L-1/T-2/CSE **Date : 31/03/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2017-2018

Sub: **CSE 103** (Discrete Mathematics)

Full Marks: 300 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) You walk to a fork from where two roads come out - one to the post office and the other to the university. You want to go to university but you do not know which road leads to university. A sentry standing on the fork knows it. But he has a peculiar habit of alternately speaking the truth and telling a lie. What single question to the sentry will help you find the right road? **(5)**

(b) Let p and q be propositions, p: You drive over 100 km per hour; q: You get a speeding ticket. Write the following propositions using p and q and logical connectives. **(5×6=30)**

(i) You do not drive over 100 km per hour.

(ii) You drive over 100 km per hour but you do not get a speeding ticket.

(iii) Driving over 100 km per hour is sufficient for getting a speeding ticket.

(iv) You get a speeding ticket, but you do not drive over 100 km per hour.

(v) If you do not drive over 100 km per hour, then you will not get a speeding ticket.

(vi) Whenever you get a speeding ticket, you are driving over 100 km per hour.

2. (a) Show that $(p \to q) \to r$ and $p \to (q \to r)$ are not equivalent. **(5×7=35)**

(b) Suppose that the domain of the propositional function P(x) consists of the integers -2, -1, 0, 1, and 2. Write down each of these propositions using disjunctions, conjunctions, and negations.

(i) $\exists x\, P(x)$ (ii) $\forall x\, P(x)$ (iii) $\exists x\, \neg P(x)$ (iv) $\forall x\, \neg P(x)$ (v) $\neg \exists x\, P(x)$ (vi) $\neg \forall x\, P(x)$ (vii) $\neg \forall x\, \neg P(x)$.

(c) Prove that at least four of any 37 days must fall on the same month in a year.

(d) Prove that there exists irrational numbers x and y such that x^y is rational.

(e) $|A| = 30$, $|B| = 42$, $|A \cap B| = 15$, $|A \cap C| = 14$, $|B \cap C| = 13$, $|A \cup B \cup C| = 80$. What could be the maximum value of $|C|$?

3. (a) Define function, 1 to 1 function, onto function and bijection. Show their differences in diagrams. **(15)**

(b) Calculate the sums (i) $\sum_{k=1}^{\infty} kx^{k-1}, 0 < x < 1$ (ii) $\sum_{k=1}^{n} k^3$ **(20)**

Contd P/2

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4. (a) Deduce the expected number of assignment to be done by the following algorithm assuming that every element of the array is equally likely to be the maximum. **(15)**

```
Procedure MAX (A, n, maximum)
maximum = A[0]
for i = 1 to n-1 do
        if maximum < A[i] then
            maximum = A[i]
        endif
endfor
```

(b) Given a set of objects with weights and profits (1, 2), (1, 3), (2, 3), (2, 5), (3, 4), (4, 7), (5, 8), (6, 9), (7, 11). Choose greedily the objects for a knapsack of weight W=12 so that the maximum profit can be earned. Objects can be chosen fractionally. **(10)**

(c) Given symbols with frequencies A(4), B(3), C(1), D(1), E(15), F(2), G(5), H(4) construct a Huffman tree so that sending codes of variable length will require minimum number of bits. Show total number of bits required. **(10)**

SECTION - B

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

5. (a) Let F be a function from a finite set X to a finite set Y. If $n \geq 1$ and $|X| > n|Y|$, then there exists an element of Y that is the image under F of at least $n+1$ elements of X. **(10)**

(b) Consider a graph $G = (V, E)$ such that $|V| = n$. Assume that $u, w \in V$. Now, vertex u is connected to vertex w. Then prove using pigeonhole principle that there exists a simple path from u to w having no more than n vertices. **(10)**

(c) In ICPC, each team consists of 3 students. Now, your teacher gave you an assignment to prove the following proposition: "Prove that every collection of six Bangladeshi students either includes an ICPC team or a group of 3 students in which no two students have been in the same ICPC team ever." Can you prove this? While you have been working on your arguments, your genius little brother made a flying comment with a crude smile that this is true for any student from around the world. Do you agree with him? Justify your answer. **(15)**

6. (a) There are 20 books arranged in a row on a shelf. How many ways are there to choose 6 of these books so that no two adjacent books are selected? **(10)**

(b) Count the elements of the set of integer solutions to $x_1 + x_2 + x_3 + x_4 + x_5 + x_6 <= 20$, where $x_1 \geq 1$ and $x_2, x_3, x_4, x_5, x_6 \geq 2$. **(10)**

(c) Is there any connection between 6.a and 6.b? Explain. **(5)**

(d) Prove that for all $n \geq 3$, the number of distinct Hamiltonian Cycles in K_n is $\frac{(n-1)!}{2}$. **(10)**

7. (a) Present the distinct root theorem and single root theorem in the context of second order recurrence relations. **(6)**

(b) Solve the Fibonacci Sequence using the appropriate theorem mentioned above. **(11)**

Contd P/3

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Contd... Q. No. 7

(c) With the help of generating function, solve the Tower of Hanoi recurrence. **(11)**

(d) There are a total of 12 under-graduate degree offering departments in BUET. Each department is led by a Head of the Department and the undergraduate program is managed by a BUGS (Board of Undergraduate Studies) Secretary. A three member committee has been formed by the Academic Council of BUET to evaluate and monitor the undergraduate programs of BUET. The committee will comprise a Chairman (one of the Head of the under-graduate degree offering departments) and two other members taken from the BUGS Secretaries. However, from one department you cannot have more than one member in the committee. Now count the number of ways to form the committee. **(7)**

