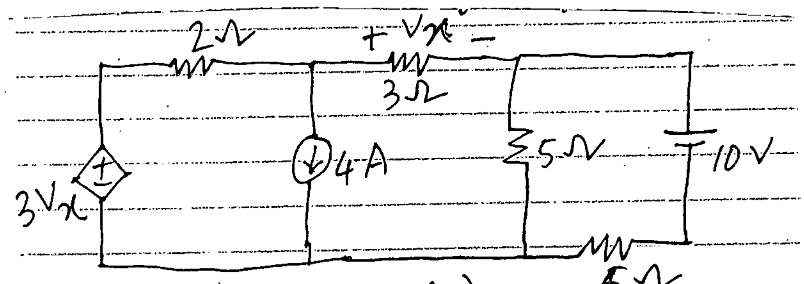


Fig. for Q.5(b)

6. (a) For the circuit shown in Fig. for Q. 6(a), find R1 so that maximum power will be transferred from the left of section a – b to the right of section a-b. What is that power? **(17)**

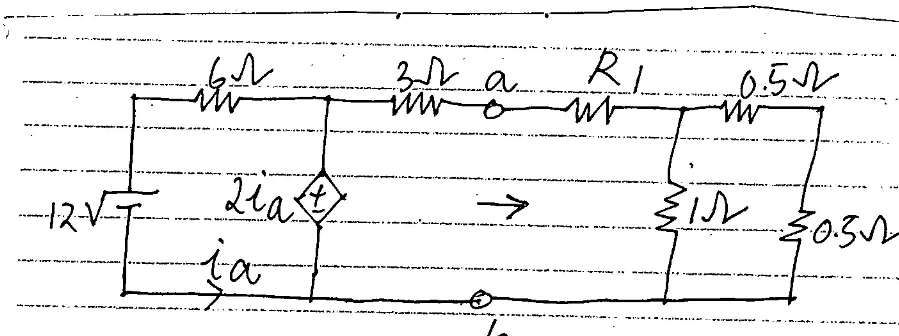


Fig. for Q.6(a)

(b) For the circuit shown in Fig. for Q. 6(b), find currents I_1, I_2, I_3 and I_4 using mesh current analysis. **(18)**

EEE 101

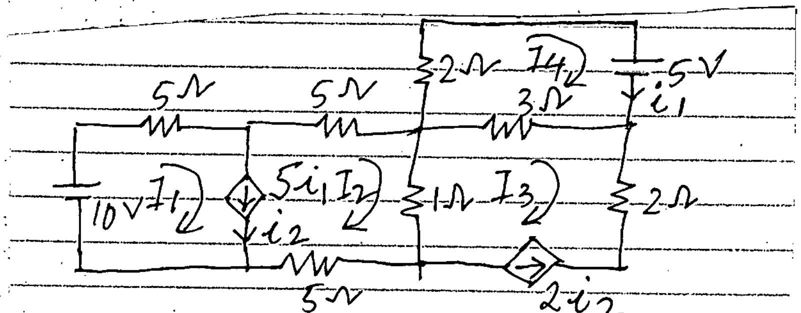


Fig. for Q. 6(b)

7. (a)

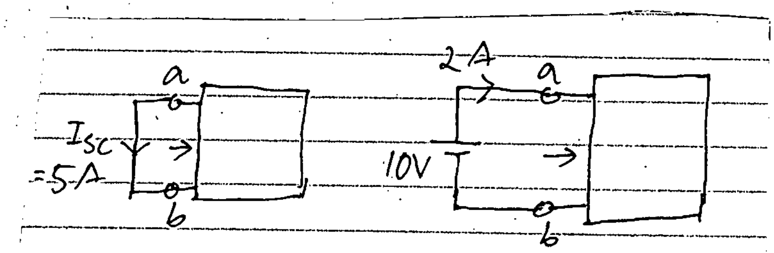


Fig. for Q. 7(a)

For the unknown circuit shown in Fig. for Q. 7(a), as a short is placed across terminals a-b, I_{sc} = 5A. If a 10 V source is connected, current is 2A. Find Thevenin and Norton's equivalent circuits for the right of terminals a-b. **(17)**

(b) For the circuit shown in Fig. for Q. 7(b), Find Norton's equivalent circuit between terminals a-b. **(18)**

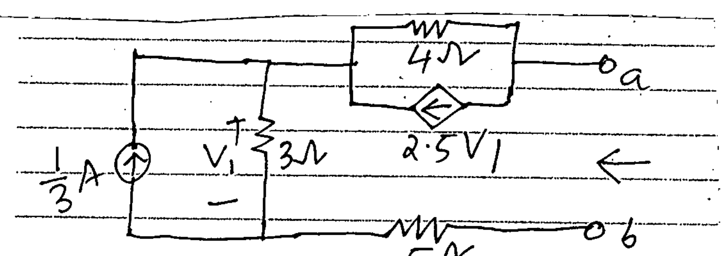


Fig. for Q. 7(b)

8. (a) For the circuit shown in Fig. for Q. 8(a), Find equivalent resistance by looking into terminals a-b. For finding equivalent resistance, connect a 1A current source across terminals a-b. No other method will be acceptable. (Hint: Find voltage across 1A current source and then use circuit concepts.) **(17)**

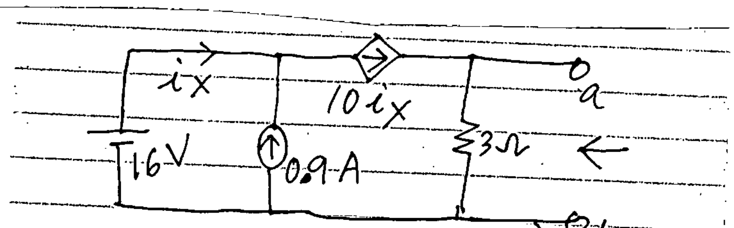


Fig. for Q. 8(a)

EEE 101

(b) For the circuit shown in Fig. for Q. 8(b), **(18)**

(i) Find R_L such that R_L absorbs maximum power (ii) If maximum power $P_L = 54$ watt find I_0.

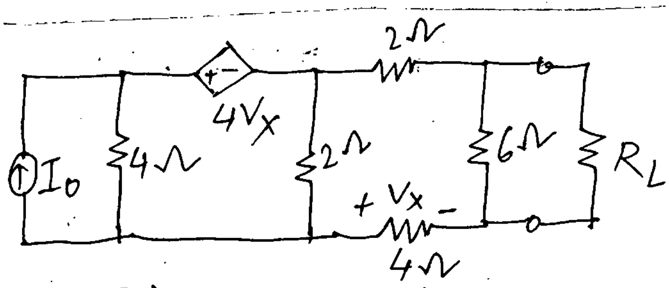


Fig. for Q 8(b)

Figures for Section A

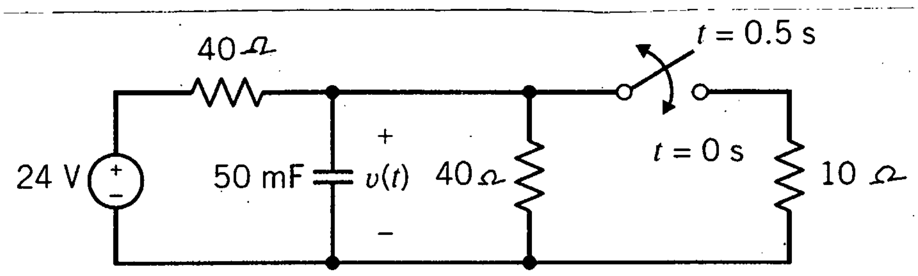
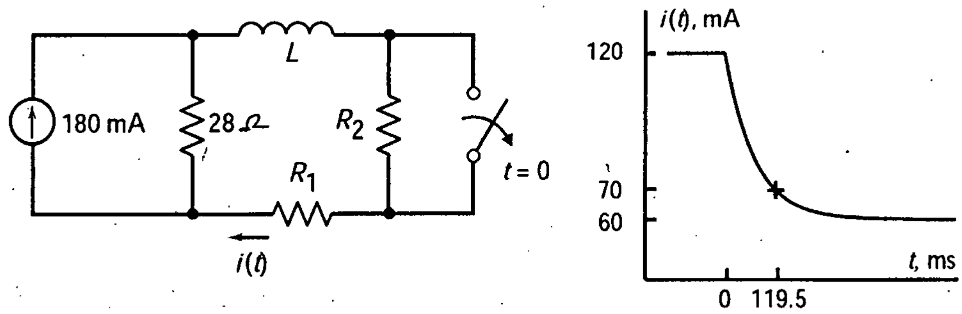


Figure for Q.1a



(i) (ii)