8. (a) Recently, Chandler enrolled in a discrete mathematics course and after a few lessons got intrigued with the concept of mathematical induction. Chandler decided to teach Joey the concept of mathematical induction. Joey was also intrigued. The next day Joey came up with a proof of the 'fact' that for all values of n, $n + 3 = n + 7$. He wrote the following arguments using the concept of mathematical induction: **(10)**

***

Let P_n be the statement that $n + 3 = n + 7$. We will prove that P_n is true for all $n \in$ N. Assume, for induction that P_k is true. That is, $k + 3 = k + 7$. We must show that P_{k+1} is true. Now since $k + 3 = k + 7$, adding 1 to both sides we get $k + 3 + 1 = k + 7 + 1$. After regrouping we easily get $(k + 1) + 3 = (k + 1) + 7$. But this is simply P_{k+1}. Thus by the principle of mathematical induction P_n is true for all $n \in$ N.

***

Find out the flaws (if any) in the above arguments.

(b) Suppose you have solved a puzzle where the goal is to tile a big square with a tromino (L-shaped tile) covering three squares. Figures 8.b.A shows an 8 × 8 puzzle with 4 trominos placed at arbitrary locations. **(15)**

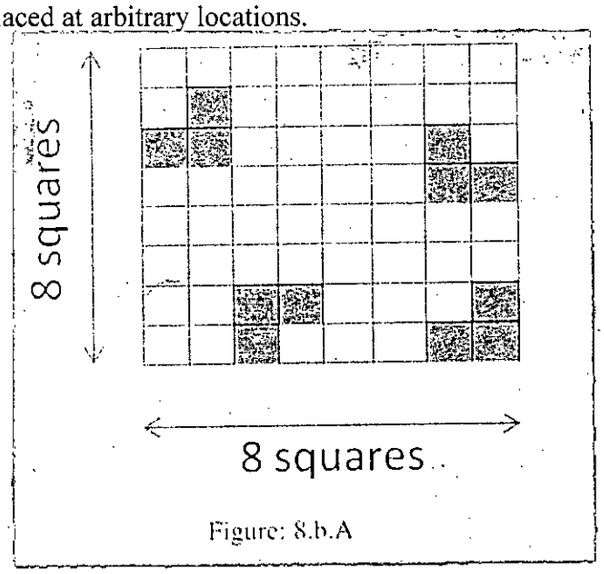

Figure: 8.b.A

Now, prove that for any $2^n \times 2^n$ puzzle a tiling with trominos is possible with only one square unfilled in the middle. Then argue that $2^{2n}-1$ is divisible by 3.

(c) With the help of Well Ordering Principle, prove that $\sqrt{2}$ is irrational. **(10)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2017-2018

Sub: **CSE 107** (Object Oriented Programming Language)

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**.

All the Questions in this Section are related with Java Programming Language.

1. (a) Write a Java program that takes a String as input and prints the number of tokens (the delimiter is space) in that String as well as the tokens. **(10)**

```
Sample Input: This is a test
Output:
4
This
is
a
test
```

(b) Write the general syntax for (i) declaring a generic class (ii) declaring a reference to a generic class and instance creation. **(5×2=10)**

(c) What is an inner class? Point out the problem in the following code segment (if any). **(3+6=9)**

```
class Outer{
    int outer_x = 5;
    void test(){
        Inner inner = new Inner();
        inner.display();
    }
    class Inner{
        int z = 60;
        void display(){
            System.out.println(outer_x);
        }
    }
    void showz(){
        System.out.println(z);
    }
}
```

(d) Differentiate between the following two statements. **(6)**

(i) `int c[], x;` (ii) `int[] c, x;`

Contd P/2

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2. (a) What is an abstract class? Write the restrictions imposed on an abstract class. Point out and fix the problems in the following code snippet. **(3+2+6=11)**

```
final class X{
    final void show(){
        System.out.println("Printed from a method");
    }
}
class Y extends X{
    void show(){
        System.out.println("In subclass method");
    }
}
```

(b) Consider the following code segment. **(9)**

```
interface Int1{
    void f1();
    void f2();
}
interface Int2 extends Int1{
    void f3();
}
class MyClass implements Int2{
    // Complete this class
}
public class Test{
    public static void main (String[] args){
        MyClass my = new MyClass();
        my.f1();
        my.f2();
        my.f3();
    }
}
```

Now complete MyClass with minimum code for successful compilation.

(c) Briefly describe the methods that Java uses for interthread communication. **(9)**

(d) What are the advantages of multithreading over process based multitasking? **(6)**

3. (a) Briefly describe the types of TCP Sockets. Write a Java Program that opens a connection to a "whois" port (port 43) on the InterNIC server (whois.internic.net), sends the command-line argument (a website address) over the socket and then prints the data that is returned. **(4+15=19)**

(b) What is a type wrapper? Name any three type wrappers. What are type wrappers needed? **(3+3+4=10)**

(c) Explain briefly dynamic method dispatching. **(6)**

4. (a) What are boxing and unboxing? Give an example for each of them. **(3+2)×2=10**

(b) Write three differences between Hashmap and Hashtable. Consider the following monthly salary of different cricketers: **(3×2+10=16)**

Contd P/3

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Contd... Q. No. 4(b)

Name	Salary (Tk.)
Sakib Al Hasan	3,00,000
Mashrafe Bin Mortaza	null
Mushfiqur Rahim	2,50,000

Now write Java code for the following:

(i) Create an appropriate Hash-based collection to store the above information and then store the above information.

(ii) Increase Sakib Al Hasan's salary by 50,000 Tk.

(c) Consider the following code snippet. **(9)**

```
class TestClass {
    String s;
    double d;
    public TestClass(String s, double d){
        this.s = s;
        this.d = d;
    }
}
public class TestDemo {
    public static void main(String[] args){
        TestClass obj1 = new TestClass("Mr. A", 18.5);
        //Your code
        TestClass obj2;
        //Your code
    }
}
```

Now write necessary Java code to write obj1 to a fill named 'test' and read the object from the same file and assign it to obj2.

SECTION - B

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

All questions in this section are related to C++ programming language.

5. (a) What are the possible problems if we use "call by value" for passing an object to a function? Explain with an example. How can we solve this problem? Explain in details with the example you provided. **(13)**

(b) "A friend function can be a global function not related to any particular class. A friend function can also be a member of another class." – Explain this statement with appropriate examples. **(12)**

(c) Consider the following statement inside main function:

myClass ob[2] = { -1, -2 };

Is this a valid statement? If yes, then what does it mean? If no, then what is the problem? **(5)**

(d) Can constructor or destructor functions be declared as virtual? Explain briefly. **(5)**

Contd P/4

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6. (a) Consider the following class: **(25)**

```
class Complex
{
public:
    int real, imag;
    Complex(int r=0, int i=0);
};
```

Consider three objects of `Complex` class as `comp1`, `comp2` and `comp3`. Now write necessary functions so that the following statements can be executed in the main function.

(i) **`comp3 = comp1 + comp2;`**

The "`real`" value of `comp3` should be the added value of `comp1` and `comp2`'s "`real`" value. The "`imag`" value of `comp3` should be the added value of `comp1` and `comp2`'s "`imag`" value. `comp1` and `comp2` should not change.

(ii) **`comp3 = comp1 + 10;`**

The "`real`" value of `comp3` should be the "`real`" value of `comp1` increased by 10. The "`imag`" value of `comp3` should be the "`imag`" value of `comp1`. `comp1` and `comp2` should not change.

(iii) **`comp3 = 10 + comp1;`**

The "`imag`" value of `comp3` should be the "`imag`" value of `comp1` increased by 10. The "`real`" value of `comp3` should be the "`real`" value of `comp1`. `comp1` and `comp2` should not change.

(iv) **`comp1++;`**

Both the "`real`" and "`imag`" value of `comp1` should be the increased by 1. This statement should behave like the usual postfix increment. That means the increment must occur after the operand is evaluated.

(v) **`++comp1;`**

Both the "`real`" and "`imag`" value of `comp1` should be the increased by 1. This statement should behave like the usual prefix increment. That means the increment must occur before the operand is evaluated.

(vi) **`cout<<comp1;`**

This should be print the complex number in an "a +bi" manner. For example, if the "`real`" and "`imag`" value of `comp1` is 2 and 3 respectively, then this statement should print "2 + 3i". If the "`real`" and "`imag`" value of `comp1` is 4 and -5 respectively, then this statement should print "4 - 5i".

(vii) **`comp3 = comp1(5);`**

The "`real`" value of `comp3` should be the added value of `comp1`'s "`real`" value and 5. The "`imag`" value of `comp3` should be the added value of `comp1`'s "`imag`" value and 5. `comp1` should not change.

(b) When and why will you make a function inline? When may a compiler ignore this specifier? When does automatic in-lining take place? **(7)**

(c) What is the difference between 'delete' and 'delete [ ]' operators? **(3)**

Contd P/5

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7. (a) What is early binding and late binding in C++? Explain with examples. **(12)**

(b) What is the output of the following program: **(9)**

```
#include<iostream>
using namespace std;
class Point{
private:
    int x;
    int y;
public:
    Point(int i = 0, int j = 0); //Normal Constructor
    Point(const Point &t); // Copy Constructor
};
Point::Point(int i, int j) {
    x = i; y = j;
    cout << "Normal Constructor called\n";
}
Point::Point(const Point &t) {
    x = t.x; y = t.y;
    cout << "Copy Constructor called\n";
}
int main()
{
    Point *t1, *t2;
    t1 = new Point(10, 15);
    t2 = new Point(*t1);
    Point t3 = *t1;
    Point t4;
    t4 = t3;
    return 0;
}
```

(c) What is wrong with the following code segment? **(6)**

```
class myclass{
   int i,j;
public:
   static void seti(int x){this->i=x;}
   int geti(){return i;}
};
```

(d) Consider the following function declaration **(5)**

```
void f1(int a=1, int b);
```

Is this a valid declaration? If yes, then what does it mean? If no, then what is the problem?

(e) Which of the operators can have default arguments when they are overloaded? **(3)**

8. (a) Write a class "`myCalculator`" using class templates to show the result of addition, subtraction, multiplication and division between two numbers. The numbers can be integer, float or double. The main function and a sample output are given below. **(15)**

Contd P/6

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Contd... Q. No. 8(a)

```
int main()
{
    myCalculator<int> intCalc(7, 4);
    myCalculator<float> floatCalc(3.4, 6.2);
    cout << "Int results:" << endl;
    intCalc.displayResult();
    cout << endl << "Float results:" << endl;
    floatCalc.displayResult();
    return 0;
}
```

```
Output:
Int results:
Numbers are: 7 and 4.
Addition is: 11
Subtraction is: 3
Product is: 28
Division is: 1

Float results:
Numbers are: 3.4 and 6.2.
Addition is: 9.6
Subtraction is: -2.8
Product is: 21.08
Division is: 0.548387
```

(b) Why virtual base classes are used? Give an example of a class hierarchy where we must use virtual base class to avoid ambiguity. You do not need to write code. **(9)**

(c) When can a function be used both as an l-value and r-value? Explain with an example. **(6)**

(d) Why the overloaded assignment operator (=) function should return the "this" pointer? **(5)**

L-1/T-2/CSE **Date : 10/04/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2017-2018

Sub : **HUM 183** (English)

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 3 **(THREE)** questions including Q. No.1 as compulsory.