Figure for Q. 1b

EEE 101

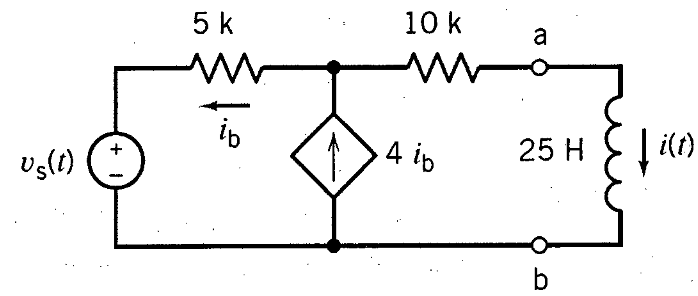


Figure for Q. 2a

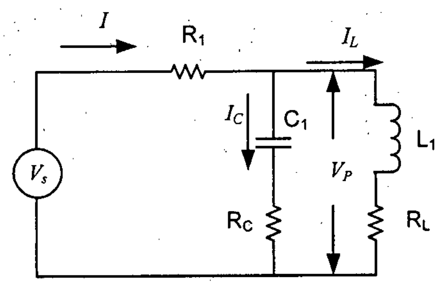


Figure for Q. 2b

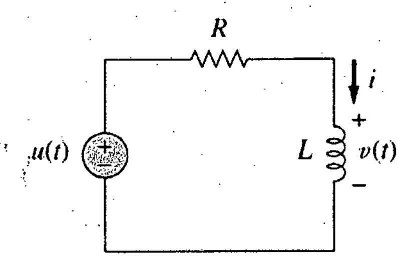
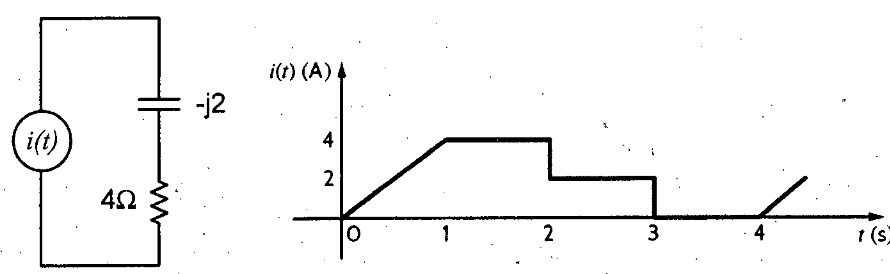


Figure for Q. 2c



(i) (ii)

Figure for Q. 3a

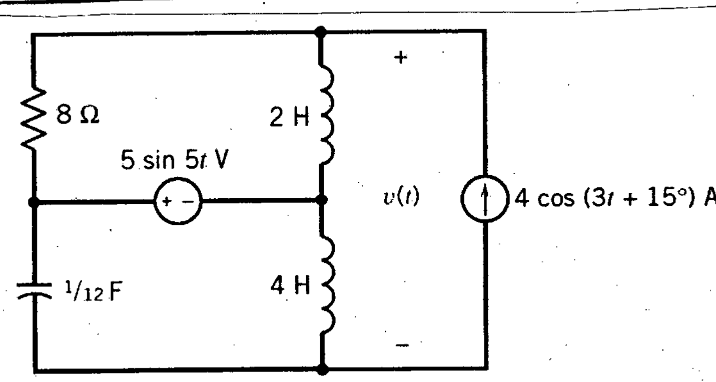


Figure for Q. 3b

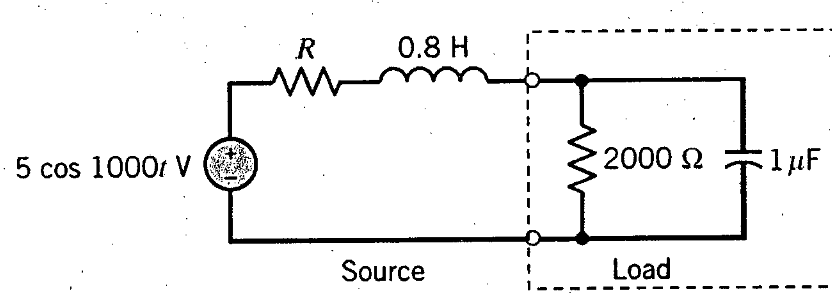


Figure for Q. 4a

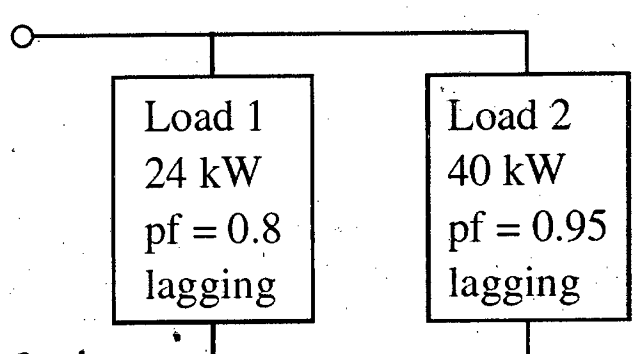


Figure for Q. 4b