1. (a) Explain with reference to the context **any Two** of the following: **(15)**

(i) "And then the house whispers, like people laughing at you behind your back. It's awful, that is! I thought if I was lucky."

(ii) ' … We want to be rescued; and of course we shall be rescued'.

(iii) A white man mustn't be frightened in front of "natives";

(b) Answer **any one** of the following: **(15)**

(i) What did the author try to showcase in the story 'An Astrologer's Day?

(ii) Write a critical appraisal of the story 'The Rocking-Horse Winner'.

(c) Answer **any three** of the following: **(15)**

(i) How did Paul prove himself lucky?

(ii) What does the 'beastie' stand for in 'Fire on the Mountain'?

(iii) How did the astrologer recognize Guru Nayak at last?

(iv) Why was the police officer in a dilemma to shoot the elephant?

(v) "He was as much a stranger to the stars as were his innocent customers"

… who was this stranger? Why was it said so about him?

2. (a) Recast and correct **any two** of the following sentences: **(15)**

(i) We accept Arum from the responsibility.

(ii) Toast and jam are her favourite breakfast.

(iii) The audience implied that the speaker was a leftist politician.

(iv) Professors will procede Associate professors in the procession.

(v) Zahid was an alumna of BUET.

(vi) That painting is highly invaluable.

Contd P/2

HUM 183 (CSE)

Contd...Q. No. 2(a)

(vii) If you work slow and steady, you can win the race.

(viii) If the tiger is annoyed, it is apt to become angry.

(ix) This idea does not make Rian enthused.

(x) Niloy can't help but laugh at the funny incident.

(xi) The committee considered the matter farther.

(xii) Rima is conscious of resentment in that embarrassing situation.

(b) Give the meanings of and make sentences with **any ten** of the following words: **(15)**

Accumulate, bewilder, castigate, conversion, drowsy, discern, disseminate, exultant, imminent, profound, reiterate, simulate.

3. Amplify **any one** of the following: **(30)**

(i) Civility costs nothing.

(ii) It is the calling of the humanities that makes us truly human in the best sense of the word.

4. Write a precis of the following passage with a suitable title: **(30)**

Most people would agree, although our age far surpasses all previous ages in knowledge, there has been no correlative increase in wisdom. But agreement ceases as soon as we attempt to define "wisdom" and consider means of promoting it. It can be asked first what wisdom is and then what can be done to teach it. There are several factors that contribute to wisdom. Of these the first is a sense of proportion; then capacity to take account of all the important factors in a problem and to attach to each of its due weight. This has become more difficult than it used to be owing to the extent and complexity of the specialized knowledge required of various kinds of technicians. To take an extreme example, which is in everybody's mind at the present time: you study the composition of the atom from a disinterested desire for knowledge, and incidentally place in the hands of powerful lunatics the means of destroying the human race? In such ways the pursuit of knowledge may become harmful unless it is combined with wisdom; and wisdom in the sense of comprehensive vision is not necessarily present in specialists in the pursuit of knowledge. Comprehensiveness alone, however, is not enough to constitute wisdom. There must be, also, a certain awareness of the ends of human life. Perhaps one could stretch the comprehensiveness that constitutes wisdom to include not only intellect but also feeling. It is by no means uncommon to find men whose knowledge is wide but whose feelings are narrow. Such men lack what could be called wisdom. It is not only in public ways, but in private life equally, that wisdom is needed. It is needed in the choice of ends to be pursued and in emancipation from personal prejudice.

Contd P/3

HUM 183 (CSE)

SECTION – B

There are FOUR questions in this Section. Answer any THREE questions, including Q. No.5 as compulsory.

5. Read the passage and answer the following questions. **(45)**

Personally disorders are a diagnostic category of psychiatric disorders that affect approximately 10% of the population (Torgersen, 2005) .Since everyone has a personality, but not everyone has a personality disorder, these disorders are considered a variant form of normal, healthy personality. This group of disorders is characterized by problematic thinking patterns; problems with emotional regulation; and difficulty achieving a balance between spontaneity and impulse control. However, the most significant and defining feature of personality disorders is the negative effect these disorders have on interpersonal relationships. People with personality disorders tend to respond to differing situations and demands with a characteristically rigid constellation of thoughts, feelings, and behavior. This inflexibility and difficulty forming nuanced responses, represents the primary difference between healthy and disordered personalities. The diagnosis of personality disorders is often very complex as these disorders frequently co-occur with each other and with other psychiatric categories of disorders. The current diagnostic system of the DSM-5 (APA, 2013) relies upon a categorical approach. An alternative to the categorical diagnostic approach, called a dimensional approach, was presented and discussed. Both methods were compared and contrasted. The exact cause of personality disorders remains uncertain. However, it is clear there are both biological, psychosocial factors that influence the development of personality and personality disorders. Several psychological theories of personality disorders attempt to explain the psychosocial origins of personality disorders. The following psychological theories of personality disorders were reviewed: object relations theory, attachment theory (including metallization), and cognitive-behavioural theory (including dialectical behavior theory and schema theory). In addition to these specific theories of personality disorder, the Structural Analysis of Social Behavior (SASB) that codes social interactions was discussed as it applies to understanding personality disorders. The contributions of neuroscience were discussed as well.

At one time personality disorders were thought to be untreatable. This is no longer the case. There are now several highly effective treatments for personality disorders that derive from the same psychological theories previously reviewed. These treatments include: transference focused therapy (TFP), metallization based therapy (MBT), cognitive-behavioral Therapy (CBT), dialectical behavior therapy (DBT), and schema therapy. Pharmacological interventions are considered an adjunct to treatment and were briefly reviewed as well. In conclusion, recent technological advancements and improvements to diagnostic methodologies have enabled researchers to study personality and personality disorders as never before. As a result, we now have a much greater understanding of these disorders. Furthermore, this research has facilitated the development of several highly effective treatments for personality disorders that are evidenced-based. As research continues, these treatment approaches will be further refined.

Contd P/4

HUM 183 (CSE)

Contd...Q. No. 5

Questions:

(i) Give a suitable title of the passage with justification.

(ii) Define personality disorders as in the text.

(iii) Why are the diagnoses of personality disorders often very complex?

(iv) Discuss the treatments of personality disorders.

(v) Give the meaning of the following words and expressions:

variant, interpersonal, constellation, psychiatric categories of disorders, facilitate.

(vi) Summarize the passage in your own words.

6. (a) 'The main purpose of a sales letter is to convert the reader into a customer.' How is this purpose achieved? **(10)**

(b) Write a letter to a firm complaining against the supply of damage and defective goods. (Provide necessary details of your own). **(10)**

(c) Give phonetic transcriptions of the following words (any five): **(10)**

Angel, Ocean, Dark, Farmer, Engineer, Cloud

7. (a) Discuss the steps for writing a formal written report. **(10)**

(b) Write a short essay on anyone of the following topics: **(10)**

(i) The Line between Love and Hatred

(ii) Tsunami: The Death Wave

(iii) Bangladesh as a Cricketing Nation

(c) Write a dialogue between two friends about online shopping. **(10)**

8. (a) Transform the following sentences as directed (any five) **(10)**

(i) He is relentlessly working so that he can finish the work. (Simple)

(ii) We sow so that we reap. (Compound)

(iii) I found that the clock had stopped. (Simple)

(iv) With your permission I will walk away. (Complex)

(v) If he had not signed, he would have been executed. (Compound)

(vi) He pleaded for his innocence. (Complex)

(b) Why is planning necessary for writing business letters? **(5)**

(c) Write short notes on any three of the following: **(15)**

(i) Adjustment Letters (ii) Literature Review (iii) Questionnaire (iv) Vowels.

L-1/T-2/CSE **Date : 25/03/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2017-2018

Sub : **MATH 147** (Ordinary Differential Equations (ODE), Partial Differential Equations (PDE) and Vector Calculus)

Full Marks: 280 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 differential equation of all circles. **(15)**

   (b) Solve the differential equation: **(15⅔)**

   $$x(x-1)\frac{dy}{dx} - y = x^2(x-1)^2$$

   (c) A certain culture of bacteria grows at rate proportional to its size. If the size doubles in 4 days, find the time required for the culture to increase to 10 times to its original size. **(16)**

2. (a) Solve the following differential equations:

   (i) $(y^4 + 2y)dx + (xy^3 + 2y^4 - 4x)dy = 0$. **(15)**

   (ii) $(D^4 + 2D^2 + 1)y = x^2 cosx$. **(15)**

   (b) Solve the differential equation $\frac{d^2y}{dx^2} + a^2y = \frac{a^2R}{p}(l-x)$ subject to the conditions $y = 0$ and $\frac{dy}{dx} = 0$ at $x = 0$, where a,R,p,l are constants. **(16⅔)**

3. Solve the following differential equations:

   (i) $(x^2D^2 - 2xD + 2)y = x^2 + sin(5lnx)$. **(16⅔)**

   (ii) $x\frac{d^2y}{dx^2} + x\left(\frac{dy}{dx}\right)^2 - \frac{dy}{dx} = 0$. **(15)**

   (iii) $y\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^2 = y^2$. **(15)**

4. (a) Form a PDE by eliminating the arbitrary function f from the equation $z = e^{mx} f(x+y)$. **(12)**

   (b) Find the integral surface of the linear differential equation: **(17)**

   $(x-y)p + (y-x-z)q = z$,

   which passes through the circle $x^2 + y^2 = 1, z = 1$.

   (c) Find the complete, singular (if exists) and general integral of $z^2(p^2z^2 + q^2) = 1$. **(17⅔)**

Contd P/2

MATH 147

SECTION - B

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

5. (a) Solve the following partial differential equations:

(i) $\left(D_x^2 + 4D_xD_y + 4D_y^2\right)z = e^{2x+y}$. **(13)**

(ii) $\left(D_x^2 - D_xD_y + D_y - 1\right)z = \sin(x+2y) + e^x$. **(13)**

(b) Solve the following boundary value problem **(20⅔)**

$$4\frac{\partial U}{\partial t} = \frac{\partial^2 U}{\partial x^2},\ U(0,t) = 0,\ U(2,t) = 0,\ U(x,0) = 2\sin\frac{\pi x}{2} - \sin \pi x + 4\sin 2\pi \sin \pi x,$$

where, $0 < x < 2, t > 0$.

6. (a) Examine whether the vectors **u** = 3**i** +2**j** –**k**, **v** = -**i** + 4**j** – 5**k** and **w** = - 2**i** + **j** – 3**k** are linearly dependent or independent. If **x** = - **i** – 3**j** + 6**k**, then find a, b, c so that **x** = a**u** + b**v** + c**w**. **(23⅔)**

(b) Given that **p** = 3**i** + **j** + 2**k** and **q** = **i** – 2**j** – 4**k** are the position vectors of points P and Q, respectively. (i) Find an equation for the plane passing through Q and perpendicular to the line PQ. (ii) What is the distance from the point (-1,1,1) to the plane. **(23)**

7. (a) A particle moves along the curve whose parametric equations are $x = 2t^2$, $y = t^2 - 4t$, $z = 3t - 5$, where t is the time. Find the components of its velocity and acceleration at time t = 1 in the direction **i** – 3**j** + 2**k**. **(14)**

(b) If $\boldsymbol{A} = (3x^2 + 6y)\boldsymbol{i} - 14\,yz\boldsymbol{j} + 20\,xz^2\boldsymbol{k}$, evaluate $\int_C \boldsymbol{A}\cdot d\boldsymbol{r}$ from (0,0,0) to (1,1,1) along the following paths C: (i) the straight lines from (0,0,0) to (1,0,0) then to (1,1,0) then to (1,1,1). **(16)**

(c) Use a line integral to find the area of the ellipse $x = a\cos t,\ y = b\sin t,\ 0 \le t \le 2\pi$. **(16⅔)**

8. (a) Evaluate $\iint_S \boldsymbol{A}.\boldsymbol{n}dS$, where **A** = 18z**i** – 12**j** + 3y**k** and S is that part of the plane 2x + 3y + 6z = 12 which is located in the first octant. **(23)**

(b) Use the Divergence Theorem to find the outward flux of the vector field **F** $(x, y, z) = x^3\,\mathbf{i} + y^3\mathbf{j} + z^3\mathbf{k}$ across the surface of the region that is enclosed by the hemisphere $z = \sqrt{a^2 - x^2 - y^2}$ and the plane $z = 0$. **(23⅔)**

L-1/T-2/CSE **Date : 14/03/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2017-2018

Sub : **CHEM 113** (Chemistry-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) What is the dimensional classification of nanomaterials? Give examples and draw structures of each type. **(5)**

   (b) Explain that the color of gold nanoparticle can be tuned by controlling aspect ratio of size. **(10)**

   (c) Draw a graph showing the approximate percentage of surface atoms as a function size of nanocrystal and explain that surface energy of nanomaterial increases with decrease in size. **(10)**

   (d) Discuss the stability of colloids? How colloids can be removed from solutions? **(10)**

2. (a) What is thermoplastic starch? Discuss the applications and limitations of thermoplastic starch. **(10)**

   (b) Identify the factors that influence the biodegradability of polymers? Discuss the effect of crystallinity on biodegradability of polymers. **(10)**

   (c) Draw the chemical structure of $\beta-\mathrm{D}-(+)-$ glucopyranose in chair conformation. Discuss the significance of β, D and $(+)$. **(10)**

   (d) Draw the mechanisms of the acid hydrolysis of methyl $-\beta-\mathrm{D}-$ glucopyranoside. **(5)**

3. (a) Why the dissolution of NaCl is an endothermic process? **(5)**

   (b) How does the increase in concentration of a nonvolatile solute in a solvent affect the following properties of solution? (i) Vapor pressure and (ii) osmotic pressure. **(10)**

   (c) Identify the factors that influence the solubility of solute in a solvent? Discuss about two factors. **(10)**

   (d) A lithium salt used in lubricating grease has the formula $LiC_nH_{2n+1}O_2$. The salt is soluble in water to the extent of 0.036 g per 100 g of water at 25 °C. The osmotic pressure is found to be 57.1 torr. Assuming that molality and molarity in such a dilute solution are the same and that the lithium salt completely dissociated in the solution, determine an appropriate value of n in the formula of salt. Atomic weight of Li is 7 g/mol. $LiC_nH_{2n+1}O_2$ dissociates as Li^+ and $C_nH_{2n+1}O_2^-$ in aqueous solution. **(10)**

4. (a) How conduction of electricity through a solution differs from metallic conduction? Explain the effect of some factors which influence the conduction of electricity in solution. **(10)**

Contd P/2

CHEM 113

Contd... Q. No. 4

(b) Differentiate molar conductivity and specific conductivity. Explain, why hydrogen and hydroxide ions exhibit exceptionally large ionic mobilities. **(10)**

(c) Mention the main apparatus for conductometric titrations? How conductometric titration can be used for the determination of the percentage of HCl and CH_3COOH in a supplied solution? **(10)**

(d) Why cations and anions carry different fractions of the current in electrolytic conduction? **(5)**

SECTION - B

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

5. (a) How is internal energy of a chemical system changed during a chemical reaction? Explain why internal energy and Gibbs free energy are considered as state functions? **(8)**

(b) How does the temperature affect on reaction enthalpies? Derive the Kirchhoff's equation for the temperature dependence of reaction enthalpies. **(12)**

(c) What is meant by a phase diagram? Draw and discuss the phase diagram for sulphur system with the application of phase rule. **(10)**

(d) How is the phase diagram of CO_2 differed from H_2O? **(5)**

6. (a) Explain what energy terms are involved in the formation of an ionic solid from atoms. In what way should these terms change (become larger or smaller) to give the lowest energy possible for the solid? **(10)**

(b) Describe the experimental basis for believing that the electrons in an atom behave as tiny bar magnets. **(15)**

(c) Draw a potential energy diagram for a molecule such as Cl_2. Indicate the bond length (194 pm) and the bond dissociation energy (240 kJ/mol). **(5)**

(d) Why does sodium chloride normally exist as a crystal rather than as a molecule composed of one cation and one anion? **(5)**

7. (a) How is the concept of electron density used to describe the position of an electron in the quantum mechanical treatment of an atom? **(7)**

(b) Describe the role played in elucidating the atomic structures by each of the followings: **(18)**

(i) Positive rays, (ii) Cathode rays, (iii) X-rays.

(c) The wave nature of matter is not noticeable in our daily observations– Why? **(5)**

Contd P/3

CHEM 113

Contd... Q. No. 7

(d) Crystal diffraction can be studied by electron diffraction as well as by neutron diffraction method. What should be the ratio of the velocities of electron and neutron for the de-Broglie wavelength to be the same? (You don't need to use any data to solve this problem). **(5)**

8. (a) Describe the bonding in H_3CCN using the Valence Bond Theory Concept? Draw and clearly label one or more pictures to show the types of orbitals that you are using to form the various σ and π bonds. **(10)**

(b) Dinitrogen (N_2) and carbon monoxide (CO) molecules are quite similar when it comes to their bonding. **(13)**

(i) Sketch and fill up a molecular orbital diagram for CO.

(ii) Provide the molecular orbital electron configuration of CO.

(iii) Calculate the bond order of CO? Should it be paramagnetic or diamagnetic?

(c) Sketch the shape or three dimensional structure of each of the following: BrO_3^- and AsF_4^-. **(6)**

Name the shapes and state the status of hybridization in the central atoms of the above ionic species.

(d) Arrange the following molecular ions in order of increasing bond dissociation energy: **(6)**

$$NO,\ Be_2^+,\ N_2^+$$

L-1/T-1/CSE

Date : 01/10/2018

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B.Sc. Engineering Examinations 2017-2018

Sub : **CSE 101** (Structured Programming Language)

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**.

Please read carefully, some questions might have additional restrictions.

1. (a) Consider the following input statement. Is it correct? Explain its format specifier. **(3)**

```
scanf("%c%*c%c", &c1, &c2);
```

(b) What is the output of the following statement? Write "error" if you think there is an error. **(3)**

```
j = 7;
printf("%d\n", 3 < j < 5);
```

(c) Rewrite the following if-else statement to another equivalent if-else statement but without using any logical operator. You can use nested if-else as needed. **(6)**

(i)
```
if(condition1 && condition2)
    statement1;
else
    statement2;
```

(ii)
```
if(condition1 || condition2)
    statement1;
else
    statement2;
```

(d) Write down a program that takes x-y coordinates of a point in the Cartesian plane and prints a message telling either an axis on which the point lies or the quadrant in which it is found. **(10)**

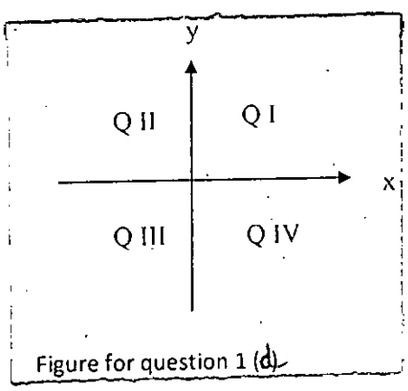

Figure for question 1 (d)

Sample lines of output:

(-1.0, -2.5) is in quadrant III

(0.0, 4.8) is on the y-axis

Contd P/2

CSE 101

Contd... Q. No. 1

(e) Write down a C program that determines the day number (1 to 366) in a year for a date that is provided as input data. As an example, January 1, 1994, is day 1. December 31, 1993, is day 365. December 31, 1996, is day 366, since 1996 is a leap year. A year is a leap year if it is divisible by four, except that any year divisible by 100 is a leap year only if it is divisible by 400. Your program should accept the user inputs for month, day and year as integers. **(13)**

2. (a) Write down a program that will find the summation of the following series **using a single Loop** (i.e., without loop nesting). You cannot use any mathematical formula to solve the problem. N will be input to your program. **(10)**

$$1+(1+2)+(1+2+3)+(1+2+3+4)+\ldots\ldots\ldots\ldots+(1+2+3+\ldots..+N)$$

(b) The number 153 has the property that it is equal to the sum of the cubes of its digits: **(10)**

$$1^3 + 5^3 + 3^3 = 153$$

Write a complete C program that will find and print all three-digit positive numbers that possess the above property.

(c) Given two positive integers a and b as input, find the smallest and largest prime numbers between them. **(15)**

3. (a) Take user input for an integer array of size N (where N will also be input) and determine whether the array is sorted or not. **(10)**

(b) Write a program in C that finds the point in a set of points that is farthest from the **geometric center** of the set of points. The geometric center of a set of points is a point whose x and y coordinates are the average of the x and y coordinates of the individual points. To represent the points in your program you must use two separate 1-dimensional arrays:-- one to store x coordinates and the other to store y coordinates. The number of points in the set will ne input to your program. The coordinates of the points will be provided as input as well. **(12)**

(c) Write a C Program that takes a string as Input and finds the largest word in the string. Assume that two words are separated by a single space. In case of tie, print the first one. **(13)**

Sample Input:

```
Enter a String: When God closes all the doors somewhere he
                lives a little window open
```

Sample Output: somewhere

Contd P/3

CSE 101

4. (a) (i) Write down a function **int fib(int n)** that returns n-th number in the Fibonacci series. The numbers in the Fibonacci series are as follows: **(3×5=15)**

1, 1, 2, 3, 5, 8, 13, 21, ...

(ii) Write down another function **int isPrime(int n)** that returns 1 if n is a prime and 0 otherwise.

(iii) Using the above two functions write a third function called **int isFibPrime(int n)** that checks whether n-th Fibonacci number is prime, returns 1 if that is the case and 0 otherwise.

(b) Take a string as input and determine whether the input is a valid password or not. A password is valid if it satisfies the following conditions: **(10)**

- A password must contain at least 8 characters.
- It must contain at least one small letter, at least one capital letter, at least one digit and at least one symbol.
- It does not contain any blank space.

Sample Input:

```
Enter password: Doob:Ahare_Jibon2
```

Sample Output:

```
VALID PASSWORD
```

(c) Write down function **int strcmp(char s1[ ], char s2[ ])** that compares strings s1 and s2, returns an integer that is:-- (i) less than 0 if s1 < s2, (ii) equal to 0 if s1 == s2 and, (iii) greater than 0 if s1 > s2. See the following examples: **(10)**

s1	s2	return value	reason
"AAAA"	"ABCD"	< 0	'A' < 'B'
'B123"	"A089"	> 0	'B' > 'A'
"127"	"409"	< 0	'1' < '4'
"abc888"	"abc888"	= 0	equal string
"abc"	"abcde"	< 0	s1 is a substring of s2

SECTION - B

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

5. (a) Explain (with necessary example and diagram) what happens when a program containing recursive function is executed. What is Stack overflow? When does it happen? **(7)**

(b) Write down the recursive function that prints the hexadecimal equivalent of a decimal integer. Draw the corresponding recursion tree for your function. **(8)**

Contd P/4

CSE 101

Contd... Q. No. 5

(c) Write down a function that takes an integer number and multiplies it by 30. [Note: You CANNOT use the multiplication operator or any loop. Assume that there will be no overflow.] **(7)**

(d) How can you invert the MSB and the LSB of an 8-bit integer number? **(5)**

(e) Write down a program that takes input of two command line arguments (x and y) and swaps the most significant digit of the two numbers. **(8)**

Sample Input	Sample Output
SwapMSD 5887 129	After Swapping: 1887 529

6. (a) Consider the following declaration of a two-dimensional array in C: **(8)**

int m[20][30];

Assume that the memory is byte-addressable, each integer requires two bytes and this array is stored starting from memory location **6000**. Find out the memory locations of m [10][10] and m [19][29]. **(8)**

(b) How can you have a 2D array whose columns are variable? Show necessary declaration and initialization (by user inputs) in a program. **(7)**

(c) What is the impact of using ***static*** before a variable inside a C function? Explain with an example. **(5)**

(d) What would be the output of the following code segment? Assume **rows = 6.** **(15)**

```
int i, space, rows, k=0, count = 0, count1 = 0;

printf("Enter number of rows: ");
scanf("%d",&rows);
for(i=1; i<=rows; ++i){
    for(space=1; space <= rows-i; ++space){
        printf("  ");
        ++count;
    }
    while(k != 2*i-1){
        if (count <= rows-1){
            printf("%d ", i+k);
            ++count;
        }else{
            ++count1;
            printf("%d ", (i+k-2*count1));
        }
        ++k;
    }
    count1 = count = k = 0;
    printf("\n");
}
```

7. (a) Consider you have an input file that have the following player information through the ***Player*** structure: **(5×4=20)**

Contd P/5

CSE 101

Contd... Q. No. 7(a)

```
struct Player{
    int  ID;
    char  name[20];
    char  category[10];
    int  wickets;
    int  runScored;
    int  runGiven;
    int catches;
    int matches;
}
```

There can be three categories: *Bowler, Batsman, WC.*
Such type of player records are stored in "info.txt" file in text mode.
Write down a C program to takes input from the **"info.txt"** file and write functions to do the following tasks:

(i) Find out the highest runs scorer in "WC" category
(ii) Print the total runs of each Batsman and show the name of the Batsman with highest average run
(iii) Show the Bowler name and the Batsman name who have the highest number of catches in each category
(iv) Print the Bowler name who has the least runs given per wicket
(v) Print the Batsman name with highest number of wickets.

(b) Write a C program to merge two text files and then write the merged contents into a third file. **(9)**

(c) What are the main differences between structure and union? Explain with examples. **(6)**

8. (a) What are the meanings of the following declarations? Explain in brief. **(6×2=12)**

```
int (*p)[20];
int *p(char (*s)[10]);
int (*p)(char *s[10]);
int (*p)(char *s);
char (*p(char *s))[10];
int p(char (*s)[10]);
```

(b) Consider you have a doubly (sorted) linked list in which each element contains an integer value (*key*) and two pointers, *prev* and *next* that point to the previous and next element in the list, respectively. All the elements are sorted in ascending order. Write down the necessary functions to perform the following operations on such a linked list: **(3+5×4=23)**

(i) Count the total number of existing elements of the list and show all the values in the linked list
(ii) Insert a new element (with value *k*) in proper location in this sorted linked list.
(iii) Delete an element (with value *k*) from this list. If k does not exist, print necessary message.
(iv) Delete last two elements of the list. If the list has only one element, just delete that one element and print message.